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CHAPTER 1

EXECUTIVE SUMMARY

CHAPTER 1 EXECUTIVE SUMMARY

The Executive Summary for the Scientific Analysis Team Report will consist of a brief summary (2-4 pages) of the entire report. This will be written in the final stages of document production after any edits prompted by the peer reviews have been made to the report. The content of the Executive Summary will not contain any information that is not already included in the remaining eight chapters of the document.

MH
Editor

CHAPTER 2

INTRODUCTION AND PURPOSE

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SAT TEAM ASSIGNMENT

The Scientific Analysis Team (SAT) was formed by the Chief of the Forest Service to respond to concerns expressed by U.S. District Court Judge William L. Dwyer regarding the Forest Service's 1992 Final Environmental Impact Statement (FEIS) on Management for the Northern Spotted Owl in the National Forests. The questions addressed to the Forest Service by the judge that were assigned to SAT for response were:

1. Does the May 15, 1992, decision by the Endangered Species Committee to allow 13 timber sales prepared by the Bureau of Land Management (BLM) that were judged by the Fish and Wildlife Service (FWS) to cause "jeopardy" for the northern spotted owl necessitate changes in spotted owl viability assessment in the FEIS? The exemption of the 13 sales from the requirements of the Endangered Species Act was considered a one-time action.

2. Does any new information, especially the assessment of ongoing demographic studies of the northern spotted owl, necessitate revision in the selected alternative in the FEIS or change the probabilities of maintaining viable populations of the northern spotted owl that were assigned in the FEIS?

3. Would implementation of the selected alternative in the FEIS (the Interagency Scientific Committee's [ISC] Conservation Strategy) lead to extirpation in Forest Service planning areas of any of the 32 species identified in the FEIS as being highly dependent on late-successional and old-growth forest within the range of the northern spotted owl? And, if so, what mitigations could to be recommended to assure that such species would not be extirpated.

Upon examination of the assignment it became apparent that other assessments were required to fully respond to the concerns expressed by Judge Dwyer. These additional tasks were determined as described below.

Instructions to analyze BLM's cutting of the 13 timber sales released by the Endangered Species Committee was made under the assumption that BLM will continue to operate under current approved management plans. The more likely situation is that the BLM would operate under the preferred alternative in their Draft Resource Management Plans released since issue of the FEIS. Therefore, the SAT analyzed the effect on owl viability of the BLM acting under their preferred alternative coupled with the various alternatives in the FEIS

1. In the FEIS, it was assumed that BLM would adopt a forest management strategy for the northern spotted owl that would be at least equal to the ISC Conservation Strategy in maintaining viability of the sub-species. Since the FEIS was issued the BLM has circulated a set of Draft Resource Management Plans that include a preferred alternative that the SAT considers to have a significantly lower probability of assuring the viability of the spotted owl than would result from application of the ISC Conservation Strategy.

2. In the FEIS it also was assumed that, consultation between BLM and the FWS under Section 7 of the Endangered Species Act over proposed timber sales

would produce a de facto spotted owl habitat management plan that would be equal to or better than the ISC Strategy in providing for viability of the spotted owl. The FWS action in not calling "jeopardy" on BLM timber sales that were in conflict with ISC guidelines on dispersal habitat in areas currently deficient in such habitat reduced confidence in that assumption. This was exacerbated when the BLM appealed the FWS's decision on 44 proposed timber sales on which the FWS had rendered a "jeopardy" opinion. When the Endangered Species Committee exempted 13 of the 44 sales from the requirements of the Endangered Species Act, this assumption was further invalidated. In addition, the Endangered Species Committee invited the BLM, if they again chose to appeal a FWS jeopardy call, to appeal for exemption of the entire forest management plan rather than on a timber sale by timber sale basis. Our discussions with FWS personnel indicated that Section 7 consultation on proposed actions that might effect spotted owls will not cause the BLM or other agencies to conform with ISC guidelines or bring about the implementation of a fully coordinated plan the Federal lands.

When the SAT analyzed the instructions from Judge Dwyer to determine if the adoption of the ISC Strategy would cause extirpation, by planning area (which was interpreted as National Forests), of any of 32 species identified in the FEIS as closely associated with late-successional or old-growth forests, it became obvious that there were numerous other species that were likely to be associated with such forests. It therefore seemed logical to fully address the concern for other species (vertebrates, invertebrates, vascular, and non-vascular plants). Therefore an assessment of the status of a broader array of species thought to be associated with late-successional old-growth forest was conducted.

RESULTS

Management Scenarios Evaluated

Three BLM management scenarios the exemptions a one-time action, their current plans, and preferred alternatives of draft resource management plans were evaluated in combination with each of the alternatives presented in the exception as a one-time action and the FEIS. However, only the FEIS selected alternative in combination with the BLM preferred alternatives is presented are this summary. This latter seems the most likely situation to occur.

Exemption of 13 BLM Timber Sales

If it is assumed that the exemption of the 13 BLM timber sales from the requirements of the ESA is a one-time action, and that BLM will thereafter comply with the ISC Strategy, the FWS Draft Recovery Plan or other strategy equivalent for the northern spotted owl, the SAT found that: 1) such action would cause a slight risk to spotted owl viability across its range and 2) such action would not warrant a change in the overall viability assessment presented in the FEIS. Therefore, the SAT did not deem it necessary to suggest mitigation in the Forest Service's selected alternative to compensate for this slight increase in risk to spotted owl viability.

Adoption of the BLM Preferred Alternative

After detailed examination of BLM's preferred alternatives in their Draft resource management plans, the SAT concluded that adoption of their plans would not provide a level of management of spotted owl habitat equal to or better than that provided by the ISC Strategy proposed for adoption by the Forest Service. This conclusion was based on; (1) the reliance by the BLM on silvicultural treatments to create suitable habitat for northern spotted owls without recognition of the risk of failure; (2) reliance on "corridors" of habitat suitable for dispersal between Old Growth Emphasis Areas without evidence to support the hypothesis that dispersing spotted owls would follow such corridors; (3) acceptance of a continued diminution of dispersal habitat over the next 40-50 period. This is the same period over which the spotted owl is at some additional risk across its range under the ISC Strategy. This risk results from continued habitat loss to the point the rate of loss matches the rate of gain (i.e., equilibrium is attained); and (4) the possibility of increasing isolation of the Oregon Coast Range spotted owl population.

Each evaluation of risk of management plans to spotted owl viability was conducted through an assessment of the following criteria:

1. Amount and size of blocks of habitat;
2. Distribution of habitat;
3. Capability of the habitat to support pairs of spotted owls;
4. Dispersal habitat;
5. Spacing between Habitat Conservation Areas;
6. Patch size of habitat;
7. Clustering of spotted owl pairs;

The information from the evaluation of each of these items pointed out shortcomings that could be addressed through mitigations.

The SAT concluded that BLM's action in adopting a forest management strategy likely to be less effective than the Forest Service's selected alternative (the ISC Conservation Strategy) would necessitate a change in the likelihood of maintaining a viable situation for spotted owls across their range. This change was from a rating of "high" to a rating of "moderate". This change in the overall viability from "high" to "moderate" would result if no mitigation measures were adopted for National Forests to make up for deficiencies on BLM lands. If mitigation measures were adopted on Forest Service lands to make up for deficiencies on BLM lands, the probability of maintaining a viable population of spotted owls increase from "moderate" to "high". This mitigation includes additions of 410,000 acres to the Habitat Conservation Areas (HCAs) strategically located on National Forest (Siuslaw, Siskiyou, Umpqua, and Willamette National Forests) adjoining BLM lands. This mitigation will protect enough additional pairs of spotted owls to compensate for pairs displaced on BLM lands if the higher-risk strategy proposed in BLM preferred alternative fails to perform as expected. The increase in HCAs will also ensure that clusters of breeding spotted owl territories are of sufficient size to maintain long term persistence of breeding pairs. Larger HCA size will also result in decreasing distances between HCAs, thereby increasing the chances of successful dispersal between HCAs. For example, nearest neighbor distances between HCAs in the Oregon Coast Range is decreased from 8.2 to 2.8 miles. In combination, these mitigations may maintain a sub-population in the Oregon Coast Range with enough numbers and adequate habitat to enhance the probability of maintenance a more an isolated population.

Assessment of New Information

Since 1991, a variety of new information has been released relative to the biology of the northern spotted owl, including new information on the demographics of the owl, dispersal, and hybridization with the barred owl. We present summaries of new information that has been released since January 1992, including updated information for most of the studies described by Drs. David Anderson and Kenneth Burnham. Implications of the new information are discussed relative to the selected alternative in the FEIS.

Between 1985 and 1987, researchers initiated five long-term banding studies of spotted owls in northwestern California, Oregon, and Washington. These studies were designed to investigate demographic parameters of spotted owls, including age-specific birth and death rates and population trends. Data from these five studies were analyzed in a workshop at Fort Collins, Colorado, in September 1991.

The Fort Collins workshop included an analysis of each individual study area as well as a meta-analysis in which data from all five areas were examined together to determine if there were any overall trends. A synopsis of the Fort Collins workshop was written by Anderson and Burnham and provided to the Fish and Wildlife Service Northern Spotted Owl Recovery Team in November 1991 for inclusion in their Recovery Plan for the Northern Spotted Owl.

The analysis at Fort Collins indicated that populations on all five study areas were declining. Estimated rates of decline on the individual study areas ranged from 6 to 16 percent per year, with an overall average of approximately 10 percent per year.

The meta-analysis conducted at the Fort Collins workshop indicated that not only were populations declining on the individual study areas, but that female survival rates were declining over time. This was probably the most troubling finding of the Fort Collins workshop because an accelerated decline in survival rates could be indicative of population that has passed some sort of demographic threshold. Some ecologists and population experts suggested that the northern spotted owl population had already passed such a threshold, beyond which it would be difficult to recover.

Since the Fort Collins results were released, there has been considerable discussion within the scientific community whether possible biases in the banding data might cause population growth rates to be underestimated. The main concern relative to the banding data is that emigration of juveniles and adults might cause survival rates to be underestimated. In a Jolly-Seber analysis, undetected emigrants are considered to be dead, when in fact, some may still be alive. To the extent that birds emigrate, survive, and go undetected, Jolly-Seber models will overestimate recapture rates and underestimate survival. It is known that undetected emigration of juveniles occurs, based on results of radio-telemetry studies.

Radio-marking of juvenile spotted owls in 1991 indicated that 22 to 45 percent of juveniles that survived the first year of life left the study areas and would not have been detected had they not been wearing radio transmitters. Although it is probable that some of these undetected individuals will be

detected by conventional calling and banding techniques as they move around and acquire territories in future years, the relatively high rates of first-year emigration from the demographic study areas do suggest that undetected emigration is causing a negative bias in juvenile survival estimates from banding data. Survival estimates based on the radio-marked samples of juveniles in the 1991-92 study were considerably higher than the average values estimated from banding studies. Comparatively high survival of the radio-marked birds may reflect the reduction of bias caused by emigration, but could also be the result of a particularly mild fall, winter, and spring in 1991-1992. The SAT concluded that it will take several more years of study before any definitive statements can be made about survival rates of juvenile owls.

Although there is less evidence to indicate significant emigration by adult owls, this is a matter of concern in population analyses because estimates of population trend are particularly sensitive to adult survival rates. If anything, emigration of adult owls will lead to underestimates of adult survival rates and a corresponding underestimate of the population growth rate.

The parameter used to estimate age-specific birth rates at the Fort Collins workshop was fecundity (defined as the number of female young produced per year per female owl). Estimates of fecundity from the demographic studies are believed to be reasonably accurate, although several sources of counteracting bias are possible.

A 1992 simulation analysis by Dr. Jonathan Bart of the Fish and Wildlife Service suggested that the combined influence of biases in measurement of fecundity, emigration, and senescence may cause underestimation of population growth rate. The factors that caused the most bias in this analysis were rates of juvenile and adult emigration.

The SAT contacted the researchers working on the five areas examined by Anderson and Burnham to see if they could update their individual demographic estimates with 1992 data on their respective study areas. Researchers on four of the five areas provided updated estimates of survival and fecundity. Adding one more of year of data resulted in only minor changes in average survival rates and fecundity. New estimates of population growth rates will be calculated from the 1992 data during spring 1993. Because our update of demographic rates on four of the five individual study areas indicates little change from the original Anderson and Burnham analysis, the SAT does not anticipate that the revised population growth estimates will differ appreciably from the original results reported by Anderson and Burnham.

An alternative method of evaluating population trends is to examine actual changes in population density over time. The SAT summarized density estimates for 12 density study areas. An analysis of these data indicated that of 10 areas with three or more years of data, only two areas near Medford, Oregon, appeared to be undergoing significant declines. Crude densities were essentially stable on seven areas, and increasing on one area. Although this analysis was based on relatively short time periods of 2 to 8 years, the SAT concluded that there was little evidence of significant changes in crude density on most of the study areas.

An analysis of timber cutting records on five study areas indicated that owl habitat on federally administered lands was declining at 0.9 to 1.5 percent per year on Forest Service study areas and 1.3 to 3.1 percent per year on BLM study areas. Cutting records were not available for priority management lands. Another analysis of rates of habitat loss using Landsat data that covered all land ownerships indicated rates of habitat loss between 1.1 percent and 5.4 percent per year. Rates of habitat loss were lower than estimated rates of population decline calculated from banding studies and greater than rates of population decline based on changes in owl numbers on density study areas. The one exception was the Medford area where relatively high rates of decline based on changes in owl numbers matched high rates of decline in habitat estimated from Landsat analyses.

It is apparent that results from demographic analyses of banding data and analyses of changes in owl density indicate different relationships between habitat loss and population response. One method (demographic studies) suggests populations declining faster than the rate of habitat loss. The other method (population density studies) indicates populations that are either stable or declining at about the same rate as habitat loss.

After the release of the Anderson and Burnham report, some observers suggested that the declining female survival rates reported by Anderson and Brunham were indicative of a population that had dropped below a demographic threshold and was crashing toward extinction. The SAT concluded from the available data that it is unlikely the overall spotted owl population has fallen below demographic threshold. In fact, given the size of the population and the amount of habitat that still exists, the SAT considers it highly unlikely that any thresholds have been passed with the possible exception of some sub-populations in highly isolated and very heavily cutover areas.

Viability ratings for spotted owl populations under the five alternatives in the FEIS were ranked using seven biological criteria (distribution, reserve size, habitat capability, spacing, etc.). Subsequently, the Forest Service was criticized for not using more quantitative, spatially explicit models to rank alternatives. While the SAT agrees that the use of quantitative, spatially explicit models to examine alternatives is a good idea, there are several good reasons why the Forest Service has not done so. First, at the time the FEIS was written, the only spatially explicit owl/habitat model was still in development and not fully tested. Second, and more importantly, the use of a spatially explicit model requires detailed, spatially explicit maps of habitat and proposed harvest areas. Although areas of old-growth and mature forest have been mapped to some extent, maps of most other age classes are incomplete or lacking, making it difficult to use spatially explicit models to evaluate the current and future distribution of dispersal habitat and many other forest types that are used for foraging and nesting by spotted owls. Thus, use of a spatially explicit model at this time would involve many assumptions about the amount and distribution of habitat and harvest areas that are unsubstantiated by data. Further, such assessments require availability of Geographic Information Systems (GIS). GIS is not fully available across most of the National Forests that are within the range of the northern spotted owl.

Since the release of the FEIS, a model designed by Dr. Kevin McKelvey and others has been considerably refined, and has been adopted by the BLM as a tool for ranking the alternatives in EISs for their Resource Management Plans.

Given that such a model is available, and that several others are in development, the SAT suggests that the Forest Service begin to acquire adequate GIS technology and develop spatially explicit maps of habitat and harvest alternatives that can be used to assess alternatives for the owl and other species.

Since 1989, crosses (hybrids) between barred owls and spotted owls have been confirmed at four widely separated locations within the range of the northern spotted owl. Although records of hybridization between barred owls and spotted owls are an interesting biological phenomenon, biologists do not know what the ultimate outcome will be. Hybridization is common in nature, having been recorded in about 10 percent of the non-marine birds in North America. In most species where it occurs it tends to be an uncommon event, and thus has little effect on the parental species -- they still continue as distinct species.

The SAT suspects that hybridization between spotted and barred owls is rare because so few hybrids have been detected during the last 15 years, despite the fact that hundreds of observers have been conducting surveys for spotted owls. Nevertheless, the barred owl is rapidly invading the range of the spotted owl, and the incidence of hybridization could possibly increase as the numbers of barred owls increase. The SAT simply does not know what the outcome of such hybridization will be. Even in the absence of interbreeding, the barred owl may represent a serious threat to the spotted owl from the standpoint of competition or displacement.

At this point, the SAT concludes that there is little the Forest Service or other forest management agencies can or should do to influence the eventual outcome of the barred owl invasion. It is not at all clear that this expansion of range is the result of forest management practices. It is equally unclear whether a change in management practices (e.g., saving all the old-growth forests or stopping all timber harvest) will have any effect on the rate or extent of the invasion. In light of this uncertainty, we believe the most reasonable course of action is to continue to manage habitat for large clusters of spotted owls dispersed across the historical range of the species.

Since the release of the FEIS, additional surveys of owls have been completed. Based on this information, we concluded that the population of spotted owls in British Columbia is very small, and will contribute little to the recovery of the species in the United States.

Between 1987 and 1992, pairs of owls were detected at 3,591 sites in Oregon, Washington, and northwestern California. As each site was not always verified in subsequent years, the occupied sites in 1992 would be less than that number by some unknown amount. These counts are near the upper limit of the population suspected by the ISC (3,000 to 4,000 pairs). Because there are still areas that have not been searched for owls, the SAT now predicts that the current population size may be somewhat larger than was suspected by the ISC. The increase in the number of confirmed owl pairs should not be interpreted as evidence of a population increase. Data from the density study areas and the demographic studies do not support such an interpretation. The obvious explanation for the increase in the number of confirmed owls is that survey effort has greatly increased during the last 10 years, including, (1) a greatly expanded effort to inventory owls in HCAs, and (2) the initiation of numerous demographic studies across the range of the owl. Given the dramatic increase

in survey effort since 1985, we would be most surprised if significantly more owls are not located with each increase in survey effort. In addition, the total number of owls that exist under current conditions is not particularly relevant - what is important is the total number of owls projected to occur when the management plan is fully implemented. The plan proposed by the ISC assumed that most pairs of owls outside HCAs would eventually disappear as habitat was removed, eventually resulting in a population of about 2,200 pairs of owls within the network of conservation areas. This estimate is independent of the size of the current population. What does change as a result of the larger current population size is that we can be somewhat more confident that the population will survive through the short-term transition period while the plan is being implemented and the amount of extant suitable habitat for northern spotted owls stabilizes after a prolonged period of decline at 1-2% per year.

We find that new information examined does not warrant proposing more restrictive measures for protecting owls aside from recommendations in Chapter 4 to compensate for BLM's preferred alternatives of their draft resource management plans that do not, in our opinion, provide for owl welfare at the same or higher level than the ISC Strategy. Assuming that the selected alternative in the FEIS is fully implemented, the ISC concluded that it will provide a high likelihood of maintaining a viable, well distributed population of northern spotted owls.

As part of our process we reviewed all the literature that we could find that was published since the preparation of the FEIS. In addition, progress reports and other unpublished information were reviewed and research scientists conducting on-going research were interviewed. A complete annotated bibliography of this information was prepared. The SAT evaluated this information and concluded that such information did not alter the underlying construct of the ISC Strategy nor indicate any reason to alter the details of that strategy except as necessary to mitigate for BLM actions.

Viability of Other Old-Growth Associated Species

The SAT expanded the evaluation of the risk of extirpation under the adoption of the FEIS Alternative B (the ISC Strategy) to include all species that have been identified by some source as being associated with old-growth forests.

This evaluation took place in three phases:

1. Identification of species closely associated with late-successional and old-growth forests.
2. Evaluation of the viability status of each such species under the five management alternatives described in the FEIS. This evaluation included estimation of the likelihood of extirpation from planning areas (interpreted by the SAT as National Forests within the range of the owl).
3. Identification of potential mitigations to ensure high viability of all species identified as closely associated with late-successional, old-growth forests that were determined to have less than a "high" probability of viability under the ISC Strategy.

The FEIS identified 32 species of terrestrial vertebrates as closely associated with late-successional, old-growth forests. The SAT refined the basis for identifying these species and expanded the evaluation beyond terrestrial

vertebrates (amphibians, reptiles, birds, and mammals) to include plants, invertebrates, and fish. This assessment was conducted because: (1) a full examination is in keeping with the mandates of the regulations issued pursuant to the National Forest Management Act to maintain viable populations of all native species well-distributed within the planning area(s); (2) such an assessment precludes "piece meal" consideration of evolving concerns with the inherent potential of infinite delays in plan approval; and (3) such an approach is in keeping with the Forest Service's recent commitment to ecosystem management. We caution, however, that this effort is not a complete ecosystem assessment -- but it is a significant step.

The SAT compiled what came to be referred to as the "long list" of all species that emerged from a review of literature, unpublished studies and data bases, Forest Service ecology data bases, and professional knowledge. A set of criteria was devised to help judge the association of the species with late-successional forest ecosystems. These criteria were used to reduce the "long list" to a "short list" of species that seemed likely to actually be closely associated with late-successional, old-growth forests. We then set up evaluation panels of seven to eight recognized experts in each of five specialty areas: (1) fungi and nonvascular plants; (2) vascular plants; (3) amphibians and reptiles; (4) birds; and (5) mammals. In separate processes, the SAT consulted with fisheries experts to develop lists and viability ratings of sensitive fish stocks, and we consulted with invertebrate specialists.

To determine the likely viability of each species under various planning alternatives described in the FEIS, each panel reviewed the available information on the species on the "short list" that were within their area of expertise, by planning area where appropriate. From this evaluation emerged a viability assessment for each species at two levels -- those rated by the panels as having a "high" or "medium high" level for overall viability were considered as being at low risk of extinction or extirpation from one or more planning areas (i.e., National Forests) and those species ranked as having a "medium low" or "low" level for overall viability were considered as having high risk of extinction or extirpation. Each species was evaluated for each alternative in the FEIS. The period of evaluation was 50 years. The SAT considered that these categories of risk responded to the population viability criteria presented in the regulations (36 CFR 219.19) issued pursuant to the National Forest Management Act of 1976.

Mitigation for Species Rated as Having a High Risk

It should be noted that the SAT proposed one set of mitigations to alleviate high risk to any species. While it may be possible to derive alternate mitigation measures and assume various levels of risk, it should be recognized that the species in question are, on the basis of present knowledge, considered to be closely associated with late-successional and old-growth forests. This simply means that, over the next 50 years at least, the welfare of these species depends on the amount, size, and distribution of such forests. Further, the assignment given to the SAT was to suggest mitigations to the ISC Strategy to alleviate risks to those species identified as being at high risk with such modification.

Building on the ISC Strategy requires some approach of "tiering" from one set of mitigations to the next. It should be remembered that the ISC Strategy

tiered off designated land uses such as National parks and Wilderness and land-use allocations in extant Federal land-use plans. In combination, these management schemes provide for high viability of 283 at-risk species. The SAT continued that process by next considering the Watershed Protection Areas from the mitigations suggested to deal with the 112 fish stocks considered to be at-risk. This set of mitigation measures for at-risk fish stocks was taken directly from the array of 6 management options for those at-risk fish stocks prepared by a panel of fisheries and watershed experts for managing pacific anadromous fish habitat on National Forests lands throughout the western states known as "PACFISH".

These mitigations involved protection areas within 300 feet on each side of fish bearing streams; 150 feet on each side of permanent non-fish bearing streams; 150 feet of lakes, ponds, and reservoirs, and wetlands larger than one acre; and 100 feet on each side of seasonal intermittent streams and wetlands less than one acre in size as well as landslide and landslide-prone areas. Within these protection areas, timber management is prohibited unless site-specific assessment indicates such activities will accelerate meeting desired ecological conditions.

Each of these options has a different risk rating for the fish stocks in question. The option we recommended was deemed by the scientists of PACFISH and by the SAT as having a "high" probability of providing for the viability of the fish stocks in question only insofar as spawning, rearing, and migration habitat on National Forests is concerned. Other factors influencing the viability of these fish runs (such as ocean fishing irrigation drawdown, or run-off from agricultural lands) is beyond the capability of the Forest Service to address. PACFISH presents two other options that give a "high" probability of success but at a greater cost in commodity resources. All other options are rated at "moderately high" (i.e., somewhat better than 50/50) probability of viability. In selecting such an option one would have to consider such a risk is acceptable in dealing with a critical habitat component for fish stocks that are very likely to be listed as either "threatened" or "endangered."

The Watershed Protection Areas provided, in combination with reserves in Parks and Wilderness areas, land-use plans, and the ISC Strategy for moving an additional 21 at risk species to the high viability category in addition to the 112 fish stocks the mitigations were designed to protect.

The next tier of mitigation is the consideration of requirements for nesting habitat on Forest Service lands for the marbled murrelet. This species was listed as "threatened" under the authority of the Endangered Species Act on September 28, 1992. This action ensures that the preparation of a recovery plan for this species will be forthcoming. It was the SAT's opinion that the prudent course of action was to reserve from manipulation all marbled murrelet habitat on National Forests within 50 miles of marine habitats in Washington and most of Oregon and within 35 miles in southern Oregon and California.

In addition, the SAT recommended that habitat recruitment stands (i.e., stands that have capability to become suitable nesting habitat) equal to 50 percent of the total of extant suitable habitat also be selected and protected. The mitigations suggested are considered by the SAT to be interim guides to preserve options until a recovery plan is prepared. It seems likely that such a recovery plan for the marbled murrelet will build on the recovery plan for

the northern spotted owl (basically the ISC Strategy) and some from of watershed protection areas put in place to protect at risk, and likely to be listed, fish stocks. The SAT estimated that 24 additional at risk species can be removed from that category by the combination of above described actions.

There were another 17 at-risk species that are rare or locally endemic. Mitigations vary for this group by species, but generally depend on surveys for occurrence of the species and protection on a site-specific basis. Another five species that are more broadly distributed require some considerations in management of the forest matrix between protected late-successional, old-growth forested areas. Such action includes leaving some large tree stems, and standing dead trees on site during silvicultural manipulations including logging, protection of talus areas, and buffering meadows and other natural openings.

* There were, in addition, 149 species of invertebrates and 52 species of plants and vertebrates (22 nonvascular plants and fungi, 18 vascular plants, 12 mammals mostly species of bats) of which so little is known that the SAT was precluded from assessment of their viability or the prescription of mitigations. Inability to assess viability does not imply that species are at risk nor does it imply the opposite. Intuitively, the reservations of late-successional, old-growth forests in parks and Wilderness, land-use plans, and the ISC Strategy should go some distance toward insuring the viability of such species. The additional mitigations described above should further add to probability of maintaining viable populations. Yet, the state of knowledge about these species is such that their viability simply cannot be assessed. It should be noted only 12 (all mammals) of the 52 species are vertebrates. SAT suggests that information necessary to evaluate viability of these species be obtained and evaluated. It is logical to assume that such a process would reveal that some of these species have a low risk of extirpation or extinction. For those species that are at risk it is likely that specific mitigations can be developed to ensure a low risk - but, such cannot be preformed without additional information. We do not believe such information currently exists. As such new information is generated we recommend its consideration through an adoptive management process.

The SAT concluded that, with the institution of the ISC Strategy and the implementation of the mitigations described above, that 463 of the 515 (90 percent) at the plants and vertebrates associated with late-successional and old-growth forests can be considered to have a low risk for extirpation or extinction.

CHAPTER 3

A REVIEW OF THE EFFECTS OF EXEMPTING THIRTEEN BLM TIMBER SALES
FROM REQUIREMENTS OF THE ENDANGERED SPECIES ACT

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FROM REQUIREMENTS OF THE ENDANGERED SPECIES ACT

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CHAPTER 3

A REVIEW OF THE EFFECTS OF EXEMPTING THIRTEEN BLM TIMBER SALES FROM REQUIREMENTS OF THE ENDANGERED SPECIES ACT ON THE VIABILITY ASSESSMENTS IN THE FINAL ENVIRONMENTAL IMPACT STATEMENT ON MANAGEMENT OF THE NORTHERN SPOTTED OWL IN THE NATIONAL FORESTS

Introduction

In January of 1992, the USDA Forest Service issued a Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests (FEIS). The FEIS analyzed five alternatives for management of spotted owl habitat. The Conservation Strategy put forward by the Interagency Scientific Committee (ISC) (Thomas et al. 1990) was the preferred alternative in the FEIS.

The ISC Conservation Strategy included lands under management by the Bureau of Land Management (BLM) in western Oregon and northern California. A major assumption for analysis of all five FEIS alternatives was that BLM would manage their lands under a strategy equal or superior to the ISC Strategy, with regards to owl viability. The FEIS also assumed that formal consultation between the BLM and the U.S. Fish and Wildlife Service (FWS) would preclude implementation of BLM timber sales in conflict with the ISC Strategy.

While the viability assessment for the FEIS was being prepared, the BLM in Oregon applied to the Endangered Species Committee for an exemption from the requirements of Section 7 of the Endangered Species Act for 44 timber sales, judged by the Fish and Wildlife Service to cause jeopardy to the spotted owl. On May 15, 1992, the committee exempted 13 of these sales. Additionally, the Endangered Species Committee required that if the BLM proceeded with the 13 exempted timber sales, the agency would then follow the mandates in the Fish and Wildlife Service's Recovery Plan (ESC 1992).

The granting of exemptions for these sales invalidates the assumption that Section 7 consultation would result in management equal or superior to that provided by the ISC Strategy. The FEIS noted that, if an exemption was granted, the viability assessment would need to be reexamined (USDA 1992). On May 28, 1992, an order of the U.S. District Court, Western District of Washington at Seattle, instructed the Forest Service to reexamine the FEIS viability analysis.

Currently the BLM in Oregon is under a court-imposed injunction which prohibits timber sales in spotted owl habitat until new management plans are implemented in full accordance with the provisions of the National Environmental Policy Act. In this analysis it was assumed that the present injunction is temporary and will eventually be rescinded, allowing the BLM to follow a course of management that provides some level of timber harvest.

Indications are that management of northern spotted owls by BLM in California will continue to be consistent with the provisions of the ISC Strategy (J. Decker pers. comm.). If this is so, the assumptions made in the FEIS regarding the participation of the California BLM in the ISC Strategy remain valid.

Purpose of the Analysis

The purpose of this analysis was to consider the effect of 13 exempted BLM timber sales on the viability assessments of the FEIS alternatives. Although this review was triggered by the exemption of these 13 sales, the exemptions are only a part of the larger question regarding BLM's participation in northern spotted owl habitat management.

Contributions by BLM to present and future projected amounts of spotted owl habitat are unclear at this time. This uncertainty requires Forest Service analysts to make assumptions. The task of the Scientific Analysis Team was to consider current evidence in the examination of the the FEIS assumption that BLM would manage similar to the ISC Strategy. The exemption of the 13 sales is part of the evidence; these assumptions cannot be examined in isolation of the role of Section 7 consultation, and BLM's current approved management plans.

Description of the Analysis

The BLM in Oregon is currently in the process of developing 10-year district resource management plans (USDI 1992) which will establish new resource management direction with consequences for northern spotted owls and their habitat. See Chapter 4 for a complete discussion of BLM's draft resource management plans.

This analysis considers the effects of harvesting the 13 exempted sales and the effects of continuing with the direction outlined in BLM's current approved management plans. The Scientific Analysis Team based this analysis on the comparison of these two BLM management scenarios.

While current evidence does not support considering the 13 sale exemption as a single, one-time action, to be followed by a management strategy equal in effect to the ISC Strategy, we analyzed this "one-time action" scenario for the purpose of comparison.

The second scenario is based on the assumption that BLM will follow its current approved plans comprised of two components: Management Framework Plans and Agreement Areas. Management Framework Plans were developed in the 1980's (D. Bibles pers. comm., see letter in Appendix 3-A) and specify 60-year rotation ages for timber harvest on lands available for logging. BLM's agreement with the Oregon Department of Fish and Wildlife established 110 "BLM/ODFW Agreement Areas" within which suitable spotted owl habitat would be protected (USDI 1988). One such area has been transferred to the Bureau of Indian Affairs leaving 109 of these Agreement Areas. The ISC Strategy (Thomas et al. 1990) describes Agreement Areas in detail beginning on page 77.

The Scientific Analysis Team assumed that the BLM would continue to plan and offer timber sales which, although in compliance with their current approved management plans, would not be equal or superior to the ISC Strategy in providing habitat for the spotted owl. Specifically, sales could be planned in spotted owl Habitat Conservation Areas (HCAs) that were prescribed by ISC. HCAs are large blocks of Federal land where habitat conditions and prescriptions are expected to provide for multiple pairs of spotted owls now, and in the future. We also assumed that sales would be proposed by BLM that do

not comply with the ISC's provisions for dispersal habitat (the 50-11-40 rule). The 50-11-40 rule provides for 50 percent of a quarter-township having trees averaging 11 inches in diameter at breast height with a canopy closure of 40 percent or greater.

Any action by a Federal agency that may affect a species listed under the Endangered Species Act is subject to consultation with FWS under Section 7 of that Act. Therefore, the Scientific Analysis Team's analysis considered the role that Section 7 consultation would play in modifying the BLM's current approved management plans and whether this would result in management that provides viability for spotted owls similar to that provided by the ISC Strategy.

BLM routinely consults with the FWS on timber sales that may affect spotted owls or their habitat. Analysis of a Biological Opinion (USDI 1991) issued by the FWS for the BLM's 1991 timber sale program reveals that such consultation did not cause the BLM to manage spotted owl habitat in a manner similar to the ISC Strategy. The BLM submitted 174 planned timber sales which conflicted with ISC's provisions for well distributed dispersal habitat in 110 quarter-townships. Jeopardy opinions issued by the FWS for 52 of the 174 timber sales involved 67 of the 110 quarter-townships in conflict. Therefore, sales conflicting with meeting the 50-11-40 standards in 43 quarter-townships were given non-jeopardy opinions and allowed to proceed. The exemption granted by the Endangered Species Committee involved another 13 sales with an additional 17 quarter-townships in conflict. The result was "approval" of sales which would not comply with the ISC's 50-11-40 rule on 60 quarter-townships. The Biological Opinion also indicated that three sales were approved in HCAs, which also conflicts with the ISC Strategy.

The Endangered Species Committee's exemption of 13 sales after the FWS jeopardy determination further demonstrates the uncertainty of assumptions made in the FEIS about the ability of Section 7 consultations to result in management that has high probabilities of providing for viable populations of threatened or endangered species. As a mitigation measure for granting the exemption for the 13 sales, the committee required the BLM to submit their new 10-year management plans for consultation as to their effects on spotted owls (ESC 1992). This decision would perhaps lend credibility to the assumption in the FEIS had the committee not added the proviso that, if the FWS determines that these 10-year plans will likely jeopardize the continued existence of northern spotted owls, the BLM could once again apply to the committee for exemption from the requirements of Section 7 of the Endangered Species Act for the entire management plan.

Discussions with Fish and Wildlife Service personnel (B. Mulder pers. comm.) and regulations pursuant to ESA in 50 CFR Part 402 (Federal Register 1986) indicate that even without exemptions granted by the Endangered Species Committee, consultation between Federal land management agencies and FWS will not necessarily cause Federal agencies to meet the requirements of a management strategy or recovery plan. Consultation is designed to ensure that agency actions are not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. This is viewed as a significantly lower standard than a recovery or management plan which provides a high likelihood of viable populations. Therefore, avoiding FWS jeopardy opinions on a project-by-project basis may be considered likely to

result, over time, in habitat conditions which would lower the viability of a subspecies. While "take" may be avoided, consultation may allow, or at least perpetuate, fragmentation of habitat and provide amounts of nesting, roosting, and foraging spotted owl habitat that are minimal both in size and arrangement for maintaining pairs in appropriate proximity to other pairs. The consequences of such situations are clearly analyzed in Thomas et al. (1990). Effects of consultation between BLM and the Fish and Wildlife Service regarding designated critical habitat are unclear at this time.

For purposes of this analysis, the Scientific Analysis Team recognized that Section 7 consultation will modify at least some BLM proposals for timber sales; however, based on Biological Opinions issued by FWS in the past, the actions of ESC, and the limitations of Section 7 regulations, this assessment was conducted under the assumption that the Section 7 consultation process will not provide a de facto "management plan" equal to or better than the ISC Strategy.

Methods

The effects of two scenarios on the viability ratings of the FEIS were assessed. The first, made for comparison purposes only, is a scenario in which exemption of the 13 BLM timber sales from ESA requirements by ESC was considered a single, one-time action after which the BLM would follow a strategy similar to that of ISC in terms of owl viability. This scenario will be referred to in the following text and tables as "Exemption/ISC".

The second scenario consists of the exemption, with BLM following their current approved management plans thereafter. This will be referred to as "Current Approved Plans".

The FEIS used seven criteria to assess how well the alternatives provided for northern spotted owls (USDA 1992). These criteria are based on habitat needs of the sub species and principles of conservation biology. They are as follows:

1. Potential change in the amount and rate of change of spotted owl nesting, roosting, and foraging habitat.
2. Distribution of designated spotted owl nesting, roosting, and foraging habitat throughout the range of northern spotted owl with emphasis on areas of concern.
3. Capability of the habitat to support pairs of spotted owls through time.
4. Provisions for dispersal habitat to facilitate successful dispersal of spotted owls between and among areas designated for spotted owl habitat management.
5. Spacing between areas designated for spotted owl habitat management.
6. Provisions for size of spotted owl nesting, roosting, and foraging habitat patches.

7. Provisions for designating multiple pairs of spotted owls, thereby increasing probabilities that such areas will be occupied consistently through time (i.e., "clustering").

More detailed discussions of the criteria can be found in the FEIS (USDA 1992:3&4-47).

We examined each criterion in relationship to the two scenarios described earlier. When possible, and where it provided insight, the criteria were used to evaluate effects of each scenario on specific sites, physiographic provinces, and the entire range of the northern spotted owl. Primary sources of information included the ISC Strategy and files (Thomas et al. 1990), the FEIS (USDA 1992), and a BLM District Draft Resource Management Plan (USDI 1992).

Results

Exemption/ISC

Criterion 1 - Potential change in habitat.

The ISC Strategy called for protection of nesting, roosting, and foraging habitat in HCAs and areas reserved from timber harvest by agency resource management plans or Wilderness areas. The ISC Strategy further provided that the lands between the HCAs and reserved areas could be logged. The exemption of the 13 BLM timber sales allowed logging of 1,763 acres of nesting, roosting, and foraging habitat outside of HCAs or reserved areas. Several of the exempted timber sales, Moore Coon, Windy, and Four Gates appear to occur within boundaries of HCAs (O-31, O-31 and O-28 respectively) as mapped in the FEIS (USDA 1992). Based on statements in the Biological Opinion prepared by the FWS during formal consultation procedures (USDI 1991), which states that these sales would affect the 50-11-40 rule, the Scientific Analysis Team assumed that these sales were not actually in HCAs. We attribute the apparent discrepancy to either mapping error or BLM revision of HCA boundaries consistent with the ISC Strategy. Therefore, assuming this is correct, there would be no effect on the assumption of the FEIS regarding the potential change in the amount of habitat (Table 3-1).

Table 3-1. Range-Wide Acres of Northern Spotted Owl Nesting, Roosting, and Foraging Habitat on BLM Administered Lands by Scenario Analyzed (% Change From ISC).¹

Scenario	(Thousands of Acres)			
	Year 0 (Present)	Year 50		Year 100
Exempt/ ISC ²	1,153	1,008	(0)	1,229 (0)
Current Approved Plans	1,153	494	(-51%)	483 (-61%)

¹ BLM, Oregon acreages from USDI 1992. BLM, California from Thomas et al. 1990.

² Assumes Forest Service follows ISC Strategy and BLM follows an equally effective strategy for spotted owl viability after the exemption of 13 timber sales.

The ISC anticipated logging outside HCAs and reserved areas would occur at rates governed by sustained yield principles. The expected rates of logging are not necessarily synonymous with expected rates of loss for spotted owl nesting, roosting, and foraging habitat since not all stands that are harvested meet the definitions of such habitat. Expectations for spotted owl habitat in areas outside the HCAs were centered primarily on amounts and distribution of dispersal habitat as provided by the 50-11-40 rule. Responses, by the ISC, to management questions from agencies following the publication of the ISC Strategy, provide further guidance concerning timber harvest in the areas outside HCAs (Thomas 1991). The responses included provisions that allowed logging which would change forest stand conditions from those favorable for nesting, roosting, and foraging by spotted owls to conditions that would limit owl use to dispersal and some foraging. This could result in fairly rapid loss of most of the nesting habitat outside HCAs and reserved areas. Therefore, since the ISC expressed no clear assumptions regarding the rate of loss of nesting, roosting, and foraging habitat outside HCAs and reserved areas, the exemptions of the 13 BLM sales by the ESC have no effect upon the assumptions made in the FEIS regarding potential change in habitat.

Criterion 2 - Distribution of nesting, roosting, and foraging habitat.

If the assumption is true that all 13 exempted sales are outside HCA boundaries (see Criterion 1), the distribution of areas (HCAs) designated for the protection of nesting, roosting, and foraging habitat would remain unchanged.

Criterion 3 - Capability of the habitat to support pairs of owls.

As in Criterion 1, the ISC Strategy assumed that forested areas outside HCAs in the forest matrix would be subject to logging and might therefore be rendered

at least temporarily unsuitable for nesting pairs of owls. Because all sales in question are outside HCAs, this criterion would not apply.

Criterion 4 - Provisions for dispersal habitat.

The ISC Strategy provided for well-distributed dispersal habitat through the application of the 50-11-40 rule. The exemption will cause conflicts with the 50-11-40 rule in 17 quarter-townships. Of the 17, 14 were already below standard and three will be reduced below standards as a result of the exempted sales.

In the short term, the quality of dispersal habitat will be most affected in the areas between HCAs in which the exempted sales are concentrated. These sales will further impact areas where lack of dispersal habitat may already adversely affect successful dispersal.

Dispersal between HCAs O-27 and O-26 is currently severely and adversely affected by large areas of private land that are not subject to, and do not meet, 50-11-40 standards. Further exacerbating the situation, distance between these adjacent HCAs is 12 miles--the maximum distance recommended by the ISC. Exempted BLM sales will impact 404 acres of dispersal habitat (i.e., stands with at least 11 inch dbh and 40 percent crown closure) adjacent to a large block of private land situated between these HCAs that does not meet the 50-11-40 criteria. A total of five quarter-townships will be affected between these two HCAs by the exempted sales. Two of these quarter-townships currently meet the 50 percent standard, but they will be reduced from 58 to 37 percent and from 55 to 34 percent. One quarter-township will remain above minimum standards at 51 percent, and two others, which are already below 11-40 standards, will be reduced even further.

The exempted sales will result in the logging of 307 acres between HCAs O-25 and O-27. A total of three quarter-townships will be affected between these two HCAs, all three of which are already below the 50-11-40 standard for dispersal habitat. They will be reduced to 29, 31, and 35 percent of the area of quarter-townships meeting the 11-40 standard. Here, the expanse of private land and a distance of 24 miles (twice the 12-mile distance considered appropriate by the ISC) between these HCAs makes the existence of adequate dispersal habitat to provide for movement of spotted owls even more critical.

The exempted sales also allow for logging of 277 acres of dispersal habitat between HCAs O-29 and O-31. The distance between these HCAs is 4 miles, well within spacing guidelines of the ISC Strategy. A total of five quarter-townships will be affected between these two HCAs, all of which are already below the 50-11-40 standard for dispersal habitat. Three will be reduced to 19 percent, one to 16 percent, and one to 31 percent of the quarter-township meeting the 11-40 standard. The BLM administered lands here are more contiguous than in the more typical checkerboard areas. Hence, while the effects of cutting such stands conflict with the ISC Strategy, they are probably less significant here than in the other areas.

All the exempted BLM sales are located in the Oregon Coast Range Physiographic Province. The Oregon Coast Range Province has been identified as an area of concern by both the ISC and FWS due to scarcity of nesting, roosting, and foraging habitat, low numbers of owls, fragmented habitat, and the distances

between patches of habitat. Prior to the exemption, 40 percent (127 of 317) of BLM quarter-townships in the Province did not meet 50-11-40 standards (USDI 1991). After the exemption, 41 percent (130/317) will not meet the standards. Seven other sales in the province which conflict with the 50-11-40 standards in seven quarter-townships were given nonjeopardy Biological Opinions by the FWS.

Three of the exempted sales (Devore Mt., Camas Valley West, and Prego) have particular potential to affect movement of owls between physiographic provinces. None of these sales disrupt direct connections with adjacent provinces, but do represent a short-term loss of dispersal habitat in areas of potential use to owls for east/west and north/south movement between provinces.

Whereas it was possible to quantify changes to habitat that will occur as a consequence of the exempted sales, it was not possible to quantify the effects on actual dispersal by spotted owls. Qualitatively, it can be expected that increasing the number of quarter-townships not meeting dispersal standards, and further degradation of habitat conditions in quarter-townships already below standards, will cause owls to experience increased exposure to predation and increased competition for prey in dispersal areas. Subsequently, these owls might be less likely to successfully disperse between HCAs. The number of owls that will not successfully disperse, and the increase in mortality rate of dispersing owls caused by the exemption, cannot be predicted.

The significant conclusion is that the cumulative effect of harvest based on management plans that do not provide for well-distributed dispersal habitat is to continue the trend of declining conditions in an area already deficient in dispersal habitat.

Recent analysis by the BLM (USDI 1992) indicates that adoption of standards which would protect dispersal habitat to the level expected by the ISC Strategy, would result in most if not all their quarter-townships meeting the standards within 40 years--i.e., by around year 2030 (USDI 1992). In other words, there is a pronounced problem with dispersal habitat on BLM administered lands for at least 30 years. This problem, acute in the short term (10-40 years) will, with adoption of standards for dispersal habitat equal or superior to those of ISC, diminish with time until alleviated in 40 years.

Criterion 5 - Spacing between areas designated for spotted owl management.

The spacing analysis in the FEIS was conducted for HCAs and Spotted Owl Management Areas (SOHAs). Since the exempted timber sales are outside of HCAs and SOHAs, this criterion is not affected.

Criterion 6 - Patch size of habitat.

If the assumption that exempted timber sales occur outside HCAs is true, neither the size of HCAs or number of owl pairs within HCAs would be affected.

Criterion 7 - Clustering of owl pairs.

The previous discussion regarding the effects of the exemption on patch size is applicable to an assessment of its effects on clustering. Since the sales are not in designated areas, there is no effect on clustering.

Current Approved Plans

Whereas the analysis of the effects of exempted sales as a one-time action indicates that only Criterion 4 is affected, the analysis of the exemption as part of BLM's current approved management plans found all the criteria affected.

Criterion 1 - Potential change in habitat.

Current approved BLM management plans in Oregon do not provide HCAs or other large blocks where habitat and areas capable of growing into habitat for spotted owls will be protected. The BLM/ODF&W Agreement Areas will protect approximately 228,000 acres of nesting, roosting, and foraging habitat compared to 734,000 acres in BLM administered HCAs in Oregon as described under the ISC Strategy (Thomas et al. 1990). Significant reductions in nesting, roosting, and foraging habitat below that described in the ISC Strategy will occur as a result. Expected changes in the amounts of habitat BLM would be expected to provide through time are displayed in Table 3-1 for the two analyzed scenarios.

There would be a 51 percent reduction (under current approved plans scenario) in the amount of nesting, roosting, and foraging habitat that BLM would contribute in 50 years compared to the amount expected by ISC. In 100 years the reduction would be 61 percent (Table 3-2). The Exemption/ISC scenario is included in Table 3-2 for comparison.

Table 3-2. Potential Change in Acres¹ of Northern Spotted Owl Nesting, Roosting, and Foraging Habitat (% Change from ISC Expectations) on Lands Administered by the FS and BLM

Scenario	(In Thousands of Acres)					
	Year 0 (Present)		Year 50		Year 100	
	FS/BLM	Total	FS/BLM	Total	FS/BLM	Total
Exempt/ ISC ²	6,073/1,153	7,226	5,605/1008 (0)	6,613 (0)	6,025/1,229 (0)	7,324 (0)
FS-Alt B BLM-Current Approved Plans	6,073/1,153	7,226	5,605/494 (-51)	6,009 (-9%)	6,025/483 (-61)	6,508 (-11%)
FS-Alt C BLM-Current Approved Plans	6,073/1,153	7,226	6,171/494 (-51)	6,665 (+1%)	6,673/483 (-61)	7,156 (-2%)
FS-Alt D BLM-Current Approved Plans	6,073/1,153	7,226	6,951/494 (-51)	7,445 (+13%)	7,640/483 (-61)	8,123 (+12%)

¹ FS acreages from USDA (1992). BLM, Oregon acreages from USDI (1992). BLM, California from Thomas et al. (1990).

² Assumes that the FS follows the ISC Strategy and BLM follows an equivalent strategy following the exemption of 13 timber sales by the ESC.

Criterion 2 - Distribution of nesting, roosting, and foraging habitat

Current approved BLM management plans would provide protection of nesting, roosting, and foraging habitat in BLM/ODF&W Agreement Areas. The BLM/ODF&W Agreement Areas are distributed over the Oregon Coast Range (51), Klamath Mountains (30), and Oregon Cascades West (28) Provinces. The Agreement Areas currently contain an average of 2,100 acres (range from 734 to 4,188) of spotted owl nesting, roosting, and foraging habitat (Thomas et al. 1990). Looking strictly at present distribution, the BLM/ODF&W Agreement Areas, because they are well distributed in the physiographic provinces, are equal to the distribution of habitat provided by the ISC Strategy HCAs. However, in the long term (100 years) it is expected that, because of limited size of Agreement Areas and deteriorating conditions of the fragmented habitat in the Areas, they will likely support many fewer or no pairs of spotted owls (USDI 1992:4-71).

As discussed earlier, the Oregon Coast Range Physiographic Province has been identified as an area of concern, where the density of northern spotted owls is one-eighth of that recorded in other coastal areas (Thomas et al. 1990:67). Habitat conditions on BLM administered lands within the Oregon Coast Range

Province are critical for maintaining a well-distributed, connected network of areas of nesting, roosting, and foraging habitat (USDA 1992). Forecasted future conditions of the BLM/ODF&W Agreement Areas indicate that under BLM's current approved management plans, the Agreement Areas will not contribute to such a network (USDI 1992).

Long-term distribution of spotted owl habitat linking the Oregon Coast Range, Klamath Mountains, and Oregon Cascades West Physiographic Provinces are highly likely to lessen chances of interchange of dispersing owls between provinces. The distribution of HCAs proposed by the ISC on National Forests (Thomas et al. 1990) alone will not meet requirements for well-distributed blocks of habitat connected by dispersal habitat.

Table 3-3. ISC Strategy HCAs Affected by Oregon BLM Following Current Approved Plans and a Comparison of Future Adjusted Expected Pairs Between ISC Expectations and Current Plans

Shared FS/BLM HCAs BLM portion Lost	Pairs of Owls		Entire BLM HCAs Lost	Pairs of Owls	
	ISC Expectations	Current BLM Plans		ISC Expectations	Current BLM Plans
O-6	23	14	O-12	24	0
O-7	25	23	O-16	22	0
O-11	22	18	O-24	20	0
O-17	25	3	O-26	23	0
O-19	29	25	O-27	28	0
O-20	17	17	O-28	24	0
O-21	23	3	O-30	25	0
O-29	20	7	O-37	17	0
O-31	23	16	O-38	5	0
O-32	21	16	O-39	2	0
O-33	20	4	O-40	14	0
O-35	20	19			
<u>O-36</u>	26	4			
TOTAL	13		11		

Criterion 3 - Capability of the habitat to support pairs of owls.

Both the BLM (USDI 1992) and the Forest Service (USDA 1992) have done assessments of the capability of habitat to support owl pairs. Unfortunately, different processes and different time scales were used. In its FEIS the Forest Service also used a process that differed from procedures previously used, such as the ISC estimates. As a result, direct comparisons between these efforts are not possible. However, it was possible to crudely assess the effects of the BLM's current approved plans on the capability of areas designated for spotted owl habitat to support pairs of spotted owls. These data were then compared with estimates made for the ISC Strategy (Table 3-4).

Table 3-4. Future Capability of BLM Category 1 and 2 HCAs or ODF&W Agreement Areas in Oregon to Support Pairs of Spotted Owls Based upon Estimates in the ISC Strategy by Analysis Scenario and by Physiographic Province

Scenario	Physiogr. Prov.	Future Adjusted Pairs ¹	Percent Reduction From ISC Expectations
Exempt/ ISC ²	Oregon Coast R.	164	0
	Klamath Mtns.	89	0
	Oregon Cascades	<u>83</u>	<u>0</u>
	Total	336	0
Current Approved Plans	Oregon Coast R.	0-23	100-86
	Klamath Mtns.	0-43	100-52
	Oregon Cascades	<u>0-24</u> ³	<u>100-71</u>
	Total	0-90	100-73

¹ Future adjusted pairs based on estimates for BLM HCAs and proportions of ownerships in joint BLM/FS HCAs, based on ISC estimates and proportions of BLM acreages lost.

² Assumes FS will follow the ISC Strategy and that BLM will follow an equal strategy after the exemption of the 13 timber sales.

³ BLM/ODF&W Agreement Areas are theoretically capable of supporting 90 pairs of spotted owls (Thomas et al. 1990). Estimates in draft resource management plans (USDI 1992) indicate that for Alternative B, an alternative very similar to the current approved management plans (Lint, pers. comm.), the outlook for sustaining owl pairs on BLM lands in Oregon is near zero (USDI 1992:4-71). The actual capability probably is somewhere between the two estimates and likely toward the low value.

Although the BLM/ODF&W Agreement Areas are expected to maintain 90 pairs of spotted owls over the long term (50-100 years), the likelihood of that actually occurring is near zero (Thomas et al. 1990; USDI 1992). Even if the agreement areas are assumed to be capable of supporting 90 pairs, when compared to the 336 future pairs expected on BLM administered lands in Oregon under the ISC Strategy, it represents a 73 percent reduction. The actual reduction, based on the analysis BLM has completed for an alternative of draft resource management plans approximating the current plans, is apt to be significantly greater than 73 percent (USDI 1992:4-71).

The effects of current approved plans of the Oregon BLM on capability of all Federal lands to support pairs of owls vary by physiographic province. The Oregon Coast Range Province is most affected. Here, the number of pairs is reduced by 141 pairs (56 percent of 250 pairs expected on Federal lands), relative to that expected by ISC in the future, assuming the BLM/ODF&W Agreement Areas support pairs at anticipated levels--which is highly unlikely for reasons documented earlier. If it is assumed that the Agreement Areas will not support any pairs of owls in the future, the number of pairs lost is 164, a 66 percent reduction. Reductions in pairs in the Klamath Mountains Province based on similar assumptions range from 12 percent to 16 percent of 600 pairs expected on

Federal lands, and from 14 percent to 19 percent of 435 pairs expected on Federal lands in the Oregon Cascades West Province.

Rangewide, the consequence of the reductions of pairs on Oregon BLM administered lands results in overall reductions from ISC estimates for Federal lands of 17 percent of the total pairs expected (1469), if the 90 pairs are assumed to be maintained in the agreement areas or a 23 percent reduction if the assumption is zero.

Criterion 4 - Provisions for dispersal habitat.

The 13 exempted BLM sales will reduce dispersal habitat by 1,763 acres. If BLM follows current approved plans, approximately 50 percent of all BLM quarter-townships in western Oregon will likely fail to meet 50-11-40 standards within about 10 years. This assumes that the increase in number of quarter-townships not meeting the 50-11-40 standard would increase at a rate of 1 percent per year if the BLM's 1991 sale program, after consultation, is any indication of future actions (USDI 1991). It also assumes that an insignificant amount of habitat will grow into a condition of 11-40 in the next 10 years.

Some dispersal habitat would be retained by means of other land allocations such as riparian zones, but in unknown amounts and distribution. Patches designated for protection as nesting, roosting, and foraging habitat would also aid dispersal. However, the ISC Strategy determined that additional measures were required to increase the probability of movement of owls between HCAs (Thomas et al. 1990:26). Recent sensitivity analyses for the BLM draft resource management plans indicated that implementation of any management alternatives lacking such provisions would likely result in most or all of the quarter-townships within the planning areas not meeting the 50-11-40 rule prescribed in the ISC Strategy (USDI 1992).

Adherence by BLM to standards that would provide for levels of well-distributed dispersal habitat equal to or better than those of ISC become particularly critical and difficult to achieve where private lands intermingle with BLM administered lands in a checkerboard pattern. Here strict compliance will, if there is no contribution from private lands, result in 25 percent of the landscape in dispersal habitat. It is likely that some contributions to dispersal habitat will come from private lands when stands on those lands exceed about 40 years of age. The amount of time such stands contribute significantly to dispersal habitat will depend on the age that such stands are harvested. This in turn will depend largely on conditions of the forest products markets. Because of concerns about risks to dispersing spotted owls in this type of landscape, the ISC called for a review of the 50-11-40 rule regarding such areas, three years after implementation.

Present forest conditions (i.e., pronounced and increasing fragmentation, lack of habitat, and intermingled clearcut private lands) of the Oregon Coast Range Physiographic Province make it likely that there will be a rapid reduction of dispersal habitat under current approved plans for the BLM in Oregon. This seems likely to continue in the short term (0-40 years) even if consultation between BLM and FWS determines logging of such habitat is likely to result in jeopardizing the continued existence of northern spotted owls. Significant additional losses of dispersal habitat will almost certainly occur, exacerbating poor conditions of dispersal habitat in the province. Short rotation ages (60

years) will restrict the future amounts of forests reaching conditions needed for successful dispersal. These factors will result in a high probability that the province will become increasingly demographically isolated from the other physiographic provinces, perhaps reaching a critical point within the next several decades.

Dispersal habitat for owls on BLM lands is crucial to enhance movement of owls within and among habitats on National Forests in the Oregon Cascades West, Klamath Mountains Provinces, and Oregon Coast Range Province. Difficulty with dispersal of owls is likely to be pronounced between HCAs O-19 and O-20 if there are no requirements to provide adequate quality and arrangement of dispersal habitat. Under current approved plans for the BLM, dispersal habitat will not be adequately and appropriately distributed. Further, habitat within the Agreement Areas will continue to deteriorate (USDI 1992). As this occurs, National Forest System lands in the Oregon Coast Range Province may well exhibit an increasingly demographically isolated population of owls. This will likely significantly increase the probability, but to an unknown extent, that spotted owls will be eventually extirpated within that province. Dispersal of juvenile owls between the Oregon Cascades West Province and the Klamath Mountains Province will also become increasingly difficult.

Rangewide, all of these collective factors seem likely to significantly increase the risk to the meta-population of northern spotted owls. How much of an increase is not precisely quantifiable.

Criterion 5 - Spacing between areas designated for spotted owl management.

Most of the 109 BLM/ODFW Agreement Areas are not expected to support pairs of owls over the long term (50-100 years). Therefore, responsibilities of the Forest Service are increased under regulations pursuant to the National Forest Management Act (NFMA) to provide for viable populations of spotted owls well distributed in the planning areas. The Forest Service portions of the 13 HCAs (Table 3-3), identified in the ISC Strategy as being shared with BLM, will support fewer pairs of spotted owls than listed in Table Q5 of the ISC Strategy. In some cases HCAs change from Category 1 HCAs (capable of supporting 20 or more pairs of spotted owls) to Category 2 HCAs (capable of supporting 2-19 pairs). Likewise, this affects ISC expectations for spacing between HCAs. Category 1 HCAs are to be no more than 12 miles apart. Distance between Category 2 HCAs is to be a maximum of 7 miles.

A total of 10 shared (Forest Service and BLM) HCAs will drop in habitat capability from Category 1 to Category 2. The average first, second and third nearest neighbor distances between HCAs will also increase (Table 3-5). The most significant increase is in the Oregon Coast Range Province where only the first nearest neighboring HCA is within the prescriptions of ISC for spacing. Here six HCAs changed in habitat capability from Category 1 to Category 2. These are in a north to south line. Because they are now Category 2 HCAs, a separate nearest neighbor analysis was conducted. The average distance from these Category 2 HCAs to the first, second and third nearest neighboring HCAs is 7.9, 19.7, and 26.8 miles respectively (Table 3-5). These distances are above the maximum prescribed for Category 2 HCAs in the ISC Strategy. One of the goals of the ISC was to have HCAs connected to at least three other HCAs. It was not possible to fully meet that goal in the ISC Strategy. Under current approved BLM plans the connections will be further weakened.

Table 3-5. Average First, Second, and Third Nearest Neighbor Distances (In Miles) Between Category 1 and 2 HCAs on National Forests and BLM by Province (NN = Nearest Neighboring HCA Within the Province)

Scenario	NN	Physiographic Province		
		Oregon Cascade W. Dist.	OR Coast Range Dist.	Klamath Mtns. Dist.
Exemption/ ISC	1st	5.2	5.1	4.5
	2nd	8.5	9.3	7.2
	3rd	12.6	15.7	12.1
Current Approved Plans	1st	5.1	8.2	4.2
	2nd	9.1	19.6	7.8
	3rd	16.1	25.4	12.8

In addition to increased distances between HCAs, BLM's current approved plans will affect areas identified as "critical links" (Thomas et al. 1990). These areas are located where movements of owls between physiographic provinces are most likely. The ISC Strategy prescribed HCAs to bridge these "gaps". The average distance between HCAs across physiographic provinces in critical linkage areas increase 3 to 4 times under BLM's current approved plans (see Table 3-6). The increased distances represent levels where movement of owls between physiographic provinces is increasingly unlikely.

Table 3-6. Average Distances (In Miles) Between HCAs Across Province Boundaries in Areas Identified as "Critical Links". Percent Column Indicates % of Radio-Tagged Juveniles Known to Disperse at Least as Far as the Average Distance Between HCAs.

Scenario	Critical Link	Distance	%
Exemption/ ISC	Oregon Coast to Western Oregon Cascade	17.4	50
	Oregon Coast to Klamath	16.5	54
	Klamath to Western Oregon Cascade	6.9	74
Current Approved Plans	Oregon Coast to Western Oregon Cascade	56.4	2
	Oregon Coast to Klamath	68.4	0
	Klamath to Western Oregon Cascade	29.6	21

Criterion 6 - Patch size of habitat.

Areas of contiguous habitat probably support a larger number of northern spotted owls than an equal amount of habitat distributed as small patches (USDA 1988; Anderson et al. 1990). Fragmentation of habitat blocks increases the ratio of edge habitat to interior habitat, resulting in a smaller amount of interior habitat overall (Thomas et al. 1990:293). A primary objective of HCAs was to

provide large blocks of nesting, roosting, and foraging habitat and offer areas which are expected to develop into superior owl habitat through time (Thomas et al. 1990:167). In this context, patch size is equated to HCA size for a quantitative analysis. A management strategy which reduces HCA size, however, must also be viewed in the light of acres of habitat removed from HCAs.

Throughout the range of the northern spotted owl, HCAs as described in the ISC Strategy are comprised of mixed ownerships, including Federal, State, private, and tribal lands. The Scientific Analysis Team analysis focused on Federal ownership only as prescribed by the ISC Strategy. Assuming that BLM follows current approved plans, the average size of HCAs generally decreases within affected provinces due to the loss of BLM's portion of shared HCAs (Table 3-7). An exception is the Oregon West Cascade Province where average HCA size increases by 8,042 acres because the HCAs lost there are the smaller ones. However, it should be remembered that total BLM habitat in HCAs decreased by 734,000 acres. Size of HCAs in the Oregon Coast Range Province decrease by an average of 15,203 acres (32 percent). Those in the Klamath Mountains Province average a reduction of 4,554 acres (5 percent). Smaller HCAs reduce the probability of reaching the desired cluster size within each HCA, and hence, population goal within each province.

Table 3-7. Number and Average Size of HCAs Under the Two Scenarios Analyzed By Physiographic Province

Province	<u>Exemption/ISC</u>		<u>Current Approved Plans</u>	
	No. of HCAs	Mean HCA Size (Ac.)	No. of HCAs	Mean HCA Size (Ac.)
Oregon Coast Range	12	47,917	7	32,714
Oregon Cascades West	18	74,333	16	82,375
Oregon Cascades East	6	22,167	6	22,167
Klamath Mtns.	43	44,279	40	42,100
CA Cascades/Modoc	12	21,283	12	21,283
No. CA Coast Range	31	7,435	31	7,435
WA Olympic Peninsula	1	676,000	1	676,000
WA Cascades West	22	67,727	22	67,727
WA Cascades East	13	39,000	13	39,000
Range-wide	127	55,975	117	39,905

Based on the loss or reduction of HCAs within the affected provinces, average HCA size would decrease from 55,975 to 39,905 acres range-wide (Table 3-7). This reduction (29 percent) in average size of HCAs would negatively affect the total number of owls on a range-wide basis (see clustering analysis criterion 7).

Criterion 7 - Clustering of owl pairs.

Currently the BLM/ODF&W Agreement Areas provide sufficient habitat to maintain pairs of owls in small clusters. The majority (range = 91-100%) of habitat areas currently provide clusters of one to four pairs of owls (Table 3-8). The sum of column totals in Table 3-8 do not total 109 Agreement Areas because groups of two or more contiguous Agreement Areas were treated as one cluster. In the long term, we assume the BLM/ODF&W Agreement Areas will support considerably fewer or no pairs of owls (USDI 1992). Loss of territorial owl pairs from these areas is expected due to anticipated loss of quality, quantity, and distribution of suitable owl habitat within these designated areas. Lack of provisions for well-distributed dispersal habitat on BLM administered lands would preclude or reduce effective dispersal and recolonization of BLM/ODF&W Agreement Areas.

Table 3-8. Number of BLM/ODF&W Agreement Areas by Cluster Size.

Cluster size	Physiographic Province					
	Klamath Mtns		OR Coast Range		OR Cascades W.	
	Presently	AFEP ¹	Presently	AFEP	Presently	AFEP
0	0	20	0	22	0	17
1-4	20	0	20	0	16	0
5-9	0	0	2	0	1	0
Total	20	20	22	22	17	17

¹AFEP = Adjusted future expected pairs of owls, based on Thomas et al. 1990.

Table 3-8 illustrates that currently only 15 percent of the Agreement Areas are capable of supporting more than four pairs of spotted owls and that none are capable of supporting more than nine pairs. Table 3-8 further displays that, in the future, the Agreement Areas will provide few or no clusters of owls.

Our analysis for this criterion focused on the number of HCAs and number of owl pairs within HCAs. Of the three physiographic provinces affected by BLM's current approved plans, the Oregon Coast Range shows the greatest reduction (42 percent) in the number of HCAs (Table 3-9). Reductions in the number of HCAs of 22 percent and 5 percent occur within the Oregon Cascades West and Klamath Mountains Physiographic Provinces, respectively. As a result, there will likely be a concomitant downward trend in the number of owl pairs within HCAs and in each affected province.

Table 3-9. Comparison of the Number of HCAs Based on the Two Scenarios Analyzed by Physiographic Province.

Physiographic Province	Number of HCAs		% Reduction
	Exemption/ISC	Cur.Approv.Plns.	
Oregon Coast Range	12	7	42
Oregon Cascades West	18	14	22
Oregon Cascades East	6	6	0
Klamath Mtns.	43	41	5
CA Cascades/Modoc	11	11	0
No. Calif. Coast Range	31	31	0
WA Olympic Peninsula	1	1	0
WA Cascades West	22	22	0
WA Cascades East	13	13	0
Range-wide	157	146	5

The number of adjusted future expected pairs of owls in HCAs will be below the desired level of 20 pairs for the majority of HCAs within two of the three affected provinces (Table 3-10). Of the affected provinces, the Oregon Coast Range would lose nine of ten Category 1 HCAs prescribed by the ISC Strategy and would have the lowest (8 percent) ratio of HCAs exceeding 20 pairs of owls. This represents a 90 percent reduction in Category 1 HCAs for the Oregon Coast Range Province, which is an area of special concern (Thomas et al. 1990). Four HCAs (27 percent) with clusters of pairs greater than 20 will be lost in the Klamath Mountains Province and six (35 percent) will be lost in the Oregon Cascades West Province.

Table 3-10. A Comparison of Frequency Distribution of HCAs and BLM/ODF&W Agreement Areas Based on the Two Scenarios Analyzed by Cluster Size and Physiographic Province. (Cluster Size Represents the Number of Adjusted Future Expected Owl Pairs.)

Cluster size	Physiographic Province ¹					
	<u>OR Coast Range</u>		<u>OR Casc West</u>		<u>OR Casc East</u>	
	Exempt/	Current	Exempt/	Current	Exempt/	Current
	ISC	Approv Plns	ISC	Approv Plns	ISC	Approv Plns
0	0	5	0	3	0	0
1-4	0	2	0	1	5	5
5-9	1	1	0	0	0	0
10-14	0	0	1	1	0	0
15-19	1	3	0	2	0	0
20-24	7	1	12	9	1	1
25-29	3	0	4	1	0	0
30+	0	0	1	1	0	0
Total	12	12	18	18	6	6

Cluster size	<u>Klamath Mtns</u>		<u>CA Casc/Modoc</u>		<u>CA Coast Range</u>	
	Exempt/	Current	Exempt/	Current	Exempt/	Current
	ISC	Approv Plns	ISC	Approv Plns	ISC	Approv Plns
	ISC	Approv Plns	ISC	Approv Plns	ISC	Approv Plns
0	8	11	4	4	7	7
1-4	11	12	6	6	7	7
5-9	1	1	0	0	2	2
10-14	2	2	1	1	0	0
15-19	6	6	0	0	0	0
20-24	12	8	0	0	1	1
25-29	1	1	0	0	0	0
30+	2	2	0	0	0	0
Unknown					14	14
Total	43	43	11	11	31	31

Cluster size	<u>WA Oly Pen</u>		<u>WA Casc West</u>		<u>WA Casc East</u>	
	Exempt/	Current	Exempt/	Current	Exempt/	Current
	ISC	Approv Plns	ISC	Approv Plns	ISC	Approv Plns
	ISC	Approv Plns	ISC	Approv Plns	ISC	Approv Plns
0	0	0	0	0	0	0
1-4	0	0	10	10	9	9
5-9	0	0	3	3	1	1
10-14	0	0	2	2	1	1
15-19	0	0	1	1	0	0
20-24	0	0	3	3	2	2
25-29	0	0	2	2	0	0
30+	1	1	1	1	0	0
Total	1	1	22	22	13	13

Table 3-10. (continued).

Cluster size	Range-wide	
	Exempt/ ISC	Current Approv Plns
0	23	34
1-4	73	77
5-9	12	12
10-14	11	11
15-19	9	13
20-24	43	30
25-29	12	6
30+	6	6
Unknown	14	14
Total	203	203

¹ Provinces: WA Oly Penn. = Washington Olympic Peninsula; WA Casc West = Washington Cascades West; WA Casc East = Washington Cascades East; OR Coast Range = Oregon Coast Range; OR Casc West = Oregon Cascades West; OR Casc East = Oregon Cascades East; CA Casc/Modoc = California Cascades/Modoc; and CA Coast Range = Northern California Coast Range.

Range wide, BLM's current approved plans will decrease the number of HCAs on Federal lands by 7 percent (11 of 157 HCAs)(Table 3-9). Approximately 21 percent (42 of 203) of HCAs would retain 20 or more adjusted future expected pairs of owls under currently approved BLM plans, compared to 30 percent (61 of 203) under the ISC Strategy (Table 3-10). In addition, 11 HCAs will decrease to a size where zero future adjusted pairs of owls are expected. This is a 41 percent increase.

The effects of BLM's current approved plans on the numbers and size of clusters prescribed by the ISC Strategy significantly reduce the overall expected future populations of that strategy. Range wide reductions in future pairs ranging from 14 percent to 19 percent (246-336) from the numbers of pairs described by ISC will result from BLM following their current approved plans.

Smaller clusters also create conditions that make occupancy by spotted owls of the remaining clusters (i.e., HCAs) less certain. Empirical data and modeling indicate that local extinction rates increase as the size of population clusters decreases (Thomas et al. 1990). Therefore, the pro-rated shares of spotted owl pairs expected in formerly shared BLM/Forest Service HCAs may not be attainable. This situation would then be further exacerbated by reduced probabilities for successful dispersal.

Reassessment of Viability Ratings for each of the FEIS Alternatives

Contributions of BLM lands to northern spotted owl habitat, based on the two scenarios analyzed, are common to all five FEIS alternatives. The effects on each scenario, of course, vary. Discussions of each alternative and how the viability assessments associated with each scenario are affected are described below. For this reassessment the Scientific Analysis Team used a five-scale rating system instead of the three used in the FEIS, because of differences between alternatives that warranted distinction. The ratings for this analysis are low; moderately low; moderate; moderately high; and high (see Chapter 6 for definitions).

Alternative A provides spotted owl habitat by using a network of habitat areas where nesting, roosting, and foraging habitat capable of supporting single pairs of spotted owls would be protected from logging. No provisions are made for dispersal habitat. This strategy was evaluated by the ISC and described as having a high risk of spotted owls being extirpated from significant portions of their range. The FEIS viability assessment likewise rated Alternative A as having a low likelihood of population viability.

The exemption of the 13 BLM timber sales, under either analysis scenario, has no effect upon this rating. No change on the "low" rating for overall viability is indicated.

Alternative B is the ISC Strategy which uses multiple pair HCAs to provide nesting, roosting, and foraging habitat and the 50-11-40 rule to provide well distributed dispersal habitat of adequate quality. Since this strategy was developed to include National Parks, National Forests, and BLM lands, deviations from its standards and guidelines affect the probability of success. Such a deviation would be the exemption of the 13 BLM sales, which

conflict with certain provisions. The magnitude of the effects depends on the analysis scenario.

Exemption/ISC

This scenario affects only the expectations Alternative B had regarding well distributed dispersal habitat. It results in the removal of 1,763 acres of habitat used for dispersal by spotted owls. This represents about 0.17 percent of the total Oregon BLM nesting, roosting, and foraging habitat. Additional, but unknown, acreages of habitat suitable for dispersal exist. When suitable habitat on all involved Federal ownership is considered, the exempted sales total less than 0.02 percent of such habitat. If, as assumed for this scenario, BLM provides for well-distributed dispersal habitat similar to the ISC Strategy standards, the loss of suitable habitat that provides dispersal habitat can be considered minor and relatively insignificant. Therefore, the overall effect of the exemption of these 13 sales, standing alone, would have negligible effects on the "high" viability rating in the FEIS.

Current Approved Plans

Effects described are significant and result in serious weakening of the ISC Strategy as a result of likely consequences.

Increasing isolation of the owl population in the Oregon Coast Range Province would occur. Instead of a future subpopulation level of about 250 pairs as anticipated under the ISC Strategy, about 86 pairs could be anticipated in 50 years. These pairs will occur in two separate geographical areas. This small number of pairs in isolated subpopulations would be susceptible to catastrophic events that could lead to extirpation within this province.

There will likely be increased difficulty for spotted owls moving between the Klamath Mountains and Oregon Cascades West Provinces, with a high probability of producing relatively isolated subpopulations of these provinces. This would result in a subpopulation of about 460 owl pairs in the Klamath Mountains and other northern spotted owl physiographic provinces of California, instead of approximately 550 pairs under the ISC Strategy. Slightly more than 350 pairs would be expected in the two provinces of the Oregon Cascades compared to 436 under the ISC Strategy.

There will be an increased likelihood that Category 1 HCAs reduced from 20 plus pair areas to smaller Category 2 HCAs will fail to actually support the number of pairs anticipated, as discussed above.

Together the effects would lower the overall viability rating of the FEIS for Alternative B from high to moderately low with a moderate probability of extirpation of the Oregon Coast Range subpopulation over the long term.

Alternative C is comprised of the components of the ISC Strategy plus Critical Habitat designated by the FWS under provisions of the Endangered Species Act. It was rated as having a high likelihood of providing for viable populations.

Exemption/ISC - As in Alternative B, this scenario will not change the viability rating of "high" described in the FEIS.

Current Approved Plans - The addition of large blocks of habitat in designated Critical Habitat Units to the HCAs has several beneficial effects that tend to alleviate the negative effects of this scenario. They include:

1. Reducing loss of habitat by protecting more acreage.
2. Increasing numbers of pairs expected in the future on National Forests by 18 percent over Alternative B.
3. Increasing the patch sizes designated for protection and therefore, the number of clusters of more than 20 owl pairs from 34 in Alternative B to 40 in Alternative C.
4. Reducing distances between HCAs thus facilitating movement of owls. This is particularly true in the Oregon Coast Range Province where first nearest neighbor distances decrease by 82 percent and second neighbor distances decrease by 65 percent. Values in the Oregon Cascades West Province are -49 percent and -37 percent respectively. Spacing in the Klamath Mountains Province remains essentially unchanged.
5. Increasing distribution of spotted owl habitat to be protected in designated areas. The CHUs will create greater redundancy in the network, an important hedge against catastrophic loss of habitat which could cause loss of connectivity among components of the network.

In spite of the benefits above, the Oregon Coast Range would still be an increasingly isolated subpopulation. This isolated subpopulation would be expected to be larger than under Alternative B by up to 122 pairs (a 42 percent increase), but would still be in two separate areas. Additionally, some of the HCAs reduced from Category 1 to Category 2 status would not be adjacent to CHUs and would remain small. This scenario makes it increasingly likely that the Forest Service could not, over the long term, meet NFMA regulations for a viable population of owls well distributed within the planning area.

Based on the above information the Scientific Analysis Team believes the FEIS viability rating will be "moderate" for overall viability of the northern spotted owl.

Alternative D entails implementation of the ISC Strategy plus protection of all remaining nesting, roosting, and foraging habitat. It provides all the benefits ascribed to Alternative C above, but to an even greater area. In addition, a larger population of owls (perhaps as many as a total of 136 pairs), would be expected for the Oregon Coast Range Province HCAs on National Forests (Federal lands). Here again, isolation of the province would be of concern, although the larger population would be somewhat less susceptible to extirpation from stochastic events.

Exemption/ISC - As in Alternative B, this scenario will not change the viability rating of "high" described in the FEIS.

Current Approved Plans - The high rating assigned in the FEIS will drop to a "moderately-high" rating because of probable isolation of the Oregon Coast Range subpopulation. Simply protecting all existing nesting, roosting, and foraging habitat between the HCAs, as in this alternative, would not result in

future habitat conditions conducive to reducing risks to such a subpopulation. This alternative, by not providing for reductions of fragmentation in the areas between HCAs, will cause the nesting, roosting, and foraging habitat to become degraded as the habitat patches get smaller through time. A strategy is needed that will provide for the maximum number of pairs possible by allowing forested lands, with the potential to do so, to grow back into nesting, roosting, and foraging habitat.

Alternative E, titled the "Multi-resource Strategy", incorporates certain elements of Alternative B in the ISC Strategy. However, it decreases the size and number of HCAs, thereby increasing distances between them. It further reduces provisions for dispersal by reducing the area where dispersal habitat was provided, and reducing the standards compared to the 50-11-40 rule. The FEIS rated this alternative as having a "low" likelihood of providing for population viability. The likelihood of maintaining viability is further reduced by increasing isolation of the Coast Range population and reducing number of owl pairs. However, "low" is the lowest rating assigned under the rating scheme used. The rating, therefore, remains "low".

Table 3-11 summarizes the effects of the analysis scenarios on viability ratings for the FEIS alternatives of the FEIS.

Table 3-11. Viability Ratings of the FEIS Alternatives Based on Assumptions of the FEIS Compared to Ratings for the Analysis Scenarios

FEIS Alternative	FEIS Viability Rating	Revised Viability Rating for Exemption/ ISC	Revised Viability Rating for Current Approved BLM Plans
A	LOW	LOW	LOW
B	HIGH	HIGH	MODERATELY LOW
C	HIGH	HIGH	MODERATE
D	HIGH	HIGH	MODERATELY HIGH
E	LOW	LOW	LOW

Recommended Options for Mitigation

Recommendations are offered as a means of offsetting the effects of the analysis scenarios.

Exemption/ISC

Since the Scientific Analysis Team determined the effects of an exemption of 13 BLM timber sales, considered as a one-time action with BLM then managing so as to provide for spotted owl viability at least equal to the ISC Strategy thereafter, to have a very minor effect to dispersal habitat and subsequently no change to the viability rating, the Scientific Analysis Team offers no mitigation options.

Current Approved Plans

The exemption of the 13 BLM timber sales, considered part of the BLM's current approved plans, require considerable mitigation. The three FEIS alternatives that received high ratings in the original analysis drop below "high". The other two alternatives which were rated low remain "low". Alternative B, the selected alternative, is rated as having a "moderately-low" probability of providing for viable populations of northern spotted owls.

A letter from Deputy Chief of the Forest Service, James Overbay (See Appendix 3-B), provided instructions for this analysis that included directions that, if the exempted BLM sales are determined to reduce the viability rating of the FEIS selected alternative, appropriate mitigating options are to be recommended to the FEIS team who will revise the FEIS as necessary. Recommendations designed to mitigate the effects of BLM's current approved plans over the long term on Alternative B and return it to conditions warranting a "high" viability rating are discussed below. Since both Alternatives C and D have incorporated all the elements of Alternative B, the recommended mitigation measures, if adopted, will also result in "high" ratings for these alternatives.

Table 3-12 lists brief summaries of the effects of BLM's current approved plans and options for mitigation. The options are discussed in greater detail following the table. Site specific mitigation recommendations are delineated on the map in Appendix 3-C.

Table 3-12. Effects of Oregon BLM Current Approved Plans on Alternative B, the Selected Alternative of the FEIS, and Recommended Mitigations

Effects	Recommended Mitigation
Reduced nesting, roosting, and foraging habitat in designated areas (i.e., HCAs).	Increase numbers or sizes of HCAs on National Forests in Oregon.
Reduced distribution of nesting, roosting, and foraging habitat.	Partially mitigated by increasing numbers or sizes of HCAs on National Forests in Oregon.
Reduced capability to support pairs of spotted owls in the long term.	Increase numbers or sizes of HCAs on National Forests in Oregon.
Reductions in well-distributed dispersal habitat.	Reduce distances between HCAs by increasing numbers or sizes of HCAs on National Forests in Oregon or strengthen standards for providing well-distributed dispersal habitat.
Increased spacing between HCAs.	Increase numbers or sizes of HCAs on National Forests in Oregon.
Decreased size of habitat patches protected in the long term.	Increase sizes of HCAs on National Forests in Oregon.
Decreased numbers and size of areas for multiple pairs of spotted owls (clusters).	Increase numbers and sizes of HCAs on National Forests in Oregon.
Increased isolation of the Oregon Coast Range Physiographic Province sub-population of spotted owls.	Partially mitigated by increasing protection of habitat to allow for maximum numbers of spotted owls in the future to reduce risks of local extirpation.

Options to mitigate the effects of BLM following their current management plans by increasing the levels of spotted owl management on National Forest System lands are limited to increasing the intensity of spotted owl habitat management on National Forests. Compensation for the loss of BLM HCAs or loss of portions of shared BLM/Forest Service HCAs can only be achieved by increasing the size and numbers of HCAs on National Forests. This means the population will be distributed differently--more concentrated on National Forests. Additions of such HCAs or expansion of HCAs also contribute to alleviating increased spacing, loss of habitat patch size, decreases in cluster size, and reduced future expected populations associated with BLM's current plans.

Loss of well-distributed dispersal habitat on BLM administered lands between the Oregon Coast Range and the other physiographic provinces in Oregon can be

only partially compensated for on National Forests. Increasing the numbers and size of the HCAs will improve probabilities of successful dispersal between and among HCAs. However, probabilities of successful movements of owls among and between the Oregon Coast Range, the Klamath Mountains, and Oregon Cascades West Physiographic Provinces will still be low. High probabilities of successful movement are possible only if BLM administered lands provide for movement among these provinces.

Another option for improving the likelihood of successful dispersal among and between HCAs includes strengthening the ISC standards for well distributed habitat by increasing the requirements of the 50-11-40 rule. The percentage of the quarter-township required to meet dispersal habitat criteria could be increased from 50 percent. The standards for average diameter and canopy closure could likewise be increased. This would tend to move the characteristics of dispersal habitat toward the attributes of nesting, roosting, and foraging habitat and afford dispersing spotted owls greater security from predation and increased opportunities for catching prey, thereby increasing odds of successful dispersal.

Loss of components of the ISC Strategy network of HCAs, specifically those on Oregon BLM administered lands, which bridged the gaps between National Forests in the physiographic provinces of Oregon are impossible to replace. Isolation of the Oregon Coast Range is inevitable if BLM follows their current approved plans. It is therefore recommended, as a hedge against extirpation, that the Siuslaw National Forest be managed to increase the future population of spotted owls to the maximum possible. The increased population would then have a higher probability of functioning as a meta-population with reduced risks of extirpation. It is unlikely that a viability rating of high for the Oregon Coast Range Province alone can be attained if BLM follows current approved plans. The disjunct nature of the National Forest System land patterns in the Oregon Coast Range and intermingled ownerships set this province apart from the Olympic Peninsula Province which is also isolated. Conditions on the Olympic Peninsula, following implementation of the ISC Strategy, which included provisions for very large habitat patches and concomitant clusters of spotted owl pairs in the future, were expected to provide a high probability of producing a viable population there (Thomas et al. 1990).

To further compensate for isolation risks, additional HCAs should be designated on the northern and southern ends of the Umpqua National Forest, and the northern end and western edge of the Siskiyou National Forest. Existing HCAs on the Rogue River National Forest in the vicinity of the I-5 Corridor, an area of concern (Thomas et al. 1990), should be increased in size. These increases will improve the probability that there will be some movement of owls among the Oregon Coast Range, Klamath Mountains, and Oregon Cascades West Physiographic Provinces.

Table 3-13 provides a summary of the viability rating of this analysis and the rating if the mitigation measures discussed above and included on the map in Appendix 3-C are implemented. A discussion and rationale for each recommended addition to the network is included in Appendix 3-D.

Table 3-13. Viability Ratings of the FEIS Alternatives of this Analysis Based on Current Approved BLM Plans Compared to Viability Ratings if Mitigation Recommendations are Implemented

FEIS Alternative	Viability Rating-BLM Current Approved Plans	Viability Rating-If Mitigation Implemented
A	LOW	No mitigation was offered as this alternative would not retain its identity if mitigated to attain a high rating.
B	MODERATELY LOW	HIGH
C	MODERATE	HIGH
D	MODERATELY HIGH	HIGH
E	LOW	No mitigation was offered as this alternative would not retain its identity if mitigated to attain a high rating.



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
P.O. Box 2965 (1300 N.E. 44th Avenue)
Portland, Oregon 97208



IN REPLY REFER TO:

1610 (933)

October 2, 1992

Jerald N. Hutchins
Northern Spotted Owl EIS Team Leader
P.O. Box 3623
Portland, Oregon 97208-3623

Dear Mr. Hutchins:

Your letter of September 22, 1992 indicated a need for information that would help you to assess the BLM's contribution to future spotted owl habitat and population numbers. You specifically asked for a description of our approved current management plan.

Although we have approved Management Framework Plans (MFPs) prepared in the early 1980s, they can no longer be viewed as an accurate indicator of present or future BLM management activities in western Oregon. Court decisions and Endangered Species Act requirements have prevented implementation of many management decisions under existing BLM land use plans.

The best present indicator of our most likely future management direction can be found in the preferred alternative for each of the six western Oregon draft Resource Management Plans (RMPs) and associated Environmental Impact Statements (EISs) recently released for public comment. Although these draft RMPs are not approved plans, and the preferred alternatives may be modified prior to a final decision, the preferred alternatives in the draft RMP/EISs indicate a more likely future direction than do the existing MFPs.

I understand that some of your EIS Team members have already been briefed on our draft RMPs. I am also enclosing two copies of our Executive Summary for the six plans and photo copies of an information sheet on our overall preferred approach. Individual copies of the DRMP/EISs for each of the districts may be obtained through this office or directly from the district offices. We would also be pleased to meet with you and other team members to discuss our plans for the future.

Please contact either Mike Crouse, Branch Chief for Biological Resources (503-280-7045) or Phil Stanbro, Branch Chief for Lands, Recreation and Planning (503-280-7081) if you have questions.

Sincerely,

D. Dean Bibles
State Director

Enclosures: As stated

APPENDIX 3-B - INSTRUCTIONS FOR THE SCIENTIFIC ANALYSIS TEAM

United States
Department of
Agriculture

Forest
Service

Washington
Office

14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

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Reply to: 2630/1950

Date: July 30, 1992

Subject: Scientific Team for Northern Spotted Owl

**WORKING DOCUMENT
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To: Deputy Chiefs, National Forest System and Research
Regional Foresters, Regions 5 and 6
Station Directors, Pacific Northwest and Pacific Southwest

On July 21 Judge Dwyer ordered the Forest Service to submit to the court a schedule for completion of a new or supplemental EIS to remedy the NEPA deficiencies he found in his May 28 order. Deputy Chief Jim Overbay has signed a declaration stating that the Forest Service will need at least 24 months to comply with his order. It is not known whether the Judge will accept this timeline or not. The Department of Justice has filed a notice of appeal of Judge Dwyer's decision with the Ninth Circuit Court of Appeals.

Before any work on an EIS can begin, a scientific review of the points ordered by Judge Dwyer must be conducted. I am assigning Dr. Jack Ward Thomas to lead a team of scientists to accomplish this task. Dr. Thomas will be assisted by Staff Assistant Jerry Hutchins. The purpose of this team will be to address the points of noncompliance with NEPA found by Judge Dwyer in the final environmental impact statement for Management of the Northern Spotted Owls on National Forest Lands. The team will also provide an assessment of management actions needed to resolve the noncompliance problems.

Specifically, the team is to:

1. Determine if the decision by the Endangered Species Committee to allow 13 timber sales proposed by the BLM causes a change in the viability rating assigned to each alternative in the final EIS. If there would be a change in the rating, the team will determine what the change should be. A precise set of assumptions will be provided to the team from the Washington Office.
2. Determine if the assessment of owl populations prepared by Andersen/Burnham, or any other information on spotted owls that was not examined in the final EIS, require adjustments to maintain a high viability rating. If such adjustments are deemed necessary, they should be identified for the selected conservation strategy.
3. Determine if the northern spotted owl conservation strategy will result in the extirpation of any of the 32 species identified in the Judge's order and develop an analysis of the effect of the conservation strategy on these species.

Dr. Thomas has suggested the following people be assigned to the team:

Grant Gunderson, R6
Bruce Marcot, PNW
Martin Raphael, PNW
Eric Forsman, PNW
David Solis, R5
Dick Holthausen, WO

I ask that you make these personnel available for this task. If there are significant difficulties with this assignment, please work with Dr. Thomas to identify alternates. The team leader may request additional personnel to assist with the work of the team. This will be coordinated by Jerry Hutchins with the appropriate line officers. Also, the team leader is authorized to approve work schedules, overtime, and travel within the United States. The team leader may utilize technical experts from outside the Forest Service and pay for such services and associated costs. The Washington Office spotted owl team will provide coordination in the WO.

This is a high priority project and I request the support of the Regional Foresters and Station Directors. Because of on-going litigation, it is very important that confidentiality of this effort be maintained. This is not the start of a NEPA process, but rather an in-house review of the Judge's order in regards to the adopted conservation strategy.

/s/ George M. Leonard

F. DALE ROBERTSON
Chief

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/s/ George M. Leonard

F. DALE ROBERTSON
Chief

United States
Department of
Agriculture

Forest
Service

Washington
Office

14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

Reply to: 1950/2630

Date: August 28, 1992

Subject: Instructions for the Scientific Analysis Team

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To: Dr. Jack Ward Thomas, Team Leader

On July 30 the Chief established a scientific analysis team to review the deficiencies noted by Judge Dwyer in the environmental impact statement and record of decision for management of the northern spotted owl. In that letter three specific tasks were identified for the team to accomplish. After the meeting on August 14, and after receipt of the Judge's August 17 order, we agreed to provide a more specific set of guidelines for use by the team.

Enclosed is a copy of those guidelines. If further clarification is needed, please work with Jerry Hutchins to coordinate that with the WO owl team. Also, attorneys from OGC will be available for consultation during the process.

Thank you for taking on this task. It is an important one and your cooperation and support is appreciated.

/s/ James C. Overbay

JAMES C. OVERBAY
Deputy Chief

cc: Jerry Hutchins
Mary Coulombe
OGC-WO

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GUIDELINES FOR THE SCIENTIFIC ANALYSIS TEAM
FOR THE NORTHERN SPOTTED OWL

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BACKGROUND

A scientific analysis team has been formed to conduct selected technical analyses associated with the environmental impact statement (EIS) for the northern spotted owl (NSO) (Leonard, 2630/1950, 7/30/92). The analyses are needed to meet Judge Dwyer's rulings of May 28, July 2, July 21 and August 17. The specific analyses include:

1. Determine if the decisions by the Endangered Species Committee to allow 13 Bureau of Land Management (BLM) timber sales changes the viability ratings assigned to alternatives in the EIS.
2. Determine if the information developed by Anderson and Burnham on owl populations (or any other "new information" considered by the scientific team to be authoritative and scientifically credible) would change the spotted owl population viability ratings in the EIS.
3. Determine how implementation of the selected NSO management strategy is likely to affect the viability of 32 old growth-related species identified in the EIS as associated with NSO habitats.

GUIDELINES

The scientific team is to conduct selected technical analyses and provide scientific interpretations. They should not be burdened with making legal, administrative, or political interpretations. The scientific team shall examine the effects of the three analyses on the viability ratings for all alternatives. For the purposes of their analyses and interpretations, the scientific team shall be guided by the following:

1. BLM timber sales

A. Revised viability assessments should incorporate the same assumptions as used in the EIS with two exceptions:

1. incorporate the fact that 13 timber sales (1700 acres) are exempted from Section 7 of the Endangered Species Act (ESA). The Endangered Species Committee required the BLM to comply with the REcovery Plan if the 13 sales are cut. Because the Recovery Plan is only in draft, the team should not consider this at this time.

2. assume that all other activities of Federal agencies will comply with Section 7 requirements regarding protection of critical habitat.

B. For analyses and/or constraints consider only approved agency plans and existing regulations.

C. The impacts of the BLM sales should be analyzed and interpreted in the context of influence on viability within physiographic provinces and range-wide viability.

D. Clearly display assumptions used in analyses and discuss sources and implications of uncertainty.

E. If the BLM sales are determined to reduce the viability rating for the selected alternative (Forest Service conservation strategy), recommend appropriate mitigating options to the EIS team.

2. Anderson-Burnham report

A. Accept Anderson-Burnham draft report(s) as new information that must be technically considered.

B. Determine and discuss how Anderson-Burnham data should and should not be used to modify the viability ratings in the EIS.

C. If considerations of Anderson-Burnham indicate need for modifying viability ratings for the alternatives, conduct appropriate viability analyses and propose mitigating options to the EIS team.

D. Items A, B, and C should represent a "reasoned discussion and response..." (Dwyer, 5/28/92, p. 17).

3. Viability of other old growth species associated with NSO habitat

A. Determine if implementation of any of the alternatives would cause the extirpation/extinction of other native vertebrate species identified in the EIS as associated with old growth NSO habitat.

B. In estimating influences on other old growth species, the team is not expected to conduct a formal viability assessment for every species (Dwyer, 7/2/92, p. 9).

C. "Common sense and expert judgement..." can be used (Dwyer), but the process used for establishing viability ratings needs to be explicitly displayed and discussed.

D. If analyses indicate low viability ratings, as a result of proposed Forest Service actions, for other old growth species, the scientific team should propose appropriate mitigating options to the EIS team.

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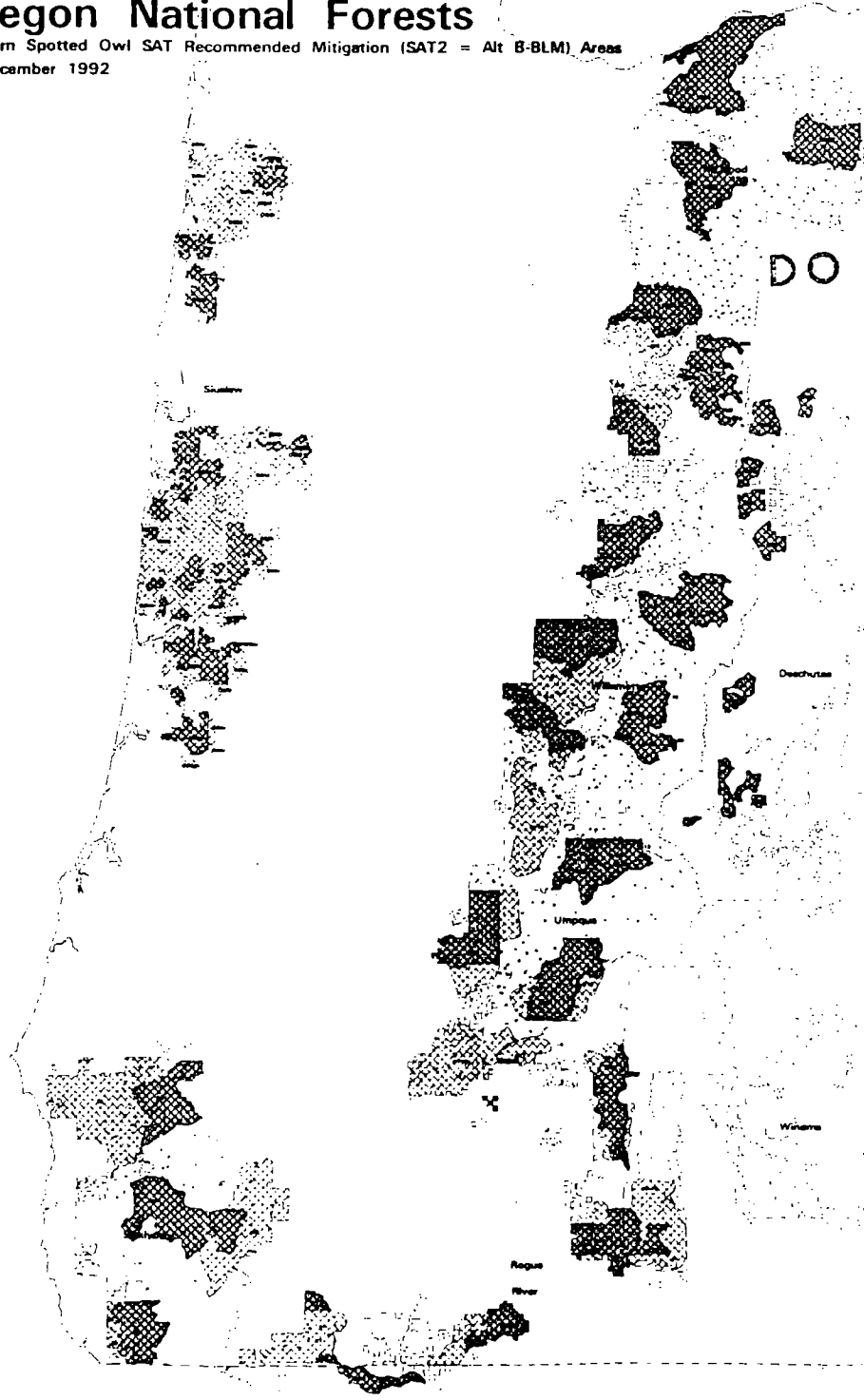
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APPENDIX 3-C
MAP OF MITIGATION RECOMMENDATIONS

Oregon National Forests

Northern Spotted Owl SAT Recommended Mitigation (SAT2 = Alt B-BLM) Areas
15 December 1992

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Legend:
■ SAT 1 area
▨ SAT 2 area
--- State Boundary
--- National Forest Boundary

NOTES

USDA FOREST SERVICE
Region 6, Corvallis, Oregon

Scale 1:700000

APPENDIX 3-D - RATIONALE FOR RECOMMENDED MITIGATION OPTIONS

The following is a description of the mitigation measures recommended to maintain a "HIGH" viability rating for the northern spotted owl under the current approved plans scenario of this analysis. These mitigations address several factors (provisions for dispersal and number and size of HCAs with concomitant owl pairs) of the ISC Strategy which would be weakened if BLM continued to follow current approved management plans. Isolation of the Oregon Coast Range Province is a primary concern, as well as movement between the Klamath and Oregon Cascades West Provinces. We attempted to solve the problems of isolation and replace lost BLM HCAs. This approach led to designation of a greater amount of Forest Service system lands than the amount lost on BLM.

Table 3-D-1 summarizes the recommended additions to HCAs and known owl pairs gained within those additions, along with known owl pairs which would be lost in the future within HCAs on BLM administered lands. A total of 1,149,000 acres are recommended for addition to HCAs. This acreage provides additional long-term protection for 197 known owl pairs, and an undetermined number of future adjusted expected owl pairs on National Forest Systems lands. Calculation of adjusted future expected owl pairs for HCA additions was not completed for this analysis but it is believed that the future number pairs added will be commensurate with the future numbers lost from BLM HCAs. On BLM administered lands, a total of 228 currently known owl pairs and 194 future adjusted expected owl pairs in Category 1 and 2 HCAs would be lost if BLM continues to follow current approved management plans.

Additions to HCAs were made on National Forests, closest to where BLM HCAs or portions were lost, where possible. This represents an attempt to maintain, as best as possible, the ISC Strategy distribution of habitat. Where lack of suitable habitat or ownership patterns prevented additions in the close vicinity, the Scientific Analysis Team selected areas which are expected to improve chances for dispersal and reduce risks of isolation.

Table 3-D-1. Known Owl Pairs Lost Within BLM Category 1 and 2 HCAs and Known Owl Pairs and Acres Added Within Recommended Additions to Forest Service (FS) HCAs by Physiographic Province.

Physiographic Province	HCA Acres Added	Known Owl Pairs	
		Added (FS) ¹	Lost (BLM) ²
Oregon Coast Range	317,400	33*	93
Klamath Mountains	361,300	56	44
Oregon Cascade West	<u>470,400</u>	<u>108</u>	<u>91</u>
<u>TOTAL</u>	<u>1,149,100</u>	<u>197</u>	<u>228</u>

* Additional owl pairs are protected in the long term even though all known and future owls on National Forest System lands are presently protected by Category 3 HCAs. Category 3 HCAs are temporary and remain a part of the network until the Category 1 or 2 HCAs reach target numbers of pairs. The recommended additions are permanent, thereby protecting the pairs permanently.

¹ All known pair numbers on Forest Service land are reported from 1987 through 1991.

² All known pair numbers on BLM land are reported from 1986 through 1990.

Oregon Coast Range Physiographic Province

The Siuslaw National Forest is the only National Forest System land within the Oregon Coast Range Province. As a hedge against demographic isolation discussed in the report, and to attain the maximum possible numbers of spotted owls to increase the probability that such a population would function as a self sustaining meta-population, it is recommended that the entire Siuslaw National Forest be designated for HCA status.

Additions will also partially compensate for the loss of BLM portions of HCAs O-28, O-29, O-30, O-31, O-32, O-33 O-35, and O-36.

Klamath Mountains Physiographic Province

Within the Klamath Mountains Province, all or portions of five BLM HCAs critical to spotted owl dispersal between provinces will be lost. To compensate for the loss of habitat and pairs of spotted owls, and to maintain spacing of habitat between the Klamath Mountains and Oregon Cascades West Provinces, Forest Service HCAs should be increased in size as well as positioned to provide for a minimal spacing distance to HCAs in the Oregon Coast Range and Oregon Cascades West Provinces. To achieve this, the following additions to the HCA system are recommended (see map Appendix 3-C):

HCA O-20 should be increased by 22,700 acres to partially compensate for loss of habitat and pairs of spotted owls in O-40.

HCA O-20 should be increased by 22,700 acres to partially compensate for loss of habitat and pairs of spotted owls in O-40.

HCA O-21 should be increased by 61,400 acres to compensate for loss of BLM habitat and pairs of spotted owls in O-21 and to maintain spacing standards to O-23.

HCA O-22 should be increased by 6,600 acres to partially compensate for loss of habitat and pairs of spotted owls in O-24.

HCA O-23 should be increased by 108,000 acres to compensate for the loss of habitat and pairs of spotted owls in O-24, to maintain adequate spacing to O-21, and to increase pair clusters within an HCA which will increase probabilities of successful dispersal between the Klamath Mountains Province and the Oregon Cascades West Province.

HCA O-25 should be increased by 162,700 acres to compensate for loss of habitat and pairs of spotted owls in O-26 and part of O-27, and to increase pair clusters within an HCA which will increase probabilities of successful dispersal between the Klamath Mountains Province and the Oregon Cascades West Province within a critical link area.

A new HCA should be designated for the northwest corner of the Siskiyou National Forest to partially replace the loss of HCA O-27 and increase the chances of successful movement of spotted owls to the Oregon Coast Range Province.

Oregon Cascades West Province

All or portions of nine BLM HCAs will be lost within the Oregon Cascades West Province. Five of these HCAs are considered parts of critical links for spotted owl dispersal between the Oregon Cascades West and the Klamath and Oregon Coast Range Provinces. To compensate for the loss of habitat and to optimize the spacing of habitat between the Oregon Cascades West Province and both the Oregon Coast Range and Klamath Provinces on National Forest System land, we recommend increases in size of HCAs O-11, O-14, and O-19. To achieve this, the following additions to the HCA system are recommended (see map):

HCA O-11 should be increased by 91,000 acres to compensate for habitat and pairs of spotted owls lost in the BLM portion of O-11 and O-39, and to increase pair clusters within an HCA which will facilitate dispersal of spotted owls to the Oregon Coast Range Province.

A new HCA totaling 78,900 acres should be placed east of BLM HCA O-12 on National Forest System land to compensate for the loss of habitat and pairs of spotted owls in O-12, and to maximize pair clusters within an HCA which will facilitate dispersal of spotted owls to the Oregon Coast Range Province.

HCA O-14 should be increased by 39,300 acres to increase pair clusters within an HCA which will aid dispersal between provinces.

A new HCA totaling 106,175 acres should be placed east of BLM HCA O-16 on National Forest System land to partially compensate for loss of habitat in O-16 and O-17, and to increase pair clusters within an HCA to aid dispersal between provinces.

HCA O-19 should be increased by 65,000 acres to partially compensate for loss of habitat and pairs of spotted owls in O-40 and to maximize pair clusters within an HCA which will increase probabilities of successful dispersal of spotted owls between the Klamath Mountains and Oregon Cascades West Physiographic Provinces.

In addition to loss of BLM "critical link" HCAs, portions or all of HCAs O-6, O-7, and O-17 will be lost. To compensate for the loss of habitat and pairs of spotted owls, the following increases to existing HCAs should be added:

HCA O-6 should be increased by 28,600 acres.

HCA O-4 should be increased by 24,100 acres.

HCA O-15 should be increased by 24,100 acres.

HCA O-18 should be increased by 12,800 acres.

APPENDIX 3-E
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*** DRAFT - WORKING DOCUMENT - NOT SUBJECT TO FOIA - DO NOT DUPLICATE ***

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CHAPTER 4

BLM PREFERRED ALTERNATIVE

CHAPTER 4
BLM PREFERRED ALTERNATIVE

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BLM PREFERRED ALTERNATIVE

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CHAPTER 4

A REVIEW OF THE EFFECTS OF BLM FOLLOWING PREFERRED ALTERNATIVES IN DRAFT RESOURCE MANAGEMENT PLANS FOR SIX WESTERN OREGON DISTRICTS ON THE VIABILITY ASSESSMENTS IN THE FINAL ENVIRONMENTAL IMPACT STATEMENT ON MANAGEMENT OF THE NORTHERN SPOTTED OWL IN THE NATIONAL FORESTS

INTRODUCTION

In January of 1992, the Forest Service issued a Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests (FEIS) (USDA 1992). The FEIS analyzed five alternatives for management of spotted owl habitat. The Conservation Strategy put forward by the Interagency Scientific Committee (ISC) (Thomas et al. 1990) was the selected alternative.

The ISC Strategy included lands under management by the Bureau of Land Management (BLM) in western Oregon and northern California. A major assumption for analysis of all five alternatives was that BLM would manage their lands under a strategy equal to or superior to the ISC Strategy, with regards to owl viability. The FEIS also assumed that formal consultation between the BLM and the Fish and Wildlife Service would preclude implementation of BLM timber sales in conflict with the ISC Strategy.

Subsequent to the preparation of the viability assessments that were included in the FEIS, the BLM applied to the Endangered Species Committee (ESC) for an exemption from requirements of Section 7 of the Endangered Species Act for 44 timber sales in western Oregon, judged by the Fish and Wildlife Service to cause jeopardy to the spotted owl. On 15 May 1992, that Committee exempted 13 timber sales. Additionally, the Committee required that if the BLM proceeded with the 13 exempted timber sales, the BLM would then follow the mandates in the Fish and Wildlife Service's Recovery Plan for the northern spotted owl (ESC 1992).

The results of our analysis of effects of the 13 exempted BLM timber sales on viability assessments of the FEIS are included in Chapter 3 of this report. That analysis concluded that the exemption of 13 timber sales, when viewed as an aberrant one-time action, would have negligible effects on the "high" viability rating of the Forest Service selected alternative (i.e., the ISC Strategy). We also concluded that exemption of the 13 BLM sales was only a part of a larger question regarding BLM's contributions to present and future spotted owl habitat. In Chapter 3, we analyzed the effects of BLM following their current plans. Based on a letter from the BLM Oregon State Director (D. Bibbes Pers. comm., Chapter 3, Appendix 3-A), preferred alternatives of draft resource management plans (USDI 1992a, USDI 1992b, USDI 1992c, USDI 1992d, USDI 1992e, USDI 1992f, USDI 1992g) for six western Oregon BLM Districts represent the closest approximations of how BLM will provide habitat for northern spotted owls in the future.

PURPOSE OF THE ANALYSIS

In the analysis documented in Chapter 3, we concluded that Section 7 consultation under the Endangered Species Act would not provide de facto management strategies that would ensure high probabilities of viability for northern spotted owls, and that, when implemented, agency management plans would ultimately determine risks associated with the continued existence of viable populations.

The first purpose of this analysis is to evaluate effects to northern spotted owl habitat resulting from implementation of preferred alternatives in draft resource management plans on six western Oregon BLM Districts (Salem, Eugene, Roseburg, Coos Bay, Medford, and Klamath Districts). The second purpose is to determine if the assumption that BLM would manage at a level equal to or superior to the ISC Conservation Strategy, which was used in the viability assessments of the FEIS, is still valid.

DESCRIPTION OF THE ANALYSIS

The BLM in Oregon is currently finalizing 10-year resource management plans for each district. These plans will establish management direction for natural resources with consequences for the northern spotted owl and its habitat. Draft resource management plans are completed and preferred alternatives identified, hereafter referred to collectively as the BLM preferred alternative. Each of the six plans also includes an Alternative D that represents the ISC Strategy, hereafter referred to collectively as BLM Alternative D.

A basic premise of the analysis is that implementation of BLM Alternative D along with implementation of the selected alternative of the FEIS (ISC Strategy and hereafter referred to as FEIS Alternative B), results in a "high" viability rating for the FEIS Alternative B. The high rating is due to full implementation of the ISC Strategy on Federal lands throughout the range of the northern spotted owl. This premise is consistent with assumptions of the viability assessments originally completed for the FEIS. Further, it remains consistent following a review of new information regarding demographics of the spotted owl (Chapter 5) and the analysis of the effects of exemption by the Endangered Species Committee of 13 BLM timber sales considered a one-time action (Chapter 3). This analysis, then, focused on comparing BLM Alternative D (i.e., ISC Strategy) to the BLM preferred alternative and assessing the significance of any differences.

BLM Alternative D = ISC Conservation Strategy
FEIS Alternative B = ISC Conservation Strategy

ISC Conservation Strategy

The ISC Conservation Strategy as represented by BLM Alternative D was described by Thomas et al. (1990). The strategy calls for large blocks of habitat spaced close enough to other large blocks of habitat to facilitate movement of owls among such blocks. These blocks, known as Habitat Conservation Areas (HCAs), have primary objectives of providing superior spotted owl habitat and

supporting stable concentrations (multiple pairs) of northern spotted owls now and in the future. The ISC Strategy prohibits timber harvest within HCAs except under special situations involving the loss of extensive areas of forest through catastrophic events. These standards were established to allow previously logged forests inside HCAs to develop naturally into superior spotted owl habitat (Thomas et al. 1990:167). Silvicultural practices applied to forests outside HCAs were to serve as a means to demonstrate that, with proper prescriptions designed to create owl habitat, timber harvest could be compatible with providing spotted owl habitat in the future.

The ISC Strategy also provided management prescriptions for Federal lands between HCAs within the range of the northern spotted owl. These prescriptions consist of retention of forest stands around spotted owl nests (Category 4 HCAs) and provisions for well distributed dispersal habitat for spotted owls based on the 50-11-40 rule. The 50-11-40 rule provides for 50 percent of a quarter-township having trees averaging 11 inches in diameter at breast height with a canopy closure of 40 percent or greater.

BLM Preferred Alternative

The BLM preferred alternative incorporates many aspects of the ISC Strategy and the Fish and Wildlife Service's Draft Recovery Plan for the Northern Spotted Owl (USDI 1992h). Basic elements of BLM's preferred alternative pertaining to spotted owl habitat include the following:

BLM's preferred alternative would establish Old Growth Emphasis Areas (OGEAs) which overlap areas designated in the ISC Strategy as HCAs. Two types of OGEAs are identified: 1) those where regeneration logging in spotted owl habitat is deferred for 80 years (deferred OGEAs); and 2) those where limited regeneration cutting begins immediately following implementation, for purposes of testing the feasibility of a number of timber harvest techniques for maintenance of both old-growth conditions and sustained timber production (non-deferred OGEAs) (USDI 1992a:13). After 80 years, regeneration cutting in deferred OGEAs will consist of small patch cuts (1 to 5 acres) with overall cutting cycles of 300 years. One-fourth to one-third of 100- to 300-acre forest stands would receive regeneration harvest every 50-100 years. Overall, regeneration harvest would occur at a rate of about 3 percent of the total acreage of suitable habitat per decade.

Both types of OGEAs would be treated through density management to promote stand diversification and development of structural characteristics needed by species that prefer old-growth habitat (USDI 1992a:13). Density management consists of timber harvest of commercial trees in younger forest stands (not considered spotted owl habitat) to control densities of trees. Objectives of density management are to accelerate creation of old-growth forest conditions and to produce timber (USDI 1992a:13). Based on discussions with BLM personnel, production of timber in OGEAs is secondary to the primary objective of the development or maintenance of spotted owl habitat. Even though BLM expects such treatments to hasten the development of suitable spotted owl habitat, analyses in draft resource management plans do not model the rate of habitat development at a rate faster than expected to occur naturally (D. Dippon pers. comm.).

Deferred OGEAs are located in essentially the same geographic locations as proposed Designated Conservation Areas (DCAs) of the Draft Recovery Plan for the Northern Spotted Owl (USDI 1992h). The locations also roughly correspond to HCAs of the ISC Conservation Strategy. One non-deferred OGEA in the western portion of the Salem District corresponds in location to both an HCA and a DCA.

The BLM preferred alternative establishes two major prescriptions for BLM's forested lands (i.e., matrix) between OGEAs. One prescription is applied to "connectivity areas" which are linear tracts of BLM administered lands between and among OGEAs. Here, the majority of the forest stands would be managed on harvest cycles of 120-200 years with 12-18 trees per acre remaining after logging. The other prescription is applied to General Forest Management Areas. In southern Oregon, some of the General Forest Management Areas would be logged on 120 year rotations (USDI 1992a:13); 18-25 trees per acre would remain after logging (J. Lint pers. comm.). BLM expects a 40 percent canopy closure to remain when such numbers of trees are left (D. Dippon pers. comm.). In other areas, the General Forest Management Areas would be logged on 80-110 year rotations; 6-8 trees per acre would remain after logging (USDI 1992b:2-41). Canopy closure of 40 percent is not expected in these areas.

All currently known and newly found spotted owl pair sites in the forest matrix outside of OGEAs will be protected to some degree. A total of 80-100 acres will be protected from logging at each location for at least 80 years in both types of General Forest Management Areas and in connectivity areas (USDI 1992b:2-43.). These small reserves correspond to Category 4 HCAs of BLM Alternative D (ISC Strategy).

Prescriptions for snags and down logs are provided in the BLM preferred alternatives and generally call for leaving snags "where feasible" and four logs per acre 24 inches diameter and 50 feet in length "where available", regardless of location relative to OGEAs (USDI 1992b:2-41).

The key elements of BLM Alternative D and the BLM preferred alternative listed above are summarized in Table 4-1.

Table 4-1. Summary of Key Elements of BLM Alternative D and the BLM Preferred Alternative.

<u>BLM Alternative D</u>	<u>BLM Preferred Alternative</u>
<u>Number of owl pairs in multiple pair reserves:</u>	
Establishes HCAs to support at least 20 pairs of spotted owls unless habitat or ownership prevented.	Unknown objectives but probably based on the objectives of the Draft Recovery Plan (USDA 1992h).
<u>Single pair reserves:</u>	
Protects an area equal to a home range (Category 3 HCAs) for all known and future pairs of spotted owls in the Oregon Coast Range Area of Special Concern (Thomas et al. 1990).	Incorporates some of the spotted owl pairs included in Category 3 HCAs into OGEAs. No provisions are made for protection of home range size areas of other known pairs.
<u>Timber harvest in reserves:</u>	
Prohibits harvest of any age-class of forest within HCAs with few exceptions.	Timber harvest allowed in OGEAs to accelerate and develop old-growth characteristics and to provide timber.
<u>Experimental forestry:</u>	
Research outside the HCAs encouraged to validate hypotheses regarding silvicultural treatments.	Provides for treatments most of which are largely experimental to be conducted in OGEAs.
<u>Protection of residual stands at pair sites:</u>	
Establishes protection areas of up to 80 acres around known spotted owl pair sites outside HCAs up to a maximum of seven per township.	Protection of 80-100 acres around all known and future spotted owl pair sites outside OGEAs.

Table 4-1. (continued)

BLM Alternative D	BLM Preferred Alternative
<u>Dispersal habitat:</u>	
Provisions for well distributed dispersal habitat per the 50-11-40 rule--to be attained as soon as possible.	Provisions for meeting 50-11-40 standards in parts of the range e.g., connectivity areas and general management areas in portions of southern Oregon. Standards of 50-11-40 will be met in most other areas in 40-50 years.
Dispersal standards apply to all areas within the range of the owl outside HCAs.	Dispersal standards apply to most areas within and surrounding OGEAs (USDI 1992e:4-70).
<u>Spacing of reserve areas:</u>	
Spacing of 20+ pair areas to be no more than 12 miles apart, 2 to 19 pair areas no more than 7 miles apart.	Not stated but probably based on the Draft Recovery Plan.
<u>Distribution of reserve areas:</u>	
Distribution of HCAs to provide a hedge against catastrophic loss of habitat and represent varying elevations and vegetative communities within the range of the spotted owl.	Not stated but probably based on the Draft Recovery Plan.
<u>Slash disposal:</u>	
No provisions for disposal of logging slash in preparation for regeneration of forest stands since logging, for the most part, is prohibited in HCAs.	Prescribes fire as preferred method of slash disposal and method of preparing harvest units for planting in OGEAs.
<u>Habitat components:</u>	
No prescriptions for numbers of snags or down logs following logging since cutting is, for the most part, prohibited in HCAs.	Prescribes retention of snags "where feasible" and four logs, 20 inches in diameter and 50 feet long per acre "where possible" following regeneration harvest in OGEAs.

Table 4-1. (continued)

<u>BLM Alternative D</u>	<u>BLM Preferred Alternative</u>
<u>Oversight of implementation:</u>	
Calls for interagency oversight to ensure consistent interpretation and implementation if adopted as per ISC recommendations.	No provisions for interagency oversight.

METHODS

Draft resource management plans provide data for seven alternatives describing resource management on BLM administered lands. The plans display effects of each alternative on several parameters of spotted owl habitat. We used these parameters to make direct comparisons between alternatives. Some parameters correspond to criteria 1 to 7 used in the FEIS viability analysis. Where data were insufficient to assess alternatives relative to spotted owl viability, members of the Team personally contacted BLM staff to seek additional information. If data were not available, we made assumptions and evaluated alternatives based on its assessment of risk.

Seven criteria were used to assess how well the five FEIS alternatives provided for viability of the northern spotted owl (USDA 1992). These criteria are based on habitat needs of the subspecies and principles of conservation biology and were likewise the basis for our assessment. More detailed discussions of the criteria can be found in the FEIS (USDA 1992:3&4-47). They are as follows:

1. Potential change in the amount and rate of change of spotted owl nesting, roosting, and foraging habitat.
2. Distribution of designated spotted owl nesting, roosting, and foraging habitat throughout the range of the northern spotted owl with emphasis on areas of concern.
3. Capability of the habitat to support pairs of spotted owls through time.
4. Provisions for dispersal habitat to facilitate successful dispersal of spotted owls between and among areas designated for spotted owl habitat.
5. Spacing between areas designated for spotted owl habitat.
6. Provisions for size of spotted owl nesting, roosting, and foraging habitat patches.
7. Provisions for designating multiple pairs of spotted owls thereby increasing probabilities that such areas will be occupied consistently through time (i.e., "clustering").

We assumed BLM Alternative D of the draft resource management plans and FEIS Alternative B (USDA 1992:96) exactly meet provisions of the ISC Strategy. Therefore, the BLM preferred alternative was assessed to determine how they varied from each BLM Alternative D in the six draft resource management plans relative to each criterion. Differences between BLM Alternative D and the BLM preferred alternative serve to demonstrate differences between the ISC Strategy and BLM's expected management strategy in providing for the viability of the spotted owl, based on the BLM preferred alternative. Increased ability to meet the criteria would result in a higher viability rating. Conversely, a decreased ability to satisfy the criteria would reflect greater risk to viability.

RESULTS

Criterion 1 - Potential Change in Habitat

Factors contributing to quantity of spotted owl habitat include, but are not limited to, total acreage, age, juxtaposition, and size of habitat blocks across the landscape.

Total Acreage of Habitat

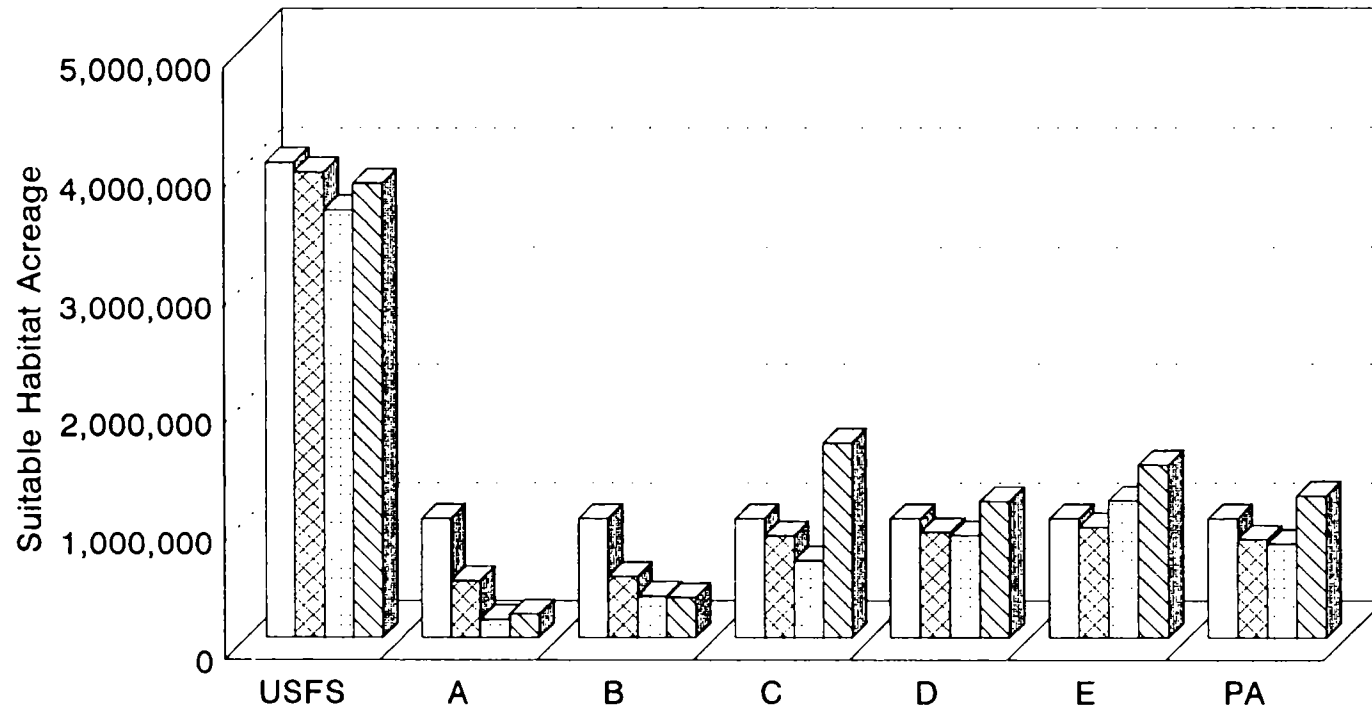
Figure 4-21 in the Roseburg District Draft Resource Management Plan, and included here as Figure 4-1, compares potential changes in spotted owl habitat on all BLM administered lands in western Oregon among alternatives analyzed in draft resource management plans. The total amount of suitable habitat decreases for about 50 years then increases thereafter in both BLM Alternative D and the BLM preferred alternative. Implementation of the BLM preferred alternative would result in less available suitable spotted owl habitat in both the first 10 years (62,000 fewer acres) and 50 years (71,000 fewer acres) compared to BLM Alternative D. In 100 years, the BLM preferred alternative would result in an increase of 46,000 acres of suitable spotted owl habitat, compared to BLM Alternative D.

Each draft resource management plan provided estimates of expected amounts of suitable owl habitat at time periods of 10, 50 and 100 years after implementation. Differences in suitable spotted owl habitat between BLM Alternative D and the BLM preferred alternative are most pronounced at 50 years (Table 4-2).

Table 4-2. Acres of Suitable Spotted Owl Habitat by BLM District After 10 Years/50 Years For BLM Alternative D and BLM Preferred Alternative.

<u>District</u>	<u>(Acres in Thousands)</u>	
	<u>BLM Alternative D</u>	<u>BLM Preferred Alternative</u>
Salem	157/159	149/146
Eugene	107/114	102/116
Roseburg	190/156	174/144
Coos Bay	112/106	100/95
Medford	312/322	291/271
Klamath Falls	<u>14/8</u>	<u>14/21</u>
Totals	892/865	830/793

Figure 4-1 Total Suitable Spotted Owl Habitat
Western Oregon - USFS and BLM Lands by Alternative



Current	4,022,000	1,009,000	1,009,000	1,009,000	1,009,000	1,009,000	1,009,000
After 10 years	3,942,000	479,000	516,000	862,000	892,000	934,000	830,000
After 50 years	3,625,000	152,000	350,000	651,000	864,000	1,160,000	793,000
After 100 years	3,848,000	198,000	339,000	1,647,000	1,155,000	1,463,000	1,201,000

USFS 10-year data prorated between current and 50-year projection

This is a reproduction of Figure 4-21 from page 4-66 of the Draft
Roseburg District Resource Management Plan and EIS (USD1 1992b).

Draft resource management plans indicate that the total amount of suitable spotted owl habitat decreases more in the short term (10-50 years) under the BLM preferred alternative than under BLM Alternative D. Overall, BLM Alternative D results in a decrease of 14 percent from the current amount (1,009,000 acres) of suitable spotted owl habitat on BLM administered lands in Oregon after 50 years. The BLM preferred alternative results in a decrease of 21 percent in that same time period. This decrease occurs in all but the Oregon Cascades East Physiographic Province and affects four of six districts (Table 4-3).

Table 4-3. Acres of Suitable Spotted Owl Habitat on BLM Administered Lands by Physiographic Province After 10 Years/50 Years For BLM Alternative D and BLM Preferred Alternative¹.

(Acres in Thousands)

<u>Physiographic Province</u>	<u>BLM Alternative D</u>	<u>BLM Preferred Alternative</u>
Oregon Coast Range	290/304	270/288
Oregon Cascades West	260/236	242/213
Oregon Cascades East	14/9	14/22
Klamath Mountains	<u>328/315</u>	<u>304/270</u>
Totals	892/864	830/793

¹ Data are from draft resource management plans for each district.

Decreases in amounts of suitable spotted owl habitat are probably somewhat related to miles of roads constructed by alternative. The Executive Summary (USDI 1992a:10) indicates an annual road construction rate of 14 more miles per year under BLM Alternative D compared to the BLM preferred alternative for the first 10 years. This results in 140 more miles of roads per decade under BLM Alternative D than the BLM preferred alternative. This seems inconsistent with projections for decreases in amounts of suitable habitat discussed above and expected timber sale volumes. The Executive Summary indicates the BLM preferred alternatives are expected to produce an additional 131 million board feet (MMBF) of timber per year compared to BLM Alternative D. Data compiled from each Draft resource management plan indicate that for the first 10 years, 98 more miles of roads will be constructed in the BLM preferred alternative than in BLM Alternative D. Estimates of annual timber production in the draft resource management plans for the BLM preferred alternative also indicate an expected increase of 131 MMBF compared to BLM Alternative D. This seems more consistent with other projections. For this analysis, we assumed each draft resource management plan was more accurate than the Executive Summary.

Age of Habitat

The amount of old-growth forest remaining across the landscape is another factor related to amounts of spotted owl habitat. Old growth is defined in BLM planning documents (USDI 1992b:4-19) as either unmanaged stands older than 195 years, or managed stands which meet the definition in USDA Forest Service Pacific Northwest Station Note PNW-447 (USDA 1986). While spotted owls do not typically use only old-growth forests, studies of habitat use by spotted owls have shown they select older forest types. Use of habitat by owls, in general, is positively correlated with stand development. Northern spotted owls use old, multilayered forests more than other structural and age classes. This pattern shows that for most forest types in Oregon, Washington, and California, old forest is clearly preferred habitat (USDA 1991:2). The ISC (Thomas et al. 1990:144) adopted the following operational approach dealing with the ecological dependency of spotted owls on preferred habitat:

"When patterns of a species' abundance and distribution show a consistent, close association with a particular type or types of habitat we assume that the habitat is essential for the species' persistence. We contend that habitat selection is a behavior that reflects the long-term needs of a given species, and that it has so evolved over thousands of years of varying environmental conditions as a result of natural selection. Consequently, preference for a given habitat or habitat attribute likely indicates a need."

Given this relationship between the needs of spotted owls and old forests, it seems likely that decreases in the amounts of existing old-growth forests will have adverse effects on spotted owls. Such effects could be disproportionate to the acreage lost. This is especially true where the amount of superior habitat is slightly less than spotted owls typically require, but where availability of additional marginal habitat may tip the balance in favor of successful occupancy or even occasional breeding (Thomas et al. 1990:143).

Data presented in the draft resource management plans for all but the Salem District indicate the BLM preferred alternatives are expected to result in 12,100 (4 percent) fewer acres of old growth in patches greater than 20 acres in 10 years, compared to 286,700 acres expected for BLM Alternative D in 10 years. The Executive Summary for the draft resource management plans (USDI 1992a:10) indicates 31,000 (6 percent) fewer acres of old-growth forests on BLM administered lands in 100 years will occur under the BLM preferred alternative compared to 506,000 acres expected under BLM Alternative D. Table 4-7 in the Roseburg Draft Resource Management Plan and included here as Table 4-4, provides an example of different expectations between BLM Alternative D and the BLM preferred alternative as to the type of land which will provide the old growth. Less than 1 percent of the acres of old growth on the Roseburg District are expected to occur on lands available for timber production under BLM Alternative D while 65 percent of the old-growth acres are expected to occur on lands available for timber production under the BLM preferred alternative. The implication of this is that timber management is expected to be compatible with maintaining or replacing old-growth forests.

Table 4-4 **Acres of Stands in the Commercial Forest Landscape Expected to Attain Old-Growth Structural Characteristics within 100 Years***

Alternative	Acres of Stands Meeting Old-Growth Definitions		Total
	Lands Available for Timber Production	Lands Not Available for Timber Production	
NA	0	39,900	53,300
A	0	22,500	22,500
B	200	45,800	46,000
C	74,600	72,400	147,000
D	200	115,800	116,000
E	5,000	174,900	175,400
PA	64,600	34,900	99,500

*Old-Growth defined as either unmanaged stands older than 195 years, or managed stands which meet the definition in USFS PNW 447.

This is a reproduction of Table 4-7 from page 4-19 of the Draft
Roseburg District Resource Management Plan and EIS (USDI 1992b).

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Juxtaposition and Size of Habitat Blocks

Five BLM districts (all but Klamath Falls) provided comparisons of the numbers of blocks of old-growth forests by various block sizes expected within 10 years for each of the draft resource management plans' alternatives. Implementation of the BLM preferred alternative results in reductions in the number of blocks of old growth in all size classes except for blocks greater than 600 acres. Numbers of large (300 to 599 acres) blocks of old growth are decreased 14 percent under the BLM preferred alternative, compared to BLM Alternative D, in 10 years on the Eugene, Roseburg, and Medford Districts (Table 4-5). Reductions in total numbers of blocks and the overall reduction in acreage of old growth may be because the BLM preferred alternative does not provide for all the single pair areas (Category 3 HCAs) called for under BLM Alternative D (D. Dippon pers. comm.).

Another factor to consider relative to amounts of suitable spotted owl habitat is the arrangement of old-growth stands across the landscape. More contiguous stands of older forests provide better habitat conditions than an equal amount in loose aggregations of fragmented blocks (Thomas et al. 1990:285). Recent work by Meyer et al. (1992) indicates that known owl sites selected at random contain more old growth, larger average size of old-growth patches, and larger maximum size of old-growth patches than occur in landscape locations selected at random (USDI 1992d:3-44). Lehmkuhl and Raphael (In press) show the same result for the Olympic Peninsula.

Table 4-5. Comparison of the Expected Number of Old-Growth Blocks In 10 Years by Size Category and District Between BLM Alternative D and the BLM Preferred Alternative (PA) of BLM's Draft Resource Management Plans

<u>Block Size</u>	<u>BLM District</u>	<u>Numbers of Blocks</u>		<u>% Change</u>
		<u>BLM Alternative D</u>	<u>BLM PA</u>	
20-79 acres	Salem	229	185	-19
	Eugene	280*	245*	-12
	Roseburg	543	516	-5
	Coos Bay	175	171	-2
	Medford	<u>492</u>	<u>476</u>	<u>-3</u>
	Totals	1,719	1,593	-7
80-299 acres	Salem	73	67	-8
	Eugene	120*	120*	0
	Roseburg	219	219	0
	Coos Bay	79	78	-1
	Medford	<u>243</u>	<u>232</u>	<u>-5</u>
	Totals	734	716	-2
300-599 acres	Salem	7	7	0
	Eugene	20*	18*	-10
	Roseburg	55	45	-18
	Coos Bay	17	17	0
	Medford	<u>47</u>	<u>38</u>	<u>-19</u>
	Totals	146	125	-14
600+ Acres	Salem	2	3	+50
	Eugene	5*	5*	0
	Roseburg	19	18	-5
	Coos Bay	14	14	0
	Medford	<u>12</u>	<u>12</u>	<u>0</u>
	Totals	52	52	0
Totals-all Blocks	Salem	311	262	-16
	Eugene	425	388	-9
	Roseburg	836	798	-5
	Coos Bay	285	280	-2
	Medford	<u>794</u>	<u>758</u>	<u>-5</u>
	Totals	2,651	2,486	-6

* = Values estimated from Bar Chart in Eugene Draft Resource Management Plan

In summary, implementation of the BLM preferred alternative, compared to BLM Alternative D, result in the following:

- 1) An additional 8 percent (71,000 acres) reduction in the amount of suitable spotted owl habitat in 50 years;
- 2) A 4 percent (46,000 acres) increase in the amount of suitable spotted owl habitat in 100 years;
- 3) A 4 percent (12,100 acres) reduction in old growth over 10 years for five of six Districts;
- 4) A 6 percent (31,000 acres) reduction of old growth after 100 years; and
- 5) A 6 percent (165 blocks) reduction in total old-growth blocks (20 acres or larger) over 10 years for five of six Districts.

Criterion 2 - Distribution of Nesting, Roosting, and Foraging Habitat

The distribution of spotted owl habitat in the BLM preferred alternative is similar to that of BLM Alternative D, with the following exceptions:

1. The BLM preferred alternative includes relatively minor inclusions and exclusions of habitat blocks from 16 HCAs (0-6, 0-7, 0-11, 0-12, 0-16, 0-17, 0-19, 0-21, 0-26, 0-27, 0-28, 0-31, 0-32, 0-33, 0-36, 0-38) identified in BLM Alternative D. The result of these changes is a net decrease of about 4,000 acres.
2. An additional 44,000 acres which can be considered a part of HCA 0-30 is included in the BLM preferred alternative.
3. An additional 16,000 acres within six new OGEAs is included in the BLM preferred alternative.

These changes result in a total addition of approximately 56,000 acres of BLM lands being managed in OGEAs for spotted owls under the BLM preferred alternative compared to BLM Alternative D. A majority (90 percent) of the added acres are within the Oregon Coast Range Province and within the portion of the province identified by the ISC as an Area of Special Concern.

The overall distribution of spotted owl habitat in reserved areas is slightly better in the BLM preferred alternative because new areas were added between existing habitat blocks (HCAs), along with a new OGEA which extends locations of habitat blocks on Federal lands 7 miles farther north in the Oregon Coast Range.

Criterion 3 - Capability of the Habitat to Support Pairs

BLM evaluated alternatives of the draft resource management plans using a population model developed by the Forest Service Pacific Southwest Research Station, Redwood Sciences Laboratory in Arcata, California (McKelvey in USDI 1992b). This model is referred to as the McKelvey Model. While this is a different method than used by the Forest Service in the FEIS to estimate capability of habitat to support pairs of spotted owls, it provides a means to compare BLM Alternative D and the BLM preferred alternative.

The McKelvey Model provides estimates of mean annual occupancy of a given habitat based on a number of factors. Amounts and arrangements of habitat are integral components. As habitat changes in the future, the model provides estimates of how likely an area will be occupied by spotted owl pairs. These estimates are not actual projections of expected populations. The model is dependent on spatially explicit vegetative data to generate accurate estimates. BLM has interpreted the mean annual occupancy estimates to be the spotted owl carrying capacity of the habitat at points in time. This may not be an appropriate use of the model.

Draft resource management plans provided estimates of spotted owl carrying capacities at 10 and 100 year intervals following implementation of these plans. Two estimates were provided: one based on the premise that 60 percent of a 2,500 acre area had to be in suitable habitat for spotted owls to constantly occupy an area, the other based on 40 percent.

Table 4-6 summarizes data from each of the draft resource management plans as corrected by BLM (D. Dippon pers. comm.) since draft resource management plans were published. Data indicate that, for all assumptions and time periods given, carrying capacity of habitats for the spotted owl increase under the BLM preferred alternative, compared to BLM Alternative D, both at 10 and 100 years (Table 4-6).

We would expect a comparison of carrying capacity to expected amounts of suitable spotted owl habitat (see discussion for Criterion 1) to show corresponding trends. Draft resource management plans, however, do not reflect such trends. Estimated carrying capacity for all BLM Districts in western Oregon increases 1 percent and 4 percent for the 60 percent and 40 percent assumptions of habitat suitability, respectively, over 10 years. During the same 10 years, 62,000 fewer acres of suitable spotted owl habitat and 6 percent (n = 165 blocks) fewer old-growth blocks are expected for the BLM preferred alternative than for BLM Alternative D. This absence of positive correlation between trends in habitat and expected carrying capacity is difficult to understand, warrants further examination, and is a cause for concern.

The McKelvey Model directly links habitat variation to demographic variation to assess effects of forest management on populations of the northern spotted owl (McKelvey 1992 in USDI 1992b:Appendix 4-107). Habitat projections developed by BLM for the BLM preferred alternatives of draft resource management plans are based on assumptions discussed later in this report. Should the assumptions prove overly optimistic, it is likely estimated carrying capacities for spotted owls will likewise be overly optimistic.

No estimates of carrying capacities were presented for spotted owls at 50 years, the period of the greatest negative difference between amounts of suitable spotted owl habitat for the BLM preferred alternative and Alternative D of the draft resource management plans.

Table 4-6. Estimated Carrying Capacity (Mean Annual Occupancy) of All BLM Administered Lands in Western Oregon by District at Years 10 and 100 For BLM Alternative D and BLM Preferred Alternative (PA).

<u>Carrying Capacity</u>	<u>District</u>	<u>BLM Alternatives</u>	
		<u>D</u>	<u>PA</u>
60% assumption at 10 years	Salem	16	17
	Eugene	7	8
	Roseburg	13	14
	Coos Bay	8	8
	Medford	39	38
	Klamath Falls	<u>1</u>	<u>0</u>
	Totals:	84	85
40% assumption at 10 years	Salem	53	50
	Eugene	28	29
	Roseburg	42	42
	Coos Bay	26	45
	Medford	88	84
	Klamath Falls	<u>5</u>	<u>2</u>
	Totals:	242	252
60% assumption at 100 years	Salem	48	48
	Eugene	21	32
	Roseburg	25	38
	Coos Bay	45	50
	Medford	105	134
	Klamath Falls	<u>3</u>	<u>1</u>
	Totals:	247	303
60% assumption at 10 years	Salem	80	80
	Eugene	56	87
	Roseburg	69	83
	Coos Bay	65	69
	Medford	183	254
	Klamath Falls	<u>7</u>	<u>6</u>
	Totals:	460	579

Criterion 4: Dispersal Habitat

Assessments of dispersal habitat in draft resource management plans were based on a total of 1,389 quarter-townships and their ability to meet 50-11-40 standards. This includes an estimated 103 quarter-townships wholly within OGEAs. To compare the BLM preferred alternative with the intent of the ISC Strategy, the Scientific Analysis Team used quarter-townships or parts of quarter-townships outside of OGEAs with the potential to meet 50-11-40 standards (n = 1,263 quarter-townships) in this analysis. BLM quarter-townships within the Willamette Valley were analyzed as being either in the Oregon Coast Range Province or Western Oregon Cascades Province. Primary sources of information included a set of BLM maps (WODDB 50-11-40, July 31, 1992) showing the expected status of quarter-townships at various time intervals (i.e., current, year 2030, and year 2040) for the BLM preferred alternative.

Alternative D

Compliance with 50-11-40 standards in BLM Alternative D of draft resource management plans provides for dispersal habitat in accordance with expectations of the ISC Strategy. The intent here is for all quarter-townships between HCAs to reach 50-11-40 conditions as soon as possible, as described in detail in Thomas et al. (1990). Under this alternative, dispersal habitat improves steadily from the current 71 percent (n = 894) (Table 4-7) of all (n = 1,263) quarter-townships with potential to meet 50-11-40, and by year 2030, fully meets 50-11-40 standards. All quarter-townships continue to meet 50-11-40 standards through year 2040 (Figure 4-2).

Data were not available to ascertain trends of quarter-townships meeting 50-11-40 standards over 50 years by physiographic province for BLM Alternative D. However, it is reasonable to assume that there will be a continual increase in the number of quarter-townships meeting 50-11-40 because assessments of all BLM administered lands in western Oregon indicate such a trend (J. Lint pers. comm.).

BLM Preferred Alternative

In the BLM preferred alternative, quarter-townships are managed to improve overall from current conditions, with an emphasis on quickly meeting 50-11-40 in quarter-townships in linear areas between OGEAs (designated as connectivity areas) and in non-deferred OGEAs (J. Lint pers. comm.).

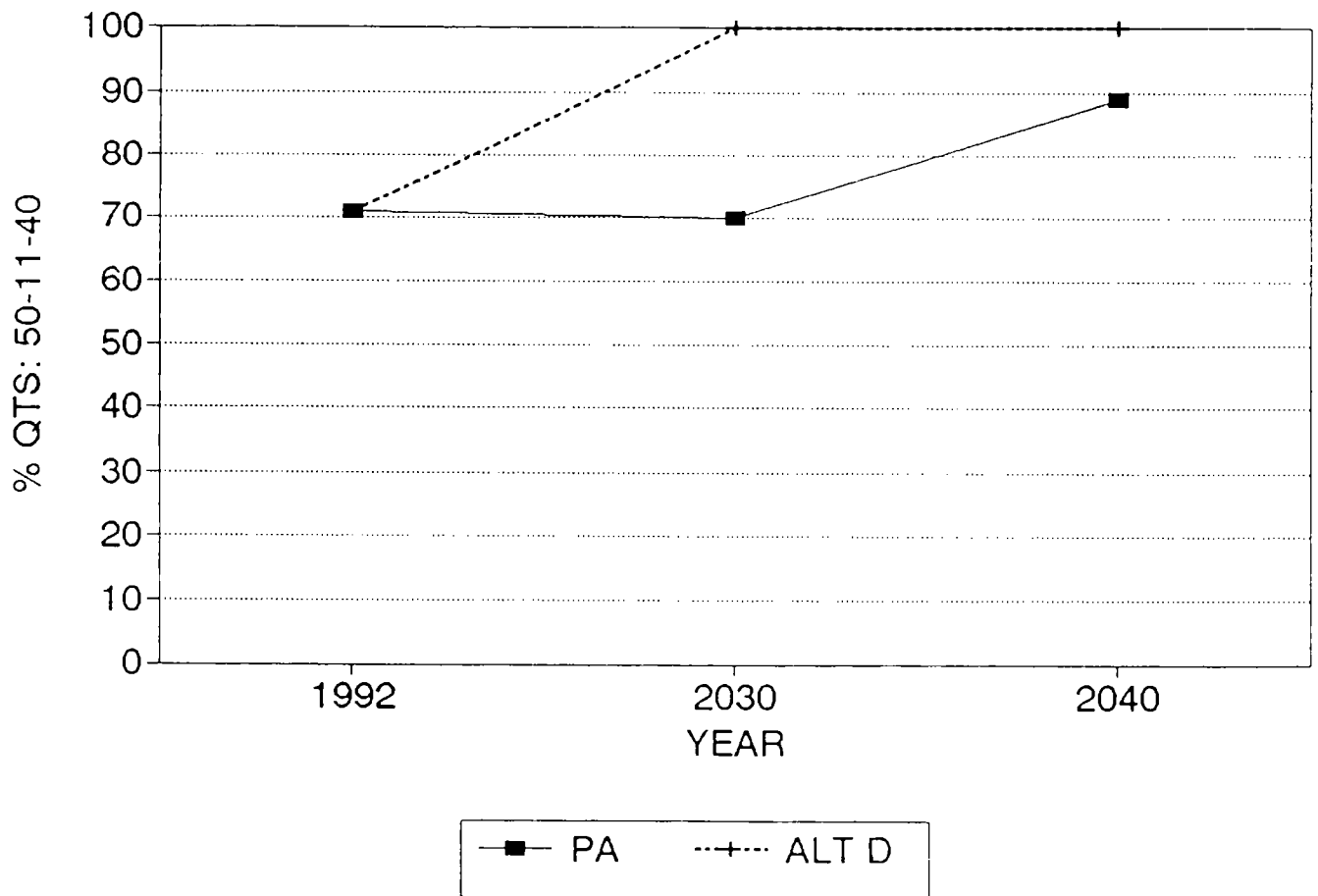
Under the BLM preferred alternative the percentage of quarter-townships meeting 50-11-40 standards initially declines from 71 percent (n = 894) at the present time to 70 percent (n = 878) by year 2030. Between years 2030 and 2040, quarter-townships meeting 50-11-40 standards increase to 89 percent (n = 1,120) (Table 4-7, Figure 4-3). Beyond year 2040, the BLM preferred alternative is expected to eventually meet 50-11-40 standards in most areas. This initial decline and following delay in meeting 50-11-40 standards represents a divergence from the intent of the ISC Strategy.

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Figure 4-2

Oregon BLM 50-11-40 PA/ALT D ENTIRE AREA



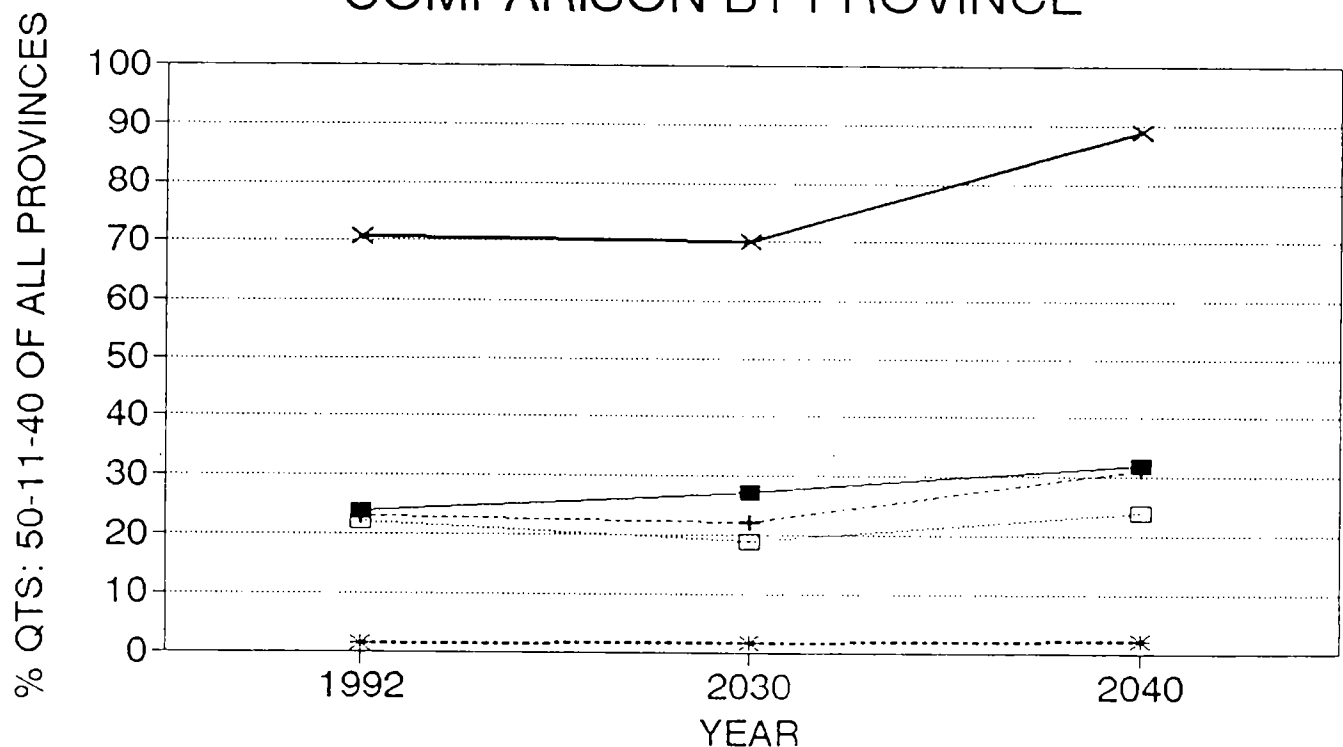
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Figure 4-3

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Oregon BLM 50-11-40 COMPARISON BY PROVINCE



—■— ORCO

—+— ORCA-W

—*— ORCA-E

—□— KLAM

—x— ALL PROVINCES

ORCO = Oregon Cascades Province
ORCA-W = Oregon Cascades West Province
ORCA-E = Oregon Cascades East Province
KLAM = Klamath Mountains Province

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Table 4-7. Number of Quarter-Townships Meeting 50-11-40 Standards on BLM Administered Lands Within the Range of the Northern Spotted Owl.

Year	Physiographic province ¹	No. of quarter-townships
Current	All	894
	ORCO	307
	ORCA-W	287
	ORCA-E	17
	KLAM	283
2030	All	878
	ORCO	341
	ORCA-W	279
	ORCA-E	23
	KLAM	235
2040	All	1,120
	ORCO	399
	ORCA-W	390
	ORCA-E	27
	KLAM	304

¹ Physiographic provinces: ORCO = Oregon Coast Range; ORCA-W = Oregon Cascades West; ORCA-E = Oregon Cascades East; KLAM = Klamath Mountains.

The following provides both a quantitative and qualitative description of the status of quarter-townships under the BLM preferred alternative.

Oregon Coast Range Province: Numbers of quarter-townships meeting 50-11-40 standards gradually increase (from 67 to 87 percent) over the next 50 years (Figure 4-4). Spatial distribution of quarter-townships meeting 50-11-40 generally improves as well. There is an immediate and significant increase in number of quarter-townships meeting 50-11-40 standards between OGEAs overlapping with HCAs O-28, O-29, O-30, O-31, O-32, O-33, O-35, O-36, O-37, and O-38 at years 2030 and 2040.

The number of quarter-townships meeting 50-11-40 standards in some areas near the outer boundaries of the Oregon Coast Range Province (e.g., northeast corner of the province on the Salem BLM District, and the southeast corner of the province on the Coos Bay BLM District) decreases or does not change. The overall effect at both years 2030 and 2040 is an improvement in amount and distribution of quarter-townships meeting 50-11-40 standards. This trend is significant because of the large (36 percent $n = 460$ of 1,263) (Figure 4-2) percentage of BLM quarter-townships in the Oregon Coast Range Province and its identification as an Area of Special Concern (Thomas et al. 1990).

Oregon Cascades West Province: Initially, the percentage of quarter-townships meeting 50-11-40 standards drops slightly from 69 percent to 67 percent at year

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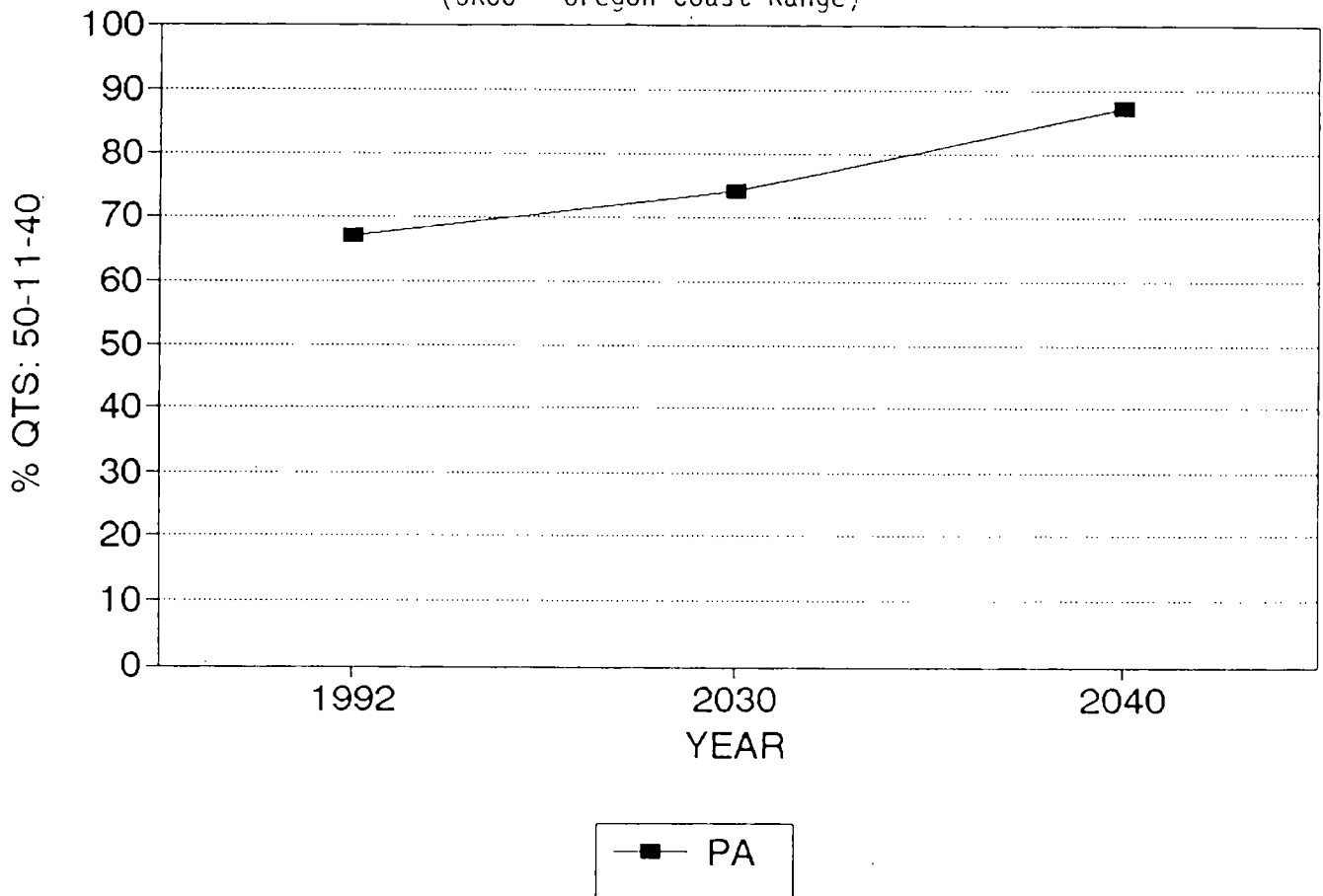
Figure 4-4

DO NOT DUPLICATE

Oregon BLM 50-11-40 PA

ORCO PROVINCE

(ORCO = Oregon Coast Range)



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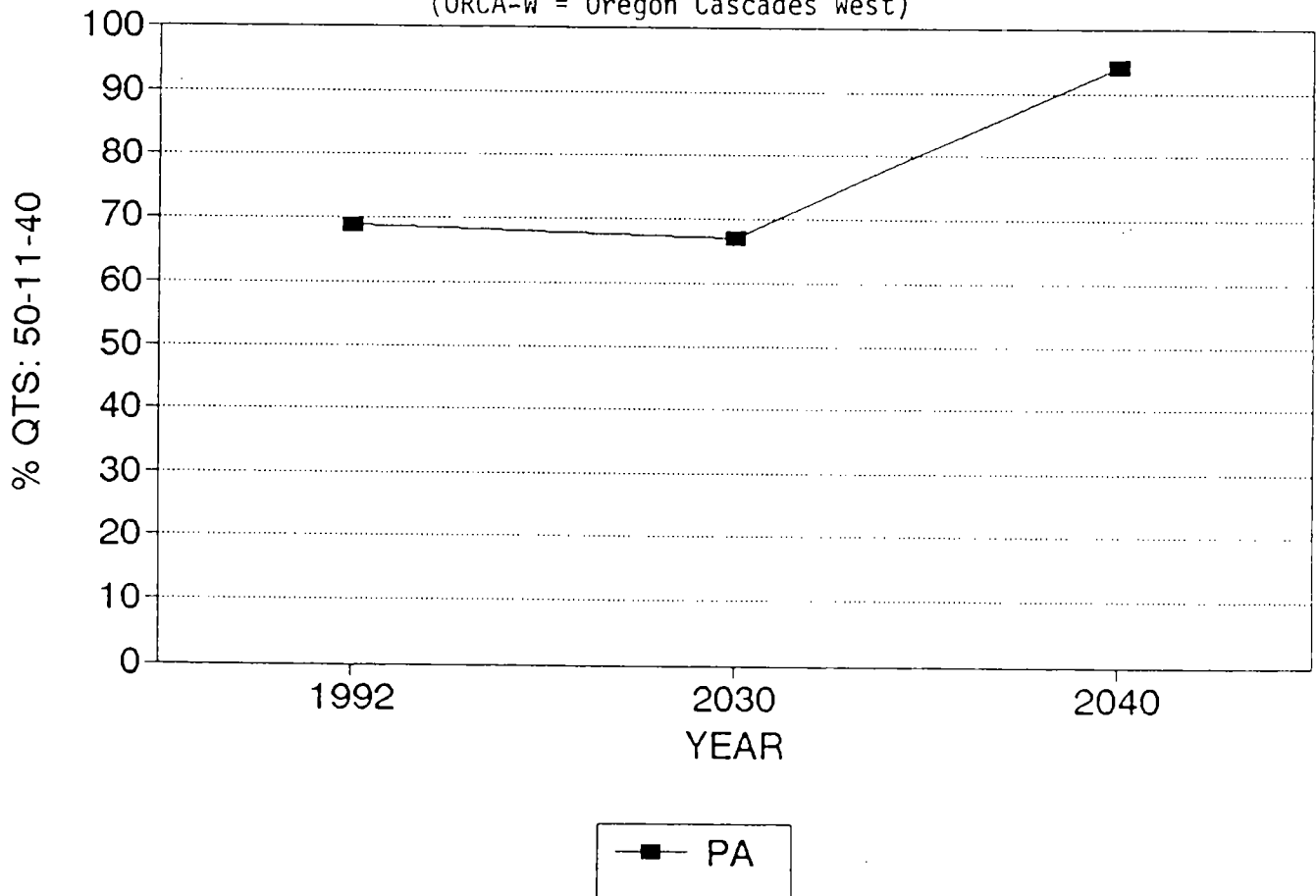
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Figure 4-5

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Oregon BLM 50-11-40 PA ORCA-W PROVINCE

(ORCA-W = Oregon Cascades West)



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2030, then reaches 94 percent in year 2040 in the BLM preferred alternatives (Figure 4-5). Quarter-townships not meeting 50-11-40 standards at year 2030 are concentrated and increase in two vicinities; one near Eugene, Oregon; the other, an area east of Roseburg, Oregon. While both areas improve by the year 2040, neither fully complies with 50-11-40 standards by year 2040.

The Fish and Wildlife Service identified the Southern Willamette/North Umpqua area between the Oregon Coast Range and Oregon Cascades West Physiographic Provinces as an Area of Concern (USDI, 1992h). Virtually all quarter-townships in this Area of Concern meet 50-11-40 standards by year 2030, a result similar to BLM Alternative D.

Quarter-townships not meeting 50-11-40 standards are highly concentrated in the southern portion of the province, an area east and north of Medford, Oregon. This condition remains virtually unchanged through year 2030. Between years 2030 and 2040, most quarter-townships meet 50-11-40 standards in this area.

This province contains approximately 33 percent (n = 414 of 1263) of all BLM quarter-townships in Oregon within the range of the northern spotted owl (Figure 4-3). A decision to defer full compliance with 50-11-40 standards for 40 years in concentrated areas within this province represents a divergence from the intent of the ISC Strategy, and may pose localized dispersal obstacles to movement by spotted owls.

Oregon Cascades East Province: The BLM preferred alternative indicates a steady increase in quarter-townships meeting 50-11-40 standards from 63 to 100 percent over the next 50 years in this province (Figure 4-6). This is the only province to fully (100 percent, n = 27 quarter-townships) meet 50-11-40 standards (Table 4-7) in all quarter-townships in a 50-year time period.

Approximately 2 percent (n = 27 of 1263) of quarter-townships on BLM ownership in Oregon within the range of the northern spotted owl are located in this province. The 50-11-40 standards are quickly and fully met under the BLM preferred alternative. However, the province represents a relatively minor percentage of the landscape under consideration (Figure 4-3).

Klamath Mountains Province: The number of quarter-townships meeting 50-11-40 standards initially drops 13 percent (from 78 to 65 percent) before increasing to 84 percent at year 2040 (Figure 4-7). The spatial distribution of quarter-townships not meeting 50-11-40 standards increases and is largely concentrated south of Roseburg, Oregon at year 2030. Conditions in this area improve by year 2040 but remain below current levels.

In other portions of the Klamath Mountains Province, dispersal conditions, as reflected by analysis of quarter-townships, remain nearly constant until year 2030 when conditions improve in an area south and west of an OGEA overlapping HCA O-16. At year 2040, conditions improve in an area between OGEAs overlapping HCAs O-16, O-26, O-24, O-20, O-21, and O-17. A band of Federal quarter-townships meeting 50-11-40 standards results between these OGEAs. A good distribution of dispersal habitat is important in this area because a large area around Grants Pass and Medford, Oregon, lacks OGEAs. Dispersal habitat in this area is likely key in facilitating movement by owls between the Klamath Mountains and Oregon Cascades West Physiographic Provinces.

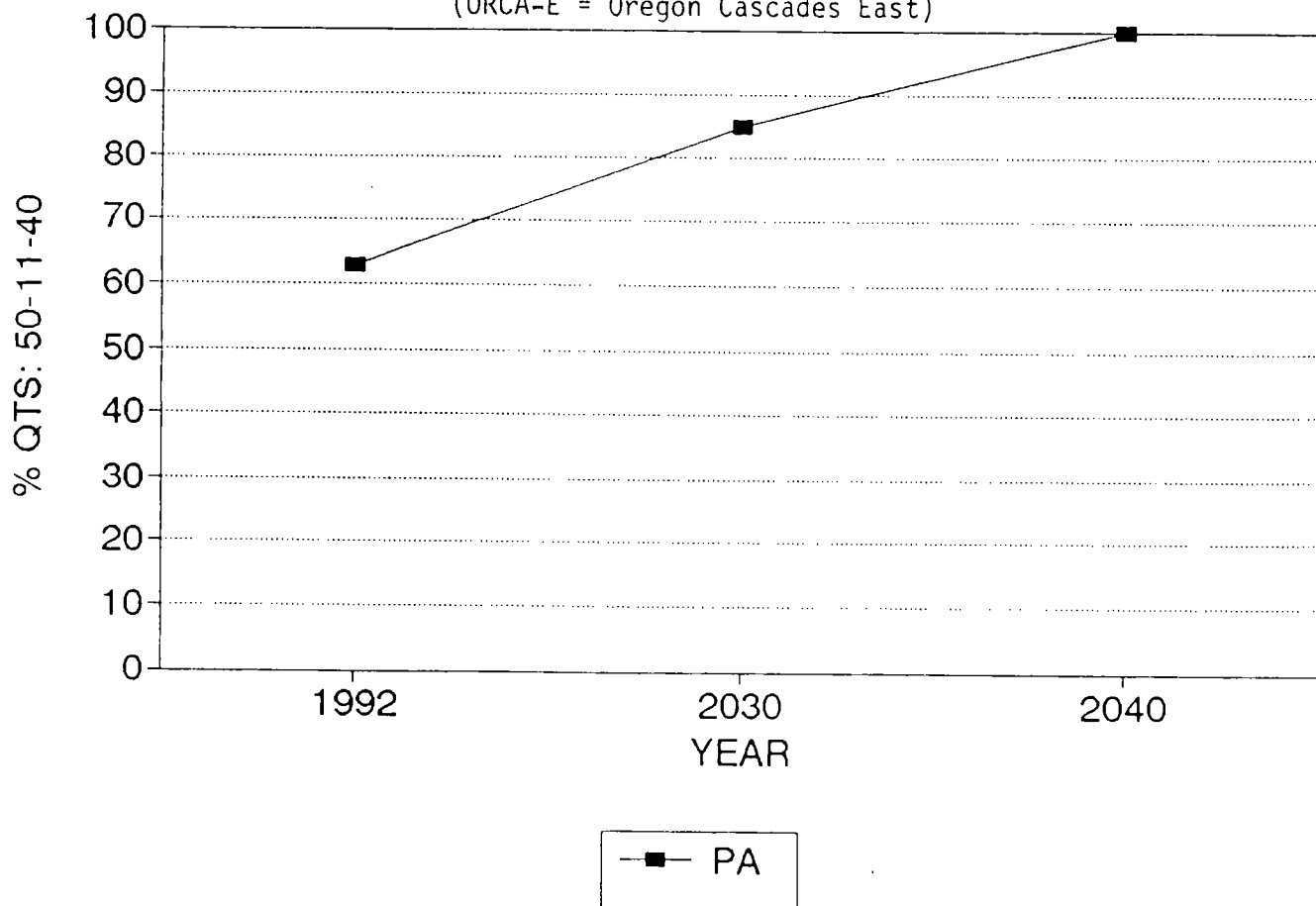
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Figure 4-6

DO NOT DUPLICATE

Oregon BLM 50-11-40 PA ORCA-E PROVINCE

(ORCA-E = Oregon Cascades East)



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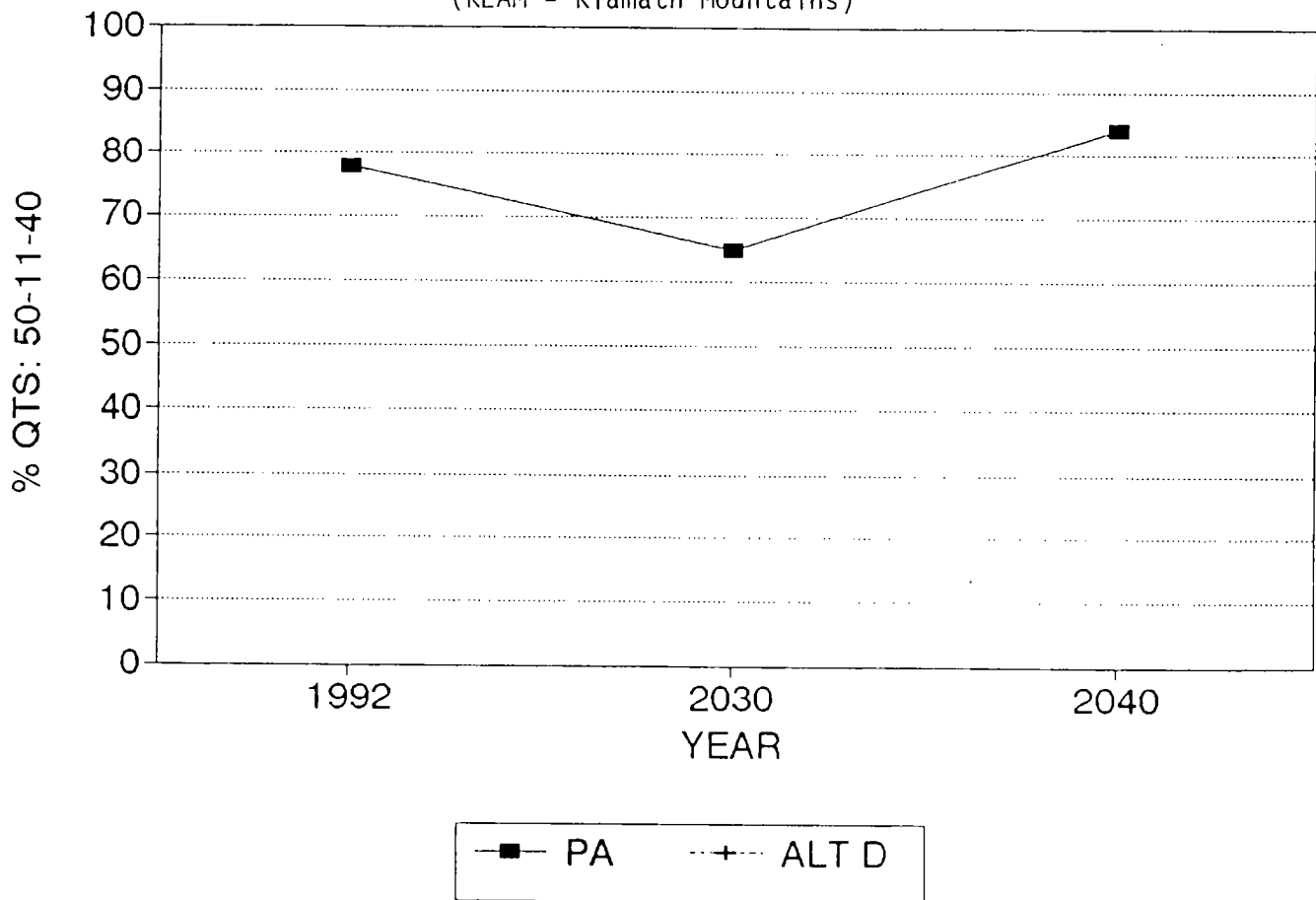
Figure 4-7

DO NOT DUPLICATE

Oregon BLM 50-11-40 PA

KLAM PROVINCE

(KLAM = Klamath Mountains)



BLM quarter-townships with potential to meet 50-11-40 standards in the Klamath Physiographic Province represent 29 percent (n = 362 of 1263) of all quarter-townships in Oregon within the range of the northern spotted owl (Figure 4-3). A decision to defer compliance with 50-11-40 standards for 40 years in concentrated areas within this province represents a significant divergence from the intent of the ISC Strategy. These local areas may pose substantial dispersal obstacles to spotted owls (USDI, 1992c).

BLM Alternative D incorporates the 50-11-40 rule across the landscape to respond to random dispersal of spotted owls as prescribed in the ISC Strategy (Thomas et al. 1990). In contrast, in some areas, implementation of the BLM preferred alternative results in linear bands of quarter-townships meeting 50-11-40 standards.

Although some researchers support corridors of continuous suitable habitat (Thomas et al. 1990: 303), BLM connectivity corridors occur in a fragmented ownership pattern, due to intermingling of other ownerships in a checkerboard pattern. This pattern may not result in the desired condition of bands of continuous suitable habitat. Even if BLM meets 50-11-40 standards in all of its quarter-townships, the actual number of quarter-townships (all ownerships) meeting 50-11-40 standards across the landscape may range from less than 25 percent to 50 percent. Patches of suitable habitat may vary in size and connectivity. Ultimately, a reduction in quantity or quality of dispersal habitat for spotted owls may reduce probabilities of successful dispersals by owls. Reductions in successful dispersal by spotted owls are likely to result in higher death rates and reductions in population sizes, unless compensated by higher birth rates or greater longevity of owls.

Criterion 5 - Spacing Between Areas Designated for Spotted Owl Management

Minor changes in acreages of OGEAs in the BLM preferred alternative reduce distances between some habitat blocks expected to be analogous to Category 1 HCAs (capable of supporting 20 or more pairs of owls) and Category 2 HCAs (capable of supporting 2 to 19 pairs of owls) in the ISC Strategy (see Criterion 2). A nearest-neighbor analysis of OGEAs and HCAs on Federal lands indicates that differences in spacing occur only within the Oregon Coast Range Province. Here the average first nearest-neighbor distance decreased from 5.1 to 4.0 miles and the average second-nearest neighbor distance decreased from 9.3 to 8.1 miles. The third nearest-neighbor distance decreased from 15.7 to 14.6 miles in the province.

Overall, 10 percent (n = 5 of 50) of spotted owl habitat blocks (OGEAs) equivalent in size to Category 1 and 2 HCAs in the State of Oregon would be closer together in the BLM preferred alternative than in BLM Alternative D. From this standpoint, the BLM preferred alternative is an improvement over BLM Alternative D.

Criterion 6 - Patch Size of Habitat

Areas of contiguous habitat probably support a larger number of northern spotted owls than an equal amount of habitat distributed as small patches (USDA 1988; Anderson et al. 1990). Fragmentation of habitat blocks increases the ratio of edge habitat to interior habitat, resulting in a smaller amount of interior habitat overall (Thomas et al. 1990:293). A primary objective of HCAs was to provide large blocks of nesting, roosting, and foraging habitat and offer areas which are expected to develop into superior owl habitat through time (Thomas et al. 1990:167). In this context, patch size is equated to OGEA size for a quantitative analysis.

The extent of density management proposed in the BLM preferred alternative within OGEAs, varies by BLM district and by decade (Table 4-8). On a district-wide basis, the Medford District would manage 8 percent (n = 16,700 of 207,600 acres) of OGEAs during the first decade. In contrast, a greater proportion (32 percent, n = 50,168 acres) of OGEAs would be managed on the Roseburg District by the fifth decade. Total area of OGEAs subjected to density management increases from 3 percent (24,417 acres) in the first decade to 20 percent (143,344 acres) of 719,500 acres comprised by OGEAs over the next 50 years. The low percentage of acres managed in the first decade is attributed to the age class distribution (an abundance of early- and late-aged stands) in OGEAs (D. Dippon pers. comm.).

Table 4-8. Acres of Density Control/Commercial Thinning in OGEAs by Decade by District for BLM Preferred Alternative. (Numbers in Parentheses Represent Percentage of Total Area in OGEAs by District.)

District	10 Years	50 Years	Total area in OGEAs (Ac.)
Roseburg ¹	593 (<1%)	50,168 (32%)	155,200
Medford ²	16,700 (8%)	33,400 (16%)	207,600
Eugene ²	3,722 (3%)	28,832 (20%)	142,000
Salem ²	2,799 (2%)	27,654 (21%)	134,200
Coos Bay ²	603 (<1%)	3,290 (4%)	80,500
Total:	24,417 (3%)	143,344 (20%)	719,500

¹ J. Graham pers. comm.

² From draft district resource management plans.

BLM draft resource management plans assume stand management practices in OGEAs will succeed in development of characteristics of foraging habitat over the next 100 years. Consequently, patch size is expected to increase and fragmentation decrease in the long term. Resource plans do not discuss development of superior owl habitat as addressed by the ISC Conservation Strategy.

Available data on the extent of timber harvest (density management and regeneration harvest) within OGEAs could not be directly translated into effects on OGEA size. Optimistically, all proposed treatments would produce desired results; all potential habitat would develop into suitable owl habitat, existing habitat would retain its suitability, and OGEA size would not be adversely affected. Pessimistically, proposed treatments would fail to produce desired results; potential habitat would not develop into suitable owl habitat, and existing habitat would lose its suitability, thus, reducing effective OGEA size.

A comparison of overall patch (OGEA vs. HCA) size (Table 4-9) indicates implementation of BLM draft resource management plans would affect three physiographic provinces: Oregon Coast Range, Oregon West Cascades, and Klamath Mountains. Mean HCA size increases (range = 36 to 4,678 acres, $n = 2$) in affected physiographic provinces, except for the Oregon West Cascades where mean HCA size decreases approximately 980 acres. Smaller HCAs would reduce the probability of reaching the desired cluster size within each HCA, and hence, population goal within each province. On a range-wide basis, average HCA size increases from 45,212 to 45,453 acres (Table 4-9).

Although the above information suggests an optimistic outlook, the Scientific Analysis Team has concerns about the likelihood that all expectations for the development of suitable habitat will be met (see Discussion Regarding Risk). If expectations are not met, the effective size of OGEAs will likely decrease over time.

Table 4-9. Comparison of Size (Acres) of BLM Alternative D to BLM Preferred Alternative Deferred OGEAs of BLM Draft Resource Management Plans by Physiographic Province.

Province	<u>BLM Alternative D</u>		<u>BLM Preferred Alternative</u>	
	No. of HCAs	Mean HCA size (Ac.)	No. of OGEAs	Mean OGEA size (Ac.)
Oregon Coast Range	12	47,917	12	52,595
Oregon West Cascade	18	74,333	18	73,353
Oregon East Cascade	6	22,167	6	22,167
Klamath	43	44,279	43	44,315
CA Cascades/Modoc	12	21,283	12	21,283
No. CA Coast Range	31	7,435	31	7,435
WA Olympic Peninsula	1	676,000	1	676,000
WA West Cascade	22	67,727	22	67,727
WA East Cascade	13	39,000	13	39,000
Range-wide	158	7,143,462	158	7,181,498
Range-wide Mean HCA size:		45,212		45,453

The preceding analysis does not include six OGEAs totaling 16,000 acres. These areas were excluded because we assumed their size or configuration of habitat precluded their functioning as Category 1 or 2 HCAs.

Criterion 7 - Clustering of Owl Pairs

The expected number of owl pairs within OGEAs in the future was not available from BLM (D. Dippon pers. comm.). Consequently, we were unable to complete a cluster analysis of owl pairs. Based on BLM's timber harvest data and projections of vegetative response to timber harvest, designed to develop characteristics of owl habitat, the McKelvey Model predicts that the ability of the landscape to support owl pairs under BLM preferred alternative will be very similar to that of the ISC Strategy (B. Noon pers. comm.). If BLM's assumption about rate of habitat development in OGEAs is correct, there would be no appreciable differences between BLM Alternative D and the BLM preferred alternative.

Although some of the above information suggests an optimistic outlook, we have concerns about the likelihood that all expectations for the development of suitable habitat will be met (see Discussion Regarding Risk).

Table 4-10 summarizes short-term (10-50 years) and long-term (100 years) expectations for spotted owl habitat and trends for the BLM preferred alternative as compared to BLM Alternative D.

Table 4-10. Summary of Comparisons of BLM Preferred Alternative to BLM Alternative D of BLM's Draft Resource Management Plans Over the Short and Long Term.

Short term	Long term
8% (71,000 acres) reduction in suitable spotted owl habitat in 50 years.	4% (46,000 acres) increase in suitable spotted owl habitat.
4% (12,100 acres) reduction in old growth in 10 years.	6% (31,000 acres) reduction in old growth.
A 1-6% (1 to 10 pairs) increased capability of habitat to support pairs of spotted owls.	A 22-26% (56 to 119 pairs) increased capability of habitat to support pairs of spotted owls.
Approximately 385 fewer (30% of 1,263) quarter-townships meeting the 50-11-40 standards after 30-40 years.	Estimated to be nearly equal (approximately 90% of 1263 quarter-townships) in meeting 50-11-40 standards.
No quantitative data were provided, but BLM expects patch size to increase in OGEAs at least equivalent to increases associated with BLM Alternative D.	Same as short term.
No comparative data for clusters of spotted owl pairs were provided but based on estimated capability to support pairs BLM probably expects clustering in OGEAs to be equal to or better than BLM Alternative D.	Same as short term.
Standards for distribution of habitat and spacing are nearly identical.	Same as short term.

Discussion Regarding Risk

Comparative analysis of BLM Alternative D and the BLM preferred alternative of BLM's draft resource management plans allowed quantitative comparisons where data exist. For many aspects of resource management planning, quantitative data were not generated or compiled. In such instances, assumptions regarding the expected consequences of particular actions or elements must be made to project the success or failure of the plans.

Assumptions introduce uncertainty into a resource strategy. The greater the number of assumptions made, the greater the uncertainty of attaining expected results. The ISC recognized that the plan that would entail the greatest probability of success, hence the lowest degree of uncertainty, would be one that protected all existing spotted owl habitat and made provisions to protect

additional acres of young forest to develop into suitable habitat as soon as possible (Thomas et al. 1990:11, USDA 1991:9). This approach would minimize assumptions regarding effects of additional human activities on suitable spotted owl habitat and expected reactions of owl populations. The ISC did not choose such an optimal approach. Instead, the committee chose to develop an approach that reduced the risk, as well as inherent assumptions and uncertainties, to acceptable levels. It must be noted that because of the risk, the ISC Strategy was developed to be treated as a working hypothesis, to be validated and amended as indicated by research and monitoring.

Based on comparative data, the BLM preferred alternative differs from the BLM Alternative D, and therefore the ISC Strategy, in three major ways based on comparative data. The BLM preferred alternative prescribes actions which delay, for 40-50 years, the development of forest stand conditions that meet the dispersal standards set forth in the ISC Strategy. The BLM preferred alternative also allows timber harvest in the OGEAs, which BLM intends to be analogous in function to the HCAs, and they do not afford protection for home range size areas for all known or future pairs of owls in the Oregon Coast Range Area of Special Concern. These variations introduce considerable risk as to the viability of spotted owls on BLM administered lands in Oregon.

The Scientific Analysis Team believes the BLM preferred alternative, specifically with BLM's intentions to manage forest stands to create conditions favorable for spotted owls represents increased risks. This increased risk is associated with at least five factors which have been identified. There may be others. A discussion of each factor and the elements of the BLM preferred alternatives of the draft resource management plans which are related to the factor follows:

1. Description of desired future conditions.

The BLM preferred alternative of the draft resource management plans call for timber harvest as a means to accelerate the development of old-growth characteristics and, therefore, create future conditions suitable for spotted owls. Current working definitions of spotted owl habitat at the stand level are general in scope and vary considerably. Thomas et al. (1990:146) identified nine variations of general definitions of stand conditions relative to spotted owl studies. These variations reflect geographic differences of habitat and a general lack of specific owl use data correlated to quantitative descriptions of the habitat used. Terms used to describe quality of habitat are equally varied. Examples of such terms for spotted owl habitat include "suitable habitat, nesting, roosting, and foraging habitat, optimal habitat, superior habitat, dispersal habitat, roosting and foraging habitat, foraging habitat, and marginal habitat". These terms reflect a recognition on the part of biologists, that spotted owl habitat exists on a continuum with respect to its ability to provide for all the life needs of the owl. The variability and generality combined with the lack of consistency in application of the definitions further illustrate the uncertainties associated with describing desired future conditions of habitat.

Suitable spotted owl habitat is referred to frequently in the draft resource management plans but is not defined in the documents. Instead, some draft resource management plans define "optimal" spotted owl habitat (USDI 1992b:3-46) or discuss nesting, roosting, and foraging habitat (USDI

1992e:3-67). Both a definition and the amount of suitable spotted owl habitat are basic data necessary for projected mean annual occupancy estimates of the McKelvey Model (USDI 1992b:Appendix 4-107) and provide a gauge for assessing how well the BLM preferred alternatives provide for spotted owls, especially in the future. McKelvey (1992 in USDI 1992b; Appendix 4-107) defines suitable habitat for an organism as habitat in which the combination of birth and death rates allows for a stable or increasing population.

Whether site-specific variability of habitat required to meet McKelvey's definition were accounted for is unknown. To provide spatially explicit suitable spotted owl data required by the McKelvey Model, BLM must have developed specific definitions. The draft resource management plans do not, for the most part, acknowledge differences between the quality of habitat that might result from silvicultural treatment or how that might affect assumptions about expected spotted owl responses. Instead, it appears that all types of suitable spotted owl habitat were viewed as equal in terms of their capability to provide for the balance between birth and death rates. Once stands were considered to attain characteristics which would support spotted owls at any level they were included in the category "suitable habitat" and used in the model. The model then viewed such stands as equivalent to older-aged stands. The model considers only the amounts and arrangement of habitat on the landscape and does not account for varying quality. This is particularly risky when assessing forest stands which develop in response to timber harvest. Assessments that do not account for the differential quality of habitats fail to fully assess the risks associated with habitat manipulation.

The Scientific Analysis Team's analysis concludes that, given current knowledge and absent site-specific definitions of spotted owl habitat that account for variation (i.e., geographic, elevational, site productivity, climatic, vegetative community, and prey species), it is not likely that accurate descriptions of desired future conditions for suitable spotted owl habitat can be offered. Considerable additional research is likely required before this can be accomplished.

2. Availability of existing mechanisms to attain desired future conditions.

Manipulation of spotted owl habitat through timber harvest involves use of silvicultural prescriptions. Silvicultural prescriptions are developed to attain desired future conditions in forest stands by establishing methods and standards for harvesting these stands. Most existing silvicultural techniques and prescriptions have been developed with an objective of maximizing growth of commercial tree species and, therefore, wood production. Lacking experience with timber harvest techniques designed to create spotted owl habitat, such practices must be approached as hypotheses requiring testing to determine their likelihood of success. Without empirical data to demonstrate expected chances of success, assumptions of probabilities of success must be made to project amounts, quality, and arrangements of spotted owl habitat.

It appears BLM made some assumptions as to the probability of success of silvicultural systems and treatments used in developing spotted owl habitat. The Draft Resource Management Plan for Roseburg District (USDI 1992b:2-41)

describes the uncertainty in a discussion of the timber management for the BLM preferred alternative.

"Since this alternative includes some elements recognized to be substantially untested, modeling its sustainable timber yield is more difficult than with the alternatives that rely wholly on traditional forest management techniques. The level of confidence in the preceding numbers is therefore lower than the numbers for alternative A, B, D, and E".

The numbers referred to in the quote above were the numbers given for allowable sale quantity (ASQ) and expected acreages treated by various silvicultural techniques. Values for ASQ are closely associated with expected vegetative responses following forest management. Data used to derive expected timber yields are likely the same considered for projecting future habitat conditions.

Specific elements of the BLM preferred alternative in the draft resource management plans are associated with uncertainties regarding existing silvicultural systems and treatments expected to develop or maintain spotted owl habitat. Suitable spotted owl habitat, notwithstanding the lack of definition, is expected to develop faster in some stands within OGEAs scheduled for silvicultural treatment. Although BLM analysts did not factor such accelerated development into projected amounts of suitable habitat, it was offered as a reason for treating stands. In particular, density management is offered as a means of promoting stand diversification, developing old-growth characteristics, and producing timber (USDI 1992b:2-41). Given the uncertainty associated with such expectations, it is likely that some silvicultural treatments, which have been characterized as largely experimental, may have an opposite effect from that expected. Consequently, such treatments may hinder the development of suitable habitat or they may only partially succeed, resulting in marginal habitat that will not fully provide for the needs of spotted owls. Results which fall short of the expected conditions might occur because of delay or failure to regenerate, increased windthrow, mechanical damage to trees remaining after logging, the spread of root rot and other diseases, and increased risk of fires associated with logging operations. Such events may occur in the areas immediately adjacent to treatment units, thereby affecting more acreage than those directly treated.

The BLM preferred alternative calls for regeneration patch cutting in the non-deferred OGEAs, and after 80 years in deferred OGEAs. In non-deferred OGEAs, patch cuts are expected to accelerate development of suitable habitat for spotted owls, whereas patch cuts in deferred OGEAs are not expected to alter the habitat suitability of the stands for spotted owls. Likewise, regeneration patch cuts are not expected to change the character of old-growth stands. Concerns about lack of data to demonstrate effects of these types of treatments as discussed above for density management, are applicable here as well.

Data describing habitat components (e.g., numbers of snags and down logs--course woody debris) across a range of vegetative conditions are poorly developed or non-existent. These components are required to provide structure for future spotted owl habitat in harvest units following logging

activities. The BLM preferred alternative calls for snags to be left "where feasible" and 4 logs, 20 inches in diameter and 50 feet long per acre, "where available". These standards are obviously not site specific and are not rigorous enough to ascertain how often they will be met. In areas where it is not "feasible" to leave snags, or logs for retention are not "available", we expect a greater amount of time would be required to return the forest stand to spotted owl habitat.

Uncertainties associated with the probabilities of successful manipulation of forest stands to maintain or create suitable spotted owl habitat combine to create additional risk. As a result, the amounts or quality of suitable habitat expected in the BLM preferred alternative may not be realized. Data presented in the discussion above for the seven viability criteria, which are based on BLM's current assumptions, would be overly optimistic should such decreases occur.

3. Implementation of prescribed activities.

Whenever a natural resource management activity is proposed it is developed through a planning process. Planning produces a description of desired future conditions or objectives and methods prescribed to attain those conditions. Treating forest stands to create or maintain spotted owl habitat entails describing habitat characteristics and identifying one or more silvicultural treatments designed to attain that desired habitat condition. The planning process culminates in a plan for a project which, for timber sales, involves legal contracts obligating the purchaser and the seller to specific provisions. The project is then implemented according to the provisions of the plan as incorporated into a contract. Our experience indicates that not all provisions of the plan are thoroughly incorporated into the contracts, nor are all contract provisions thoroughly administered to ensure compliance. This results in a less than 100 percent probability that objectives for attaining desired habitat conditions will be met. The BLM preferred alternative does not describe whether such risk was considered in projections of suitable habitat.

4. Ascertaining success or failure.

Silvicultural treatments of forest stands designed to accelerate development of old-growth characteristics or to maintain suitable habitat for spotted owls will require aggressive monitoring to determine whether such treatments are successful. The BLM plans to monitor implementation of their resource management plans (J. Lint pers. comm.). The monitoring plan is being developed and will be completed pending finalization of the resource management plans.

Any monitoring plan has probabilities as to how well it will provide relevant and accurate data to demonstrate success or failure of a given plan. The more complex the plan (i.e., the more variables to track) the less likely the monitoring plan will successfully detect problems. Manipulation of forest stands to accelerate development of spotted owl habitat on a landscape scale, as prescribed in the BLM preferred alternative, is an extremely complex issue involving a myriad of variables. Development of a monitoring plan intensive enough to isolate

the causes of observed variations for wide-scale implementation of the BLM preferred alternative is unlikely.

The probability of successful monitoring is also affected by the availability of adequate and consistent funding.

5. Adaptive management.

The term adaptive management has been used in the context of resource management to identify a strategy which essentially acknowledges the need to make decisions without perfect knowledge. It entails monitoring results of resource management and, where required based on the monitoring feedback, modifying the decisions. Adaptive management is a means to reduce the risk of erroneous assumptions or decisions. A basic requirement for a viable adaptive management strategy is the existence of resources necessary to make the required adjustments. Adaptive management can only be expected to reduce risk if options to adjust the management plan are not eliminated. Adaptive management, therefore, can be considered a means to reduce risk associated with a resource management plan commensurate with the options for adjustment which remain during the time the plan is in effect.

Consideration of the uncertainties and risk associated with the above factors and pertaining to manipulation of spotted owl habitat, or younger stands expected to develop into spotted owl habitat, compelled the ISC Conservation Strategy to incorporate provisions which did not allow timber harvest in HCAs. Thomas et al. (1990:167) discuss the objectives for spotted owl habitat in HCAs. "Given the current distribution of old forests, we see no alternative in the short-term but to protect significant amounts of the remaining superior habitat for northern spotted owls through the creation of HCAs. Under the conservation strategy proposed here, most logging activities within HCAs would cease. The ultimate management goal within HCAs, therefore, is to recreate a relatively unfragmented, natural landscape. This strategy will ultimately maximize the amount of superior habitat and minimize the amount of marginal and unsuitable habitat...Until we can demonstrate that silvicultural treatments can benefit spotted owls, natural succession will be the primary means to achieve an unfragmented landscape within HCAs."

In answers to questions from the United States Senate Subcommittee on Energy and Natural Resources (USDA 1991:53) members of ISC provided additional background regarding the intent for habitat in HCAs. "The intent of the HCAs is to provide a network of large blocks of habitat for northern spotted owls until reasonable certainty exists that forest practices are available for producing and maintaining equally good habitat. Such management can then be applied in HCAs. Proven technology to achieve that end does not currently exist. Because extant populations will be greatly reduced (perhaps by 50 percent or more) by cutting, we believe that ensuring that the quality of the habitat retained within HCAs must be as high as possible...so the team recommended that existing old forests in HCAs should be left unmanaged, and that some previously harvested stands be allowed to develop in an unmanaged condition."

The combined risks associated with treatment of spotted owl habitat or stands expected to develop into suitable habitat for spotted owls will likely result in situations where either habitat development is inhibited or only marginal

habitat for spotted owls is developed. The exact frequency of these partial successes or failures is unknown. Given the cumulative risks for each factor, it appears to us that the overall risk of not meeting habitat objectives is high. In view of this high risk of producing habitat conditions for spotted owls that are less than superior, an ISC response to a question about the desirability of low intensity management of habitat from Congress is especially pertinent. Members of ISC indicated that, because a plan (the ISC Strategy) was put forth which proposes to reduce the population of a threatened species by as much as 50 percent, providing the survivors with only marginal habitat would be extremely risky and certainly in their minds not "scientifically credible" (USDA 1991::45) .

The ISC recognized the need for research designed to provide data regarding the applicability of silvicultural treatments for creating or maintaining superior spotted owl habitat. The ISC Strategy called for this research to be conducted outside the HCAs. This approach allows for the questions to be addressed while risk in the keystone elements of the ISC Strategy, the HCAs, is reduced to acceptable levels.

CONCLUSIONS

After examination of the data available for comparing BLM's Alternative D and the BLM preferred alternative of the draft resource management plans and weighing the elements of risk discussed above, we conclude that the BLM preferred alternative represents resource management plans that introduce significant additional risk to spotted owls compared to Alternative D (ISC Strategy). Increased risk can be attributed to three basic elements of the BLM preferred alternative: 1.) provisions allowing a delay of 40-50 years before meeting the dispersal standards of the ISC Strategy (the 50-11-40 Rule); 2.) plans to conduct density management (commercial thinning) in younger developing stands in OGEAs and patch cuts in non-deferred OGEAs that overlap HCAs; and 3.) lack of provisions to protect home-range size areas for all currently known and future pairs of spotted owls in the Oregon Coast Range Area of Special Concern.

We further conclude that, although research and monitoring studies are presently being initiated, no significant new data to suggest the degree of certainty of silvicultural treatments exists. Therefore, it is our opinion that the course prescribed in the ISC Strategy, pertaining to timber harvest in HCAs, remains the most likely to result in superior habitat conditions within HCAs (i.e., OGEAs).

Our conclusions indicate that the viability ratings of the FEIS alternatives will be affected if BLM implements their preferred alternatives of the draft resource management plans. Therefore, a reassessment of the viability ratings is warranted and follows.

RE-ASSESSMENT OF VIABILITY RATINGS FOR EACH OF THE FEIS ALTERNATIVES

Contributions of BLM lands to northern spotted owl habitat are common to all FEIS Alternatives. Discussions of each FEIS Alternative and how the viability assessment of each would be affected by the BLM preferred alternative follows.

Alternative A provides spotted owl habitat by using a network of habitat areas where nesting, roosting, and foraging habitat capable of supporting single pairs of spotted owls would be protected from logging. No provisions are made for dispersal habitat. This strategy was evaluated by the ISC and described as having a high risk of spotted owls being extirpated from significant portions of their range. The FEIS viability assessment therefore rated Alternative A as having a low likelihood of population viability.

Implementation of BLM's preferred alternative, rather than an alternative that employs single pair habitat areas, would slightly improve conditions for spotted owls in a range-wide context but would have no effect upon the overall viability rating. No change on the "low" rating for overall viability is indicated (Table 4-11).

Alternative B is the ISC Strategy for National Forests in the range of the northern spotted owl. The ISC Strategy was previously described above. Since this strategy was developed to include National Parks, National Forests, and BLM lands, deviations from its standards and guidelines affect probabilities for a successful conservation strategy.

The BLM preferred alternative in draft resource management plans represents a considerable deviation from some of the criteria set forth in the ISC Strategy (i.e., 50-11-40 Rule, exclusion of timber harvest within HCAs, and protection of home range-size areas for all pairs in Oregon Coast Range Area of Special Concern). These deviations introduce additional risk. In our opinion, the draft resource management plans prepared by the BLM do not adequately discuss or account for these uncertainties. Discussions in the sections of this report titled "Discussion Regarding Risk" and "Conclusions" are applicable here.

Cumulatively, the effects of implementing the BLM preferred alternative would lower the overall viability rating of the FEIS for Alternative B from "high" to "moderate" (Table 4-11).

Alternative C is comprised of the components of the ISC Strategy plus Critical Habitat designated by the FWS under provisions of the ESA. It was rated as having a high likelihood of providing for viable populations in the original viability assessment for the FEIS.

The addition of large blocks of habitat in designated Critical Habitat Units (CHUs) to the HCAs has several beneficial effects that tend to alleviate the negative effects of the BLM preferred alternative in draft resource management plans. They include:

1. Reducing loss of habitat by protecting more acreage.
2. Increasing numbers of pairs expected in the future on National Forests by 18 percent over Alternative B.
3. Increasing patch sizes designated for protection and, hence, the number of clusters of more than 20 owl pairs from 34 in Alternative B to 40 in Alternative C.
4. Reducing distances between HCAs facilitating movement of owls. This is particularly true in the Oregon Coast Range Province where first nearest neighbor distances decrease by 82 percent and second neighbor distances decrease by 65 percent. Values in the Oregon Cascades West Province are -49 percent and -37 percent respectively. Spacing in the Klamath Mountains province remains essentially unchanged.
5. Increasing the distribution of spotted owl habitat to be protected in designated areas. The CHUs will create greater redundancy in the network, an important hedge against catastrophic loss of habitat which could cause loss of connectivity among components of the network.

Based on the above information, we believe the FEIS viability rating would remain "high" for overall viability of the northern spotted owl if BLM implements their preferred alternative (Table 4-11).

Alternative D entails implementation of the ISC Strategy plus protection of all suitable habitat. It provides some of the benefits ascribed to Alternative C above by adding to the amount of spotted owl habitat protected. There are however, no provisions to allow young forests, presently contributing to the fragmented condition of the habitat added, to develop into spotted owl

habitat. It is probable that, because of the perpetuation of fragmentation in the added habitat, much will be degraded in the future. We therefore believe this alternative has a slightly higher risk to viability compared to Alternative C. The risk was not deemed significant enough to warrant a viability rating less than high. For this assessment, we believe that if BLM implements their preferred alternative the rating would remain "high" (Table 4-11).

Alternative E, titled the "Multi-resource Strategy" incorporates certain elements of Alternative B in the ISC Strategy. However, it decreases the size and number of HCAs, thereby increasing distances between them. It further reduces the land base subject to the 50-11-40 Rule. The FEIS rated this alternative as having a "low" likelihood of providing for population viability. The likelihood of maintaining viability would be somewhat improved if BLM implemented their preferred alternative, rather than a strategy comparable to Alternative E, but not enough to raise the rating from "low" (Table 4-11).

Table 4-11. Viability Ratings of the FEIS Alternatives Based on Assumptions of the FEIS Compared to Ratings if BLM Alternative D or BLM Preferred Alternative (PA) of BLM's Draft Resource Management Plans are Implemented

FEIS Alternative	FEIS Viability Rating	Revised Viability Rating If BLM Alternative D is Implemented	Revised Viability Rating if BLM PA is Implemented
A	LOW	LOW	LOW
B	HIGH	HIGH	MODERATE
C	HIGH	HIGH	HIGH
D	HIGH	HIGH	HIGH
E	LOW	LOW	LOW

RECOMMENDED OPTIONS FOR MITIGATION

Recommendations are offered as a means of offsetting the effects of BLM implementing their preferred alternative of draft resource management plans. Mitigation for Alternative B, the selected alternative of the FEIS is presented. No recommendations for Alternatives A or E are offered as mitigation required to attain high viability ratings would cause these alternatives to become essentially the same as Alternative B.

Table 4-12 lists brief summaries of the effects of the BLM preferred alternative and options for mitigation. The options are discussed in greater detail following the table. Site-specific mitigation recommendations are delineated on the map in Appendix 4-B.

Table 4-12. Effects of Implementing the BLM Preferred Alternative of Western Oregon BLM District Draft Resource Management Plans on Alternative B, the Selected Alternative of the FEIS and Recommended Mitigations.

Effects	Recommended Mitigation
Increased risk of reducing nesting, roosting, and foraging habitat in designated areas (i.e., HCAs/OGEAs).	Increase numbers or sizes of HCAs on National Forests in Oregon.
Increased risk of reducing distribution of nesting, roosting, and foraging habitat.	Mitigate by increasing numbers or sizes of HCAs on National Forests in Oregon.
Increased risk of reducing the habitat capability to support pairs of spotted owls in the long term.	Increase numbers or sizes of HCAs on National Forests in Oregon.
Reductions in well-distributed dispersal habitat for 40-50 years.	Reduce distances between HCAs by increasing numbers or sizes of HCAs on National Forests in Oregon
Higher risk of increasing distances between reserves.	Increase numbers or sizes of HCAs on National Forests in Oregon.
Increased risk of decreasing effective size of habitat patches protected in the long-term.	Increase sizes of HCAs on National Forests in Oregon.
Increased risk of decreasing numbers of and sizes of clusters of pairs of spotted owls (multiple pairs).	Increase numbers and sizes of HCAs on National Forests in Oregon.
Increased risk of isolation of the Oregon Coast Range Physiographic Province sub-population of spotted owls.	Partially mitigated by increasing protection of habitat to allow for increased numbers of spotted owls in the future to reduce risks of local extirpation

Options to mitigate the effects of BLM implementing their preferred alternative of draft resource management plans are limited to increasing the intensity of spotted owl habitat management on National Forest System lands. An increased number and size of HCAs in National Forests would compensate for increased risk of losing habitat, and concomitant pairs of spotted owls, in BLM OGEAs. Adjustments to numbers and sizes of HCA on National Forests alleviates additional risk of increased spacing, loss of habitat patch size, decreases in cluster size, and reduced future expected populations associated with the BLM preferred alternative.

Loss of well-distributed dispersal habitat on BLM administered lands between the Oregon Coast Range and the other physiographic provinces in Oregon can be only partially compensated on National Forests. Increased number and size of HCAs would improve probabilities of dispersal attempts, and perhaps success, between and among HCAs. However probabilities of successful movements of owls among and between the Oregon Coast Range, the Klamath Mountains, and Oregon Cascades West Physiographic Provinces will still be reduced by some unquantifiable amount.

BLM administered lands are an integral link between the Klamath, Oregon Coast Range, and Oregon Cascades West Physiographic Provinces. Loss of components of the ISC Strategy, specifically numbers and sizes of HCAs and dispersal habitat on Oregon BLM administered lands which bridged gaps between National Forests in the physiographic provinces of Oregon, increases risk of isolating physiographic provinces. The Oregon Coast Range Physiographic Province is of immediate concern. Our recommended mitigation focuses on increasing the size of HCAs on the Siuslaw National Forest to increase the future population of spotted owls. We would expect an increase in dispersal attempts of owls among physiographic provinces as a result.

To further compensate for increased risks of isolation, and to hedge against risks of reductions in amount of habitat and numbers of pairs of spotted owls, we recommend additional HCAs designated at locations near the critical links between physiographic provinces (Appendix 4-C). These critical links include the northern portion of Klamath Mountain Physiographic Province; the west and southwest portion of the Oregon Cascades West Physiographic Province and the Oregon Coast Range Physiographic Province.

Our recommended mitigation measures compensate for anticipated levels of risk associated with the PAs in Draft RMPs sufficiently to maintain the overall high viability rating for FEIS Alternative B. It is important to recognize that our proposed mitigation measures do not account for BLM's proposed regeneration harvest within deferred OGEAs. Although we are concerned about the possible effects on habitat and owls resulting from regeneration harvest, we assumed that BLM will not implement regeneration harvesting within deferred OGEAs for 80 years, or when reliable data are available to demonstrate such practices can maintain or develop conditions of habitat suitability for northern spotted owls. Therefore, we do not believe that mitigation for activities planned far in the future and dependent on demonstration of success prior to actual implementation is required at this time. Deviations from this assumption must be evaluated for possible changes to our recommendations.

Appendix 4-C contains site-by-site discussions and rationales for mitigation recommendations.

Table 4-13 provides a summary of the viability rating of this analysis and the rating if the mitigation measures discussed above and in Appendix 4-C are implemented. The map in Appendix 4-B provides locations.

Table 4-13. Viability Ratings of the FEIS Alternatives of this Analysis Based on Implementation of the BLM Preferred Alternative (PA) in the Draft Resource Management Plans Compared to Viability Ratings if Mitigation Recommendations are Implemented.

FEIS Alternative	Viability Rating-BLM Implementation of PA	Viability Rating-If Mitigation Implemented
A	LOW	No mitigation was offered as this alternative would not retain its identity if mitigated to attain a high rating.
B	MODERATE	HIGH
C	HIGH	HIGH
D	HIGH	HIGH
E	LOW	No mitigation was offered as this alternative would not retain its identity if mitigated to attain a high rating.



United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Oregon State Office
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Portland, Oregon 97208



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October 2, 1992

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Jerald N. Hutchins
Northern Spotted Owl EIS Team Leader
P.O. Box 3623
Portland, Oregon 97208-3623

Dear Mr. Hutchins:

Your letter of September 22, 1992 indicated a need for information that would help you to assess the BLM's contribution to future spotted owl habitat and population numbers. You specifically asked for a description of our approved current management plan.

Although we have approved Management Framework Plans (MFPs) prepared in the early 1980s, they can no longer be viewed as an accurate indicator of present or future BLM management activities in western Oregon. Court decisions and Endangered Species Act requirements have prevented implementation of many management decisions under existing BLM land use plans.

The best present indicator of our most likely future management direction can be found in the preferred alternative for each of the six western Oregon draft Resource Management Plans (RMPs) and associated Environmental Impact Statements (EISs) recently released for public comment. Although these draft RMPs are not approved plans, and the preferred alternatives may be modified prior to a final decision, the preferred alternatives in the draft RMP/EISs indicate a more likely future direction than do the existing MFPs.

I understand that some of your EIS Team members have already been briefed on our draft RMPs. I am also enclosing two copies of our Executive Summary for the six plans and photo copies of an information sheet on our overall preferred approach. Individual copies of the DRMP/EISs for each of the districts may be obtained through this office or directly from the district offices. We would also be pleased to meet with you and other team members to discuss our plans for the future.

Please contact either Mike Crouse, Branch Chief for Biological Resources (503-280-7045) or Phil Stanbro, Branch Chief for Lands, Recreation and Planning (503-280-7081) if you have questions.

Sincerely,

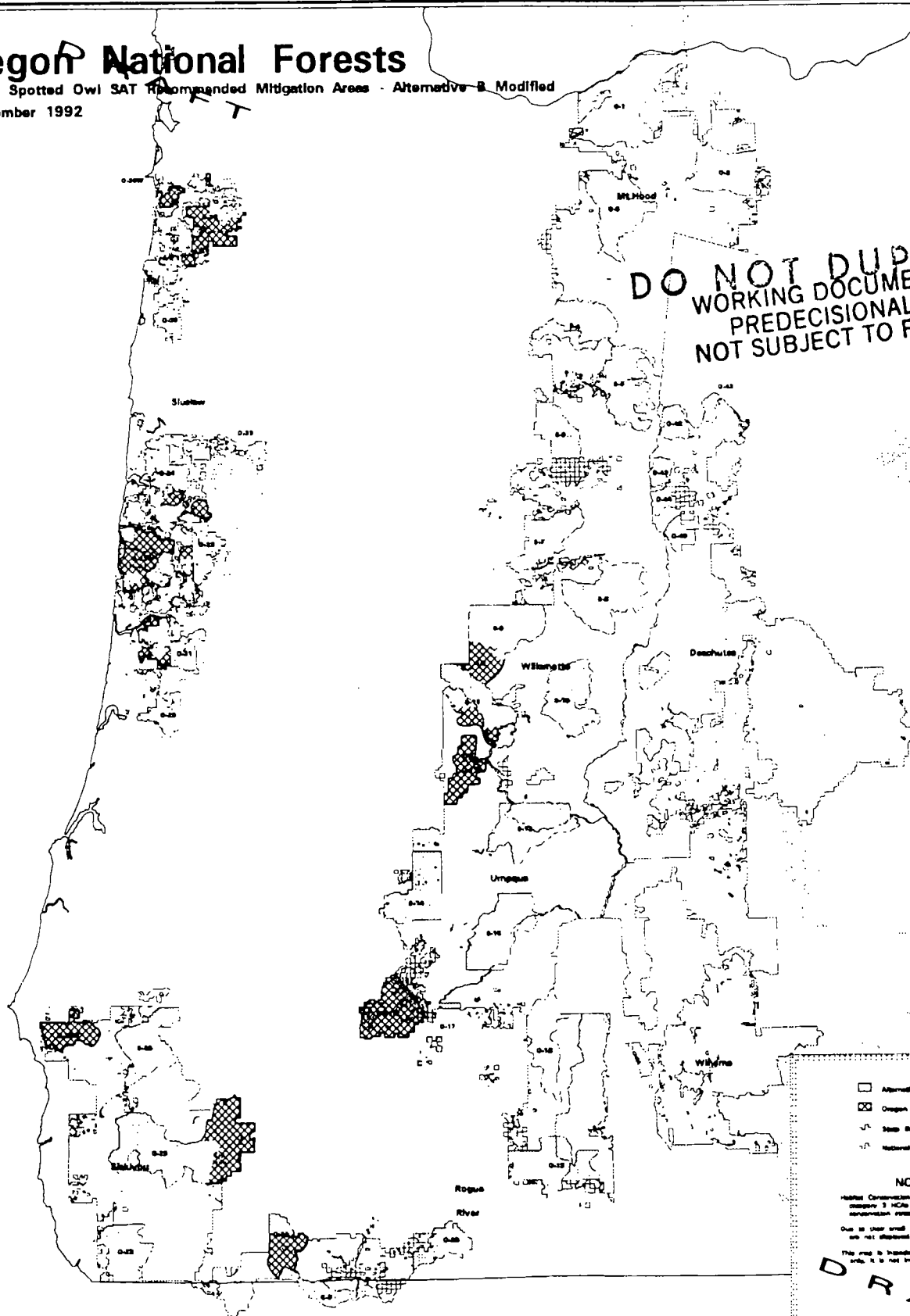
D. Dean Bibles
State Director

Enclosures: As stated

Oregon National Forests

Northern Spotted Owl SAT Recommended Mitigation Areas - Alternative B Modified
23 December 1992

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- ☐ Alternative B HCA
- ☒ Oregon HCA Additions
- ☐ State Boundary
- ☐ National Forest Boundary

NOTES

Hatched Contention Areas (HCA) include
category 1 HCAs not required as the ISC
contamination history map.
Due to their small scale, category 4 HCAs
are not shown.
This map is intended for display purposes
only. It is not intended for analysis.

DRAFT
Scale 1:700000



USDA FOREST SERVICE
Region 6, Seaside, Oregon

APPENDIX 4-C - RECOMMENDED OPTIONS FOR MITIGATION

The following is a description of the mitigation measures recommended to maintain a "HIGH" viability rating for the Northern spotted owl with BLM implementing their preferred alternative in draft resource management plans. We expect these mitigation measures to remain in effect until such time BLM either demonstrates habitat management results in 1) desired habitat structure and population goals at levels equal to or better than the ISC Strategy, or 2) efforts to reduce risk are made through the adaptive management strategy. Should BLM incrementally adjust its habitat management strategy, we expect the Forest Service to similarly reconsider our proposed mitigation measures on an incremental basis. Recommended mitigation measures are designed to compensate for the increased risk of loss of habitat and decrease of patch size in OGEAs, and ultimately increased risk of loss of owl pairs and pair clusters, by increasing the size and number of HCAs on National Forests.

Method

We recognize the addition of 56,000 acres in OGEAs under the BLM preferred alternative. This acreage compensates in part for deferral of meeting 50-11-40 Standards and patch cutting in a nondeferred OGEA coinciding with HCA 0-36. However, we recommend a total of 410,000 acres for addition to the ISC Strategy for spotted owl management within Forest Service HCAs. Our rationale for the addition to the HCA system is as follows: we identified a minimum of five critical areas of risk associated with managing spotted owl habitat through density control harvest.

1. Accurately describing the Desired Future Condition (DFC) of suitable spotted owl habitat.
2. Assuming DFC can be adequately described, are mechanisms (e.g. silvicultural prescriptions) available to attain the desired future conditions?
3. Assuming proper silvicultural prescriptions are written, can prescriptions be successfully implemented?
4. Assuming prescription are successfully implemented, will monitoring be adequate to ascertain if prescriptions succeed or fail in achieving the DFC over time?
5. If monitoring shows that DFC is not being met and adjustments are necessary, will options be foreclosed for an adaptive management strategy?

We assume that BLM will achieve an 80 percent success rate at each level of the implementation phase. Cumulatively, this will result in successful implementation of BLM's management strategy only 33 percent of the time over a total of 143,400 treated acres. Given this rate of success, BLM would not be expected to achieve desired results on approximately 96,100 acres. We assumed density control units to average 40 acres in size resulting in a total of 2402 such units being managed within 50 years. We calculated a potential edge effect from the units of 600 feet out from the unit edge. This results in a total of 145 acres affected per density control management unit, totaling about

348,300 acres within the next 50 years. Additionally, there will be 62,000 acres less suitable spotted owl habitat under PA than under Alternative D within the next ten years. Rounded, this totals 410,000 acres.

Results

We applied mitigation to HCAs within the three physiographic provinces, the Oregon Coast Range, Klamath, and Oregon Cascades West, most affected by BLM's preferred alternative. A summary of mitigation in each province follows.

The Oregon Coast Range Province was identified in the ISC as an Area of Special Concern. The density of spotted owls is one-eighth of that recorded in other coastal areas (Thomas et al. 1990:67). As stated previously, there is concern that BLM's management of dispersal habitat and OGEAs under the preferred alternative may not meet the needs of the spotted owl. The Oregon Coast Range may be subject to increased risk of demographic isolation by year 2030 due to higher large numbers of deficit quarter-townships on BLM ownership than under BLM Alternative D.

An additional 160,000 acres is recommended for the Oregon Coast Range Province to increase sizes of existing Category 1 HCAs (0-31, 0-32, 0-34, 0-35, and 0-36) and create a new HCA to reduce the likelihood of catastrophic events removing large blocks of suitable habitat. A single catastrophic event has a greater chance of eliminating an entire small designated area than a large designated area (Thomas et al. 1990). The total loss of habitat expected under the BLM preferred alternative, compared to BLM Alternative D, through density management and reductions in habitat blocks in the Salem and Eugene Districts is approximately 46,300 acres.

Within the Klamath Province, 135,000 additional acres are recommended for inclusions in HCAs. A new HCA west of 0-25 would be created along with an HCA combining 0-23 & 0-24, and 0-21 & C-5 along the common boundary between the Forest Service and the BLM. These areas were identified as critical links in the ISC for owl dispersal across province boundaries. We consider these additions important for increasing the likelihood of providing habitat for owls dispersing to the Oregon Coast Range and Oregon Cascades West provinces.

Within the Oregon Cascades West Province 115,000 acres are recommended for inclusions in HCAs, of which 57,000 acres on National Forest System lands will be added to HCA 0-16. Under the ISC Strategy this HCA is located entirely on BLM administered lands. Other additions include 40,000 acres to 0-12 and 18,000 acres to 0-11. These areas are considered critical links for dispersal of spotted owls across province boundaries. Previously discussed concerns of BLM management of OGEAs and dispersal habitat makes these HCA additions important for spacing needs of habitat blocks. These areas represent the best available habitat on National Forests within the critical link area that would contribute to the needs of the spotted owl.

Our proposed additions to these HCAs provide additional protection for pairs of owls and reduced distances between HCAs. An additional 87 pairs of owls are protected within HCAs. In addition, nearest neighbor distances between HCAs are reduced within all affected provinces as indicated in Table 4-C-1. Distance in miles.

Table 4-C-1. National Forest HCA Nearest Neighbor Analysis--Without Mitigation/With Mitigation by Physiographic Province (distance in miles).

<u>Physiographic Province</u>	<u>1st Neighbor</u>	Distance to:	
		<u>2nd Neighbor</u>	<u>3rd Neighbor</u>
Oregon Coast Range	8.2/2.8	19.6/7.3	25.4/18.1
Oregon Cascades	5.1/4.2	9.1/7.3	16.1/11.9
Klamath Mountains	4.2/4.0	7.8/6.8	12/8/12.3

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CHAPTER 5

NEW RESEARCH ON THE NORTHERN SPOTTED OWL

CHAPTER 5

NEW RESEARCH ON THE NORTHERN SPOTTED OWL

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CHAPTER 5
NEW RESEARCH ON THE NORTHERN SPOTTED OWL

A SUMMARY AND DISCUSSION RELATIVE TO MANAGEMENT PROPOSED IN
THE SELECTED ALTERNATIVE OF THE FEIS

Introduction

Since completion of the Interagency Scientific Committee's (ISC) Conservation Strategy in 1991, a variety of new information has been released relative to the biology of the northern spotted owl, including new information on the demographics of the owl (Anderson and Burnham 1992, Bart 1992), dispersal (Forsman et al., unpubl. data), and hybridization with the barred owl (Hammer et al. 1992). Some observers (e.g., Harrison 1992, Karieva 1992, Orians 1992) have suggested these findings indicate that the ISC Conservation Strategy, which is the selected alternative in the Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests (FEIS) (USDA Forest Service 1991), is not adequate to protect viable, well distributed northern spotted owl populations. This chapter contains summaries of new information released since January 1992, including updated information for most of the studies described by Anderson and Burnham (1992). Implications of the new information are discussed relative to the selected alternative in the FEIS. Information on location, size, and types of demographic studies that are being conducted on the spotted owl is provided in Appendix 5-A. An annotated list of reports and publications released since January 1992 is provided in Appendix 5-B.

Demographic Analyses of Population Trends

Between 1985 and 1987, researchers began five long-term banding studies of spotted owls in Washington, Oregon, and northwestern California. These studies were designed to investigate demographic parameters of spotted owls, including age-specific birth and death rates and population trends. In September 1991, a group of researchers convened at Fort Collins Colorado to conduct an analysis of the banding data from the five demographic studies. The Fort Collins workshop was led by Drs. David Anderson and Ken Burnham of the Colorado Cooperative Fish and Wildlife Research Unit, and by two visiting French scientists Dr. John Dominique Lebreton and Rodger Pradel.

Methods used to analyze the data at Fort Collins were based on Jolly-Seber open population models (Pollock et al. 1990) which provide estimates of age, sex, and time-specific survival rates based on the capture histories of samples of marked animals. In this case, the marking technique consisted of placing color bands on the legs of owls. A "capture history" is simply a row of zeros or ones, representing the year-by-year capture history for an individual. A 1 means the animal was seen during a particular year, and a 0 means it was not seen. By examining multiple years of data, Jolly-Seber models estimate a recapture probability (the probability that a marked individual will be observed or recaptured in a given year, given that it is still alive). The recapture probability is then used to calculate an adjusted survival estimate, based on the number of individuals actually reobserved each year. Estimates of survival rates and reproductive rates are then used to calculate the population growth rate, which is referred to as "Lambda" or " λ ." In a stable population, Lambda

is equal to 1. In a population that is declining or increasing, Lambda is less than or greater than 1, respectively.

The Fort Collins workshop included an analysis of each individual study area as well as a meta-analysis in which data from all five areas were examined together to determine if there were any overall trends in the data. The latter analysis was conducted by Drs. John Dominique Lebreton, David Anderson, Ken Burnham, and Rodger Pradel. A synopsis of the Fort Collins workshop was written by Drs. Anderson and Burnham and provided to the U.S. Fish and Wildlife Service Northern Spotted Owl Recovery Team in November 1991 for inclusion in their Draft Recovery Plan for the Northern Spotted Owl. The version of the report that appeared in the April 1992 Draft Recovery Plan is hereafter cited as Anderson and Burnham (1992). A copy the report is provided in Appendix 5-C.

The analysis at Fort Collins indicated that population growth rates on all five study areas were significantly less than 1, suggesting that all five populations were declining. Estimated rates of decline on the individual study areas ranged from 6 to 16 percent per year, with an overall average of approximately 10 percent (Anderson and Burnham 1992:Table C.4.). Minor corrections in the data on two study areas were made after the Fort Collins workshop (E. Forsman pers. comm.), but did not result in significant changes to the findings that were made at Fort Collins. Both the Anderson and Burnham report and the results of the Fort Collins workshop were presented at the Annual Meeting of the Cooper Ornithological Society in Seattle Washington on June 23, 1992.

The meta-analysis conducted at the Fort Collins workshop indicated that not only were populations declining on the individual study areas, but that female survival rates were declining over time. This was probably the most troubling finding of the Fort Collins workshop because theory would predict that a population that has passed some sort of demographic threshold might begin to decline at an accelerated rate either as a result of declining survival rates or declining reproductive rates. Some ecologists and population experts were quick to pick up on this, suggesting that the northern spotted owl population had already passed such a threshold, beyond which it would be difficult to recover (Orians 1992, Kareiva 1992, Harrison 1992). Anderson and Burnham (1992:328) were somewhat more conservative in their assessment, concluding only that "...the rate of population decline has probably accelerated." Based on their meta-analysis, Anderson and Burnham (1992) estimated that the average rate of population decline was 7.5 percent per year from 1985 through 1991.

Since the Fort Collins results were released there has been considerable discussion within the scientific community relative to possible biases in the banding data that might cause the population growth rate to be underestimated. These potential biases were discussed at length at the Fort Collins workshop and in the Anderson and Burnham report, and have since been discussed at several different scientific meetings and in unpublished manuscripts (Bart 1992, Franklin 1992, Forsman 1992a,b).

The main concern relative to the banding data is that emigration of juveniles and adults may cause the models to underestimate survival rates. In a Jolly-Seber analysis, undetected emigrants are considered to be dead, when in fact, some of them may still be alive. To the extent that birds emigrate, survive, and go undetected, Jolly-Seber models will overestimate recapture rates and underestimate survival. It is known that undetected emigration of juveniles

occurs, based on results of radio-telemetry studies (see Dispersal Studies), and there is evidence that bias caused by such movements may be greater in some study areas than in others. For example, on the Olympic Peninsula the banding study area surrounds the Olympic National Park, and is itself surrounded by extensive private holdings. If juvenile owls disperse into the park or onto adjacent private lands, there is a high likelihood that they will go undetected. By comparison, on study areas like the Roseburg BLM study area, which is surrounded on three sides by other demographic study areas, bias caused by emigration out of the study area may be considerably less.

Although there is less evidence to indicate significant emigration by adult owls, this is a matter of concern in population analyses because estimates of population trends are particularly sensitive to adult survival rates (Noon and Biles 1990). Even a small bias in estimates of adult survival can have a considerable effect on estimates of population growth. Telemetry studies of adult spotted owls have indicated little emigration of adult owls (Thomas et al. 1990:237), but there are exceptions. For example, Meslow et al. (1989) noted two radio-marked females that emigrated from the H.J. Andrews study area. If anything, emigration of adult owls will lead to an underestimate of adult survival rates.

The reproductive parameter used to estimate age-specific birth rates at the Fort Collins workshop was fecundity, defined as the number of female young produced per year, per female owl. Fecundity was determined by counting the number of young leaving nests, and dividing by two (a 50:50 sex ratio was assumed). Females that did not nest or that nested and failed were assigned a fecundity value of 0. Adult and subadult fecundity estimates among the five study areas in the Anderson and Burnham report were remarkably similar, ranging from 0.327 to 0.358 for adults and 0.094 to 0.229 for subadults (Anderson and Burnham 1992:Table C.3.). The Scientific Analysis Team believes these estimates are reasonably accurate, although several sources of counteracting bias are possible. For example, breeding pairs may be more detectable than non-breeding pairs. If breeding pairs are over-represented in the sample, this would cause an overestimate of fecundity. The team believes this source of bias was slight because a concerted effort was made each year to verify the status of all females, regardless of their breeding status.

Another potential bias in fecundity was that broods were rarely located immediately upon leaving the nest. If some mortality occurred after the young left the nest, but before broods were observed, this would cause an underestimate of fecundity. Again, because researchers made a concerted effort to locate broods as soon as possible after the young left the nest, the Scientific Analysis Team believes bias from post-fledging mortality was minor. A third potential source of bias in fecundity estimates was that many individuals within the floating population of non-territorial birds were not detected. As a result, these non-breeding, non-paired birds are undoubtedly under-represented in the sample used to estimate fecundity. This would lead to an overestimate of fecundity, relative to the entire population of owls. Thus, estimates of fecundity used in the studies examined at the Fort Collins workshop really apply only to the territorial population.

Still another reason that we believe caution is warranted relative to the results of the Fort Collins analysis, is that all of the current demographic studies have been conducted over relatively short periods of time, (3 to 8

years). In our opinion, this is insufficient time to clearly establish population trends, even if there were no biases in the data.

Dispersal Studies

A radio-marking study of juvenile spotted owls was initiated on three study areas within the range of the northern spotted owl in 1991 (E. Forsman, unpublished data). Based on the first year of study, it appeared that 22 to 45 percent of juveniles that survived the first year of life left the study areas and would not have been detected had they not been wearing radio transmitters (Table 5-1). It is probable that some of these undetected individuals will be detected by conventional calling and banding techniques as they move around and acquire territories in future years, thus reducing the amount of undetected emigration. Nevertheless, the relatively high rates of first-year emigration from the demographic study areas do suggest that undetected emigration is causing a negative bias in juvenile survival estimates from banding data. Areas that adjoin Wilderness and National Parks (e.g., the Olympic Peninsula study area) appear to be most influenced by undetected emigration (Table 5-1).

Survival estimates based on the radio-marked samples of juveniles were considerably higher than the average values estimated from banding studies (compare Table 5-2 with values reported in Anderson and Burnham 1992:Table C.2.). Comparatively high survival of the radio-marked cohorts may reflect the reduction of bias caused by emigration, but could also be the result of a particularly mild fall, winter and spring in 1991-1992. It should also be noted that transmitters were not placed on juvenile owls until July or August. Thus, survival estimates are based on the period from July-August of the first summer to July-August of the second summer, and did not include the first 1 to 2 months that young owls spent out of the nest. Forsman et al. (1984) and Miller (1989) reported relatively high mortality rates for juvenile owls during the first several months of life. Thus, it is possible that estimates based on radio-telemetry results are biased high because they do not include the period of particularly high mortality that immediately follows fledging. It should be noted that this bias also affects estimates from banding studies, since many juveniles are not banded until July or August. Because of the above uncertainties, we believe it will take several more years of study before more definitive statements can be made about survival rates of radio-marked juvenile owls.

A recent simulation analysis by Bart (1992) suggests that the combined influence of biases in measurement of fecundity, emigration and senescence may cause Lambda to be considerably underestimated. This assessment was based on a model in which the amount of undetected emigration was estimated based on study area size and shape, and dispersal distances of spotted owls. The factors that caused the most bias in this model were juvenile and adult emigration. Bias due to overestimates of fecundity was relatively insignificant. While it would be a mistake to assume that the parameter estimates used as input to the simulation model were entirely accurate, the results do suggest the possibility of considerable bias in the data. Such possibility begs testing through continued field studies.

Update of Demographic Estimates on Study Areas Examined by Anderson and Burnham (1992).

Since 1991, another year of data has been collected on the five study areas examined by Anderson and Burnham (1992). The SAT contacted researchers on all five areas to see if they could update their individual area trend estimates with 1992 data. Researchers on four of the five areas provided updated estimates of survival and fecundity. In addition, the team requested that researchers on other study areas provide estimates of fecundity for their areas, which could be used to examine differences among areas.

On the four areas that were examined in Anderson and Burnham (1992), and which provided updated survival estimates, adding one more year of data resulted in some relatively minor changes in average survival rates and fecundity (compare estimates in Tables 5-3 and 5-4 with Tables C.2. and C.3. in Anderson and Burnham). In two areas, survival rates of adult females increased slightly, in one area they decreased slightly, and in one area they were unchanged.

In 1992, reproduction by spotted owls was particularly high on most areas within the range of the northern spotted owl. As a result, average fecundity increased slightly on all five study areas that were included in the Anderson and Burnham report (Table 5-4). Because population growth rate calculations are relatively insensitive to fecundity, however, we anticipate that this will have only a very slight positive effect on population growth estimates. It should be noted that fecundity estimates from some areas are considerably higher than estimates from the study areas examined in the Anderson and Burnham Report (1992). The most notable differences were for studies on the east slope of the Cascades where fecundity averaged nearly twice the average reported in the Anderson and Burnham Report (compare values for Wenatchee studies in Table 5-4, with values in Anderson and Burnham 1992:Table C.3.). The team cannot account for these differences except to hypothesize that weather conditions and prey populations may be more conducive to nesting sites on the east slope of the Cascades, at least during those years studied. It should also be noted that fecundity is relatively high for owls occupying predominantly young forests and mixed-age forests on private lands in northwestern California (Simpson and LP-Calif study areas in Table 5-4). By comparison, owls occupying predominantly young and mid-aged forests in western Oregon had relatively low fecundity (Siuslaw and Eugene BLM-east study areas in Table 5-4).

The SAT examined general trends in fecundity on 15 different study areas (Table 5-5). Fecundity varied considerably among years on some study areas, while remaining fairly stable on others (Table 5-5). None of the areas exhibited consistent increases or decreases in fecundity over time. Although quantitative information is lacking, it is suspected that annual variation in fecundity is strongly influenced by variations in food supply and weather conditions.

We anticipate that new estimates of population growth rates will be calculated from the 1992 data during winter or spring 1993 as researchers complete their analyses. Because our update of demographic rates on four of the five individual study areas indicates little change from the original Anderson and Burnham analysis, the SAT does not anticipate that the outcome of the new analysis will differ appreciably from the 1992 analysis. The team stresses that the reanalysis of the 1992 data on four study areas is preliminary, and that further analysis may result in small changes in the parameter estimates. However, the team does not anticipate that parameter estimates from the individual study areas will change appreciably with further analysis.

Density Studies of Spotted Owls

An alternative method of evaluating population trends is to examine actual changes in population density over time. A number of demographic studies of spotted owls have included "density study areas" (DSAs) in which researchers have attempted to locate and band all owls that are present each year. This requires a complete search of the study area, with repeated surveys to insure that owls are not overlooked. Some studies have used a minimum of three complete surveys, while others have used a minimum of six complete surveys. Differences in survey effort may bias comparisons among study areas, but as long as the effort is consistent within individual areas, trend counts should reflect actual changes that are occurring. The objective of the owl counts in DSAs is to monitor population trends over time. Trends can be analyzed in terms of total numbers of owls, numbers of pairs and single owls, numbers of females, etc. In the following summary, the team focuses on the total number of adult and subadult owls detected in each density study area by year. We refer to this estimate as the "crude density" of owls.

The SAT summarized density estimates for 12 density study areas (Table 5-6). An analysis of these data by Franklin and Ward (1992) indicated that of the 10 areas with three or more years of data, only two areas near Medford Oregon appeared to be undergoing significant declines. Crude densities were essentially stable on seven areas, and increasing on one area. Although this analysis was based on relatively short time periods, we concluded there was no evidence of significant changes in crude density on most of the density study areas during the study period.

There are several factors that can bias estimates of trend data based on changes in density. Spotted owls are long lived, site specific animals that may concentrate in the remaining habitat within an area (as the amount of habitat declines), maintaining short-term densities that are not sustainable in the long term. This phenomenon is referred to as "packing". Thus, densities within a DSA could remain artificially high for some time, as the amount of habitat declined, then eventually reach equilibrium at or near the carrying capacity of the area. Thus, trend data from studies with durations less than about one average owl lifespan (about 10 years) should be viewed with considerable skepticism. It should be noted that of the studies the team examined, none has been conducted for more than 8 years (Table 5-6).

Another concern with density studies is how well they represent the population at large. If a DSA does not include habitats and landscapes typical of surrounding areas, it may not be a good indicator of what is happening to the population at large. If a DSA is not within a Habitat Conservation Area (HCA) for example, it may be managed differently than the HCA, and may, therefore, not represent what is happening in the HCA. The DSAs included in this review were all selected because they are fairly typical of forested areas within the landscapes in which they are embedded. However, none of them were laid out to conform to exact HCA boundaries. Thus, most density study areas include some areas within HCAs and some areas outside HCAs. At present, data summaries for DSAs have not been subdivided for areas inside and outside HCAs, so the team can only provide estimates for DSAs as a whole. The SAT does not consider this a serious problem, because at this point, the ISC Conservation Strategy has been

in effect for such a short period of time that treatments inside and outside HCAs have not diverged appreciably.

Another possible bias with density studies of spotted owls is that observers become more efficient at locating owls as they become more familiar with their study areas and learn more about the distribution of resident pairs. This could at least partially explain the gradually increasing numbers of owls observed in some studies.

An additional problem with density studies is that very small changes in population size (e.g., 1 to 2 percent per year) will be difficult to detect until many years of data have been collected. In short-term studies, variation due to demographic variability, observer effort, and other factors can mask gradual changes in population size. Thus, in a gradually declining population it is highly unlikely that a short-term density study will produce a clear picture of long-term trends in the population. However, if populations are declining at the relatively dramatic rates suggested by the Anderson and Burnham analysis (6 to 16 percent per year), it should take only a few years of study before densities begin to change significantly. The fact that most of the DSAs have not begun to exhibit significant changes in owl density, leads the SAT to be cautious about accepting the Fort Collins estimates of population growth rates.

Rates of Habitat Loss

Although it is commonly assumed that spotted owl populations are declining as a result of habitat loss, exact correlations between rates of habitat loss and rates of population decline are poorly understood. To compare rates of habitat loss with rates of population change on the five demographic study areas described by Anderson and Burnham (1992), the team used two methods. In the first approach, the team compiled Forest Service and BLM records of the amount of owl habitat harvested each year within density study areas. We also examined habitat loss within a buffer area around three of the density study areas to determine if harvest rates inside and outside the DSA were similar. In cases where there were multiple density study areas in the same vicinity (e.g., Medford Study), we examined the density study areas and their corresponding buffer areas as one combined unit. To estimate the amount of habitat present at the beginning of the study period, we estimated the area currently covered by owl habitat, and then added the number of acres harvested during the course of the study period. Average annual rates of habitat removal were estimated by dividing the number of acres harvested during the study period by the calculated amount of habitat present at the beginning of the study period, and then dividing the result by the number of years in the study period. Rates of habitat loss were particularly difficult to compute on BLM study areas because of lack of harvest information from private lands, which comprised approximately half of the landscape. For the sake of analysis we assumed that private landowners cut the same proportion of their lands each year as did the BLM. An additional confounding factor in assessing rates of habitat loss on BLM lands was that considerable harvest involved removal of selected trees rather than clearcutting, which made it very difficult to determine if a stand should still be considered owl habitat after logging had occurred. We relied on the opinion of local biologists about whether or not such stands should be considered owl habitat. Although these estimates are admittedly crude, the team believe that they are not unreasonable.

The team's second method of analysis was to use Landsat imagery to examine rates of habitat loss on three of the five study areas from 1977 to 1988. Landsat MSS data was used for the 1977 time period while Landsat TM imagery was used for the 1988 time period. All image processing was conducted using ERDAS (ERDAS, Inc., Atlanta, GA). The MSS sensor had a nominal resolution of 79x56 meters while the TM imagery had a resolution of 30x30 meters. The MSS data was rectified to the TM imagery and both data sets were resampled to 50x50 meter resolution. Initially, an unsupervised classification approach (ISODATA clustering) was used that grouped spectral reflectance values into 20 classes. These spectral classes were identified using digital stand information from the BLM (Forest Operations Inventory data), digital habitat data from air photo interpretations, and visual inspection. Spectral signature files were created by lumping the 20 spectral classes into four information classes: non-forest, open canopy young forest, closed canopy young forest, and closed canopy mature/old forest. A fifth class (water) was added where large rivers, lakes, or ponds occurred in the imagery. The spectral signature files were used as input to a maximum likelihood classification algorithm which classified all pixels in the imagery into one of the five above classes. Infrared wavelength bands were included in the classification to improve discrimination between vegetated and non-vegetated areas. Classified files were subsetting ('clipped') to the boundaries of the density study area and to the boundary of a buffer area around each density study area. The width of buffer areas was set equal to the average range width of the spotted owl in each area.

The analysis of harvest records indicated that owl habitat was declining at 0.9 to 1.5 percent per year on Forest Service study areas and 1.3 to 3.1 percent per year on BLM study areas (Table 5-7). This assumed that rates of harvest were about equal on private and Federal lands. Analysis of rates of habitat loss using Landsat data indicated rates of habitat loss between 1.1 percent and 5.4 percent per year (Table 5-8). Rates of loss within DSAs and surrounding buffer areas were relatively similar for both harvest-based and Landsat analyses except on the Roseburg study area, which had a much higher level of habitat loss in the buffer area than in the DSA.

The two methods used to examine rates of habitat loss are not directly comparable because they measure different things and are subject to different types of bias. For example, the Landsat analysis examined all ownerships within the study areas, whereas the harvest analysis focused on Federal lands in most cases. The harvest analysis was also influenced by the initial estimate of the amount of habitat currently present. Although the team believes that the Landsat analysis was a reasonable first attempt to examine rates of habitat loss, the team also feel the need to make several qualifying statements about the data. These are: (1) the effects of deeply shadowed areas were not specifically addressed and may cause an over estimation of the older age classes in areas of high relief, such as the Olympics and the H.J. Andrews Experimental Forest, (2) classification was based primarily on unsupervised clustering of spectral values; therefore, some classification error must be expected in classifying different seral stages with similar spectral responses, (3) even though digital habitat information was used to guide the classifications, the results have not been subjected to a detailed accuracy assessment and some error in classification must be expected, and (4) the wavelength characteristics of each band differ between sensors; therefore, differences in reflectance from objects on the ground may influence between year classification comparison.

Despite these qualifications, the above analyses indicate that rates of habitat loss are considerably lower than rates of population decline based on banding studies (Anderson and Burnham 1992). Conversely, rates of habitat loss on most study areas were greater than rates of population decline based on empirical observations of changes in owl numbers (Franklin and Ward 1992). The one exception was the Medford area where the rate of decline based on changes in owl numbers (4.7 percent) and rates of decline based on Landsat analyses (5.42 percent in DSAs and 4.78 percent in buffer areas) were similar.

Based on the above analyses it is apparent that demographic studies and density studies indicate different relationships between habitat loss and population response. One method (demographic studies) suggests populations declining faster than the rate of habitat loss. The other method (population density studies) indicates populations that are either stable or declining at about the same rate as habitat loss. The highest rate of habitat loss was on BLM's Medford District, which is also the area in which owl populations appear to be declining most rapidly.

Population Thresholds

Population models described in the ISC Report (Thomas et al. 1990) indicated that two distinct population thresholds occur, either of which can lead to the eventual extinction of a species. One of these thresholds occurs as a result of habitat loss. If the amount of habitat is reduced to an excessively small fraction of the landscape, then (1) it becomes difficult for owls to find suitable territories, and (2) the resulting small populations are subject to random demographic and environmental effects. Both of these factors cause the overall population to show precipitous declines. The other threshold occurs as a result of the Allee effect: if population numbers fall below a certain level, it becomes so difficult to find a mate that reproductive rates fall below the level needed to maintain a stable population. The ISC emphasized that, although the models indicated the presence of thresholds, knowledge was inadequate to "accurately predict the population size, suitable habitat, or amount of habitat fragmentation thresholds that, once crossed, would lead to a population crash" (Thomas et al. 1990:253). In the team's opinion this situation has not changed. The SAT still does not know at exactly what point these thresholds occur. In all likelihood we will never know the exact locus of such thresholds because they are moving targets that change over time and location with a changing environment.

After the release of the Anderson and Burnham report (1992), some observers (e.g., Orians 1992, Kareiva 1992, Harrison 1992) suggested that the declining female survival rates reported by Anderson and Burnham were indicative of a population that had dropped below a demographic threshold. Aside from the fact that these observers were unfamiliar with the data and with the possible biases in the data, they also chose to ignore one of the key cautions found on page 249 of the ISC Report where the authors pointed out that, "assessing population trends from data collected during periods of declining carrying capacity (for example, the harvest of suitable owl habitat) may be very difficult because of the difficulty of distinguishing a collapsing population ... from one that eventually reaches a long-term stable equilibrium..." Thus, it is important to realize that just because a population experiences a significant decline or because survival rates temporarily decline, it does not necessarily follow that

the population cannot recover to a dynamic equilibrium at some lower equilibrium. It was under the assumption of recovery to a new, lower equilibrium population size that the ISC proposed its Conservation Strategy. If adult survival shows a slow decline for some time during the period of transition, this does not necessarily mean that the population will continue to decline to extinction.

Other data that may provide insights relative to whether the spotted owl population has gone beyond some demographic threshold are estimates of fecundity and density. We have already discussed the absence of significant changes in density on most density study areas. It could be predicted that if the Allee effect was causing a population to fall below a threshold, a reduction in fecundity would be observed because females would have a lower probability of finding mates. The team examined estimates of fecundity for a number of study areas and could not determine any consistent downward trends in fecundity for adult females (Table 5-5). While this does not prove that the population is above some demographic threshold, it certainly does not support the notion that the population has declined to a level at which the Allee effect is seriously effecting fecundity rates.

Our conclusion relative to the issue of thresholds is that it is not at all clear from the available data that the spotted owl population has fallen below either of the thresholds predicted by the ISC models. In fact, given the size of the population and the amount of habitat that still exists, we believe it is highly unlikely that those thresholds have been passed, except possibly in some very isolated and very heavily cutover portions of the owl's range such as the northern half of the Oregon Coast Ranges where there are almost no Federal lands. Furthermore, the team does not believe it is credible to draw only upon the results of the Anderson and Burnham report (1992) as evidence that thresholds have been exceeded, when there are equally persuasive data that may indicate contradictory conclusions (e.g., data from density study areas). Scientific analyses by nature draw upon all sources of information, weigh each, and reach conclusions based on the evidence. That being said, the team does feel that the Anderson and Burnham report serves a very useful purpose in that it has focused attention on the need to closely examine current methods of estimating demographic parameters of spotted owls, caused investigators to consider alternative methods of assessing population trends, and has focused attention on the need to maintain multiple, long-term demographic studies to assess population trends.

Population Viability Models and Assessing the Transition Period

Alternatives in the FEIS were ranked using seven biological criteria (Chapter 3). Subsequently, the Forest Service was criticized for not using more quantitative, spatially explicit models to rank alternatives (Kareiva 1992, Doak 1992). Whereas the SAT agrees that the use of quantitative, spatially explicit models to examine alternatives is a good idea, there are several reasons why the Forest Service has not done so to date. First, at the time the FEIS was written, the only spatially explicit owl/habitat model was still in development and not fully tested. Second, and more importantly, the use of a spatially explicit model requires detailed maps of present and future proposed habitat and proposed harvest areas. Although areas of old-growth and mature forest have been mapped, maps of most other age classes are incomplete or lacking, making it difficult to use spatially explicit models to evaluate the distribution of

dispersal habitat and many other forest types that are used for foraging by spotted owls. Thus, use of a spatially explicit model at this time would involve many assumptions about the amount and distribution of habitat and harvest areas that are unsubstantiated by data. In addition, lack of maps of spatially explicit forest age classes, locations of present and future forest management activities, and forest age-class specific vegetation growth and change models make it impossible to project future habitat conditions.

Since the release of the FEIS, a model designed by McKelvey et al. (1991) has been considerably refined, and has been adopted by the BLM as a tool for ranking the alternatives in their draft resource management plans. Given that such a model is available, and that several others are in development, the team believes that the Forest Service should begin as soon as possible to develop (1) spatially explicit maps of forest age classes and harvest alternatives, and (2) vegetation change and growth models that can be used to assess alternatives for the owl and other species. While the team does not believe that the results of these modeling efforts can or should overshadow good biological judgement on the part of biologists and land managers, the use of spatially explicit models will undoubtedly provide additional insights into biological processes and will allow the Forest Service to better identify areas that are particularly at risk.

A key point not addressed in the FEIS was the transition period during which habitat in the HCAs recovers from the present condition to the condition that is the desired target. It was simply assumed in the FEIS that because of the redundancy of protective measures built into the selected alternative, as well as the relatively large size of the existing population, owls would persist in adequate numbers during the transition period to eventually reach the desired long-term equilibrium level. While population viability models such as the McKelvey Model (McKelvey et al. 1991) indicate that the transition period is a risky period in terms of population persistence, the SAT believes it is unlikely that spotted owls will reach population levels during the transition period from which they cannot recover provided that the BLM adopts a management plan that is equal to or better than the plan proposed by the ISC (Thomas et al. 1990) or that the Forest Service adopts measures to mitigate for lack of BLM compliance with ISC (see Chapter 4). The team considers this to be the case because: (1) surveys of HCAs in 1991 and 1992 indicate that most Category 1 and 2 HCAs currently contain numbers of owls close to the long-term equilibrium targets specified in the ISC Strategy; and (2) changes in owl density within density study areas do not indicate rapidly declining populations. Even if there are problems with inadequate dispersal habitat between some HCAs during the transition period, the SAT thinks it unlikely that any but the most isolated and understocked HCAs might run the risk of population extirpation. Even that risk is mitigated by the additional protection measures proposed by ISC for Areas of Special Concern.

Hybridization With the Barred Owl

Since 1989, hybrid crosses between barred owls and spotted owls have been confirmed at four widely separated locations within the range of the northern spotted owl (Hamer et al. 1992). The four cases included two male hybrids that were found paired with female barred owls, one female hybrid that was found paired with a male spotted owl, and one case in which a 1-year-old spotted owl paired with a female barred owl and produced a hybrid offspring. In all cases, the adult hybrids that were observed were believed to be first generation (F1) crosses. One of the hybrid males that was paired with a female barred owl produced young in at least two separate years, thus demonstrating that first generation hybrid males, at least, are capable of back-crossing. First generation hybrids are characterized by very distinctive plumage and vocalizations, which include attributes of both of the parent species. These observations have been described in a draft manuscript by Hamer et al. (1992) who concluded that the Mayr and Short (1970) classification of the spotted owl and barred owl as a superspecies (two species that only recently diverged from the same parental stock) is probably correct.

Although records of hybridization between barred owls and spotted owls are an interesting biological phenomenon, we do not know what the ultimate outcome will be. Hybridization is common in nature, having been recorded in about 10 percent of the non-marine birds in North America (Mayr and Short 1970) and between two other species of Strix in Europe (Scherzinger 1983). In most species where it occurs it tends to be an uncommon event, and thus has little effect on the parental species - they still continue as distinct species for very long periods of time.

For every case in which hybridization is confirmed, there are undoubtedly other cases that go undetected. Nevertheless, we suspect that hybridization between spotted and barred owls is rare for the following reason. During the last 15 years, hundreds of observers have been surveying and banding spotted owls and have confirmed several thousand pairs of spotted owls and hundreds of pairs of barred owls. Despite that effort, only four F1 hybrids have been observed. This suggests that the behavioral isolating mechanisms that normally keep the two species from hybridizing are relatively effective. Nevertheless, the barred owl is rapidly invading the range of the spotted owl and the incidence of hybridization could possibly increase as the numbers of barred owls increase. We do not know what the outcome will be. One observer (Vincent 1990:42) has taken a pessimistic view and concluded that the "...prognosis is poor for the spotted owl to maintain an undiluted gene pool."

Even in the absence of interbreeding, the barred owl may represent a serious threat to the spotted owl from the standpoint of competition or displacement. Even that is highly uncertain, as discussed by Hamer et al. (1989) and Vincent (1990). At this point, barred owls are relatively uncommon in most upland areas in Washington, Oregon and California, and it remains to be seen whether they will eventually become common enough to displace significant numbers of spotted owls.

At this point, we believe there is little the Forest Service or other forest management agencies can or should do to influence the eventual outcome of the barred owl invasion. It is not at all clear that the invasion is the result of

forest management practices. It is equally unclear whether a change in management practices (e.g., saving all the old-growth forests or stopping all timber harvest) will have any effect on the rate or extent of the invasion. In light of this uncertainty, we believe that the most reasonable course of action is to continue to manage habitat for a reasonably large population of spotted owls, widely dispersed within the historical range of the species (as proposed by the ISC and by the selected alternative in the FEIS).

Owl Numbers and Distribution

Since the release of the FEIS, additional surveys of owls have been completed. This information has been summarized by state agencies and by the U.S. Fish and Wildlife Service Recovery Team (Table 5-9). In British Columbia, Dunbar et al. (1992) described results of surveys of spotted owls and barred owls in British Columbia from 1985 to 1988. During those surveys, which covered a large portion of the historical range of the northern spotted owl in British Columbia, spotted owls were found at only six locations, including pairs at two sites and single owls at four sites. The authors concluded that the spotted owl was rare in British Columbia, with an estimated population of less than 100 pairs. They also hypothesized that the population had probably declined as a result of habitat loss and displacement by barred owls. Since 1988, additional surveys have been conducted in British Columbia and the total number of sites where spotted owls have been located has increased to 14 pairs and 12 single individuals (Blackburn, I.R., and A.A. Bryant 1991, Dunbar pers. comm. September 1992). Based on this information, we conclude that the population of spotted owls in British Columbia is very small, and will contribute little to the recovery of the species in the United States. Numbers of owl pairs located in Washington, Oregon and northwest California during surveys conducted from 1987 to 1992 are summarized in Table 5-9. These data were summarized from personal communications with persons responsible for maintaining State Department of Wildlife data bases in the three states, and with Fred Seavey of the U.S. Fish and Wildlife Service Spotted Owl Recovery Team. The total number of owls reported in the three-state area included 3,591 pairs, and approximately 1,000 sites where single owls were observed but status was not confirmed. These counts should not be considered a minimum population estimate because 1) not all landowners and agencies reported their annual summaries of 1992 data in time to be included in the population estimate, and 2) the count included only owls located since 1987-88, and undoubtedly did not include some pairs that were still occupying sites not visited since 1986-87.

The above owl counts are near the upper limit of the population estimate provided by the ISC (3,000 to 4,000 pairs). Because there are still areas that have not been searched for owls, the SAT now believes that the current population size is larger than estimated by the ISC. Extensive areas of Forest Service and BLM lands have been searched for owls during the last 10 years, but, on some National Forests, private lands, and National Parks there are still considerable areas that have not been searched for owls.

Two important points should be made here. First, the increase in the number of confirmed owl pairs should not be interpreted as evidence of a population increase. Data from the density study areas and the demographic studies do not support such an interpretation. The obvious explanation for the increase in the number of confirmed owls is that survey effort has greatly increased during the last 10 years, including (1) a greatly expanded effort to inventory owls in

HCA's, and (2) the initiation of numerous demographic studies across the range of the owl. Given the dramatic increase in survey effort since 1985, we are not surprised that more owls are being located as new areas are being searched.

The second important point to emphasize is that the total number of owls that exist under current conditions is not particularly relevant; what is important is the total number of owls projected to occur when the management plan is fully implemented. The Conservation Strategy proposed by the ISC assumed that most pairs of owls outside HCA's would eventually disappear as habitat was removed, eventually resulting in an estimated future population of about 2,200 pairs of northern spotted owls in HCA's. This estimated number will not likely change, regardless of the size of the current population. What does change as a result of the larger current population size is that the team can be more confident that the population will survive through the short-term transition period during which the plan is implemented.

SUMMARY

The fact that most density studies, where there are actual field observations of spotted owl pairs, do not indicate significantly declining populations leads to doubt that populations are declining at the rates estimated from demographic studies. For that reason, we are very cautious about accepting the initial analyses from the five demographic studies analyzed at the Fort Collins workshop at face value. If rates of decline were as precipitous as indicated for some of the study areas, then we would expect to observe a fairly rapid population decline in the field, unless there was a large scale net immigration from areas outside the study areas. We find the idea of a large scale net immigration difficult to believe, because we have not observed better vegetative or habitat conditions in areas outside most demographic study areas than those inside the study areas. Some of the demographic study areas (e.g., Roseburg and Medford) are so large that they encompass the majority of lands managed by the BLM in western Oregon, as well as large areas of interspersed private lands. To the SAT, it seems highly unlikely that demographic performance of owls within those study areas should be significantly different than for owls outside those areas. It could be argued that populations on private lands and those managed by the BLM are being sustained by healthier populations on adjacent lands managed by the Forest Service. That seems unlikely, however, in light of the fact that the Fort Collins analysis indicated that populations in study areas on lands managed by the Forest Service (H.J. Andrews and Olympic Peninsula) are also declining.

The ISC (Thomas et al. 1990:64) assumed that the rate of decline in northern spotted owl populations in the Pacific Northwest was roughly commensurate with the rate of habitat loss (1 to 2 percent per year). This is less than the average rate of decline indicated by demographic studies (Anderson and Burnham 1992) and more than the average rates of decline indicated by most density studies (Franklin and Ward 1992). Because of the uncertainty relative to the various estimates, we believe it is reasonable to proceed with the management approach of the ISC Conservation Strategy. The SAT does not find reason to propose more restrictive measures for protecting owls; the data simply do not support the need for such measures. Further, the team does not believe there is evidence to warrant modifications to the Conservation Strategy proposed by the ISC based on modeling results, threats from barred owl invasion or competition, or increased counts of spotted owls. Assuming that the ISC Conservation

Strategy, as represented by Alternative B of the FEIS, is fully implemented, the team continues to feel it will provide a high likelihood of maintaining a viable, well distributed population of owls. The SAT recognizes that a key part of this plan is to continue to track owl numbers through monitoring, inventory, and demographic studies, and to conduct experiments to assess the extent of bias in mark-recapture estimates based on banding data.

Finally, the SAT calls for adoption of an adaptive management process to facilitate the orderly review and synthesis of new information as it becomes available.

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Table 5-1. Proportion of radio-marked juveniles that emigrated from demographic study areas, survived for one year, and went undetected by conventional calling and banding techniques on three study areas in Oregon and Washington, 1991-1992.^a

Study area	<u>n</u>	Proportion emigrating
Roseburg BLM	18	0.22
Olympic Peninsula	11	0.45
Wenatchee N.F.	5	0.40

^a Unpublished data from studies conducted by E. Forsman, Stan Sovern, and Janice Reid at the Forest Service Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.

Table 5-2. Annual survival estimates (ϕ) of radio-marked juvenile spotted owls on three study areas in Oregon and Washington, 1991-1992. Estimates from programs SURVIV and MICROMORT are compared.^a

Study area	n	<u>Program SURVIV</u>		<u>Program MICROMORT</u>	
		(ϕ)	95% CL	(ϕ)	95% CL
Roseburg BLM	27	0.70	0.50-0.91	0.66	0.50-0.88
Olympic N.F.	16	0.75	0.51-1.00	0.73	0.54-0.99
Wenatchee N.F.	16	0.31	0.09-0.72	0.24	0.10-0.56

^aStarting dates for annual estimates were July 1, 1991, for Roseburg BLM and Wenatchee N.F., and August 1, 1991, for the Olympic Peninsula. It is important to note that the estimates do not include the first two months after owlets left the nest, a period when mortality could be particularly high. Starting dates differed among areas because transmitters were not installed at the same times on all areas. Unpublished data from studies conducted by E. Forsman, Stan Sovern and Janice Reid at the Forest Service Pacific Northwest Forest and Range Experiment Station, Corvallis, OR.

Table 5-3. Estimates of age-specific annual survival (λ) of female northern spotted owls on four study areas in Oregon and Washington.

Study Area	First year		All later years	
	(λ_J)	s.e. (λ_J)	(λ_A)	s.e. (λ_A)
H.J. Andrews (Western Oregon)	0.190 ^a	0.043	0.836 ^a	0.016
Medford (Southwestern Oregon)	0.220 ^a	0.031	0.826 ^a	0.011
Roseburg (Southwestern Oregon)	0.266	0.046	0.860 ^a	0.011
Olympic Peninsula (Western Washington)	na ^b	na ^b	0.846	0.018

^a No sex-specific differences in adult survival rates were detectable, thus estimates are for males and females combined.

^b Estimates not available.

Table 5-4. Estimates of age-specific fecundity (b) for female northern spotted owls on study areas in Oregon and Washington. Fecundity^a is defined as the number of female young produced per female owl per year.

Study area	Subad 1 (12 mos.)		Subad 2 (24 mos.)		Adult (36 mos.)	
	(b ₁)	s.e.(b ₁)	(b ₂)	s.e.(b ₂)	(b)	s.e.(b)
Willow	0.115	0.058	0.344	0.023	0.344	0.023
H.J.A.	0.163	0.086	0.163	0.086	0.359	0.096
Medford	0.132	0.055	0.132	0.055	0.323	0.048
Roseburg	0.110	0.047	0.110	0.047	0.325	0.041
Olympic	0.223	0.089	0.223	0.089	0.396	0.087
Wen-PNW	0.262	0.178	0.262	0.178	0.763	0.081
Wen-NACASI	--	-- ^b	--	--	0.544	0.089
Eug-West	0.000	na	0.000	na	0.366	0.130
Eug-East	0.000	na	0.000	na	0.181	0.078
Chetco-PSW	--	--	--	--	0.355	0.205
Coos BLM	0.204	0.102	0.204	0.102	0.477	0.139
Siuslaw	0.167	0.167	0.167	0.167	0.293	0.129
Simpson	0.139	0.042	0.139	0.042	0.414	0.021
LP-Calif.	0.000	na	0.000	na	0.571	0.051

^a Summarized from annual reports and from information provided by researchers from September to November 1992. Individual study areas are described in Appendix 5-A.

^b Sample too small to calculate standard error.

Table 5-5. Yearly variation in fecundity of adult female northern spotted owls on 15 demographic study areas.^a

Study area	Year							
	1985	1986	1987	1988	1989	1990	1991	1992
Willow Cr.	0.296	0.350	0.330	0.325	0.367	0.306	0.273	--
H.J. Andrews			0.400	0.486	0.025	0.276	0.250	0.717
Medford	0.234	0.500	0.158	0.457	0.213	0.356	0.344	--
Roseburg	0.196	0.552	0.279	0.300	0.364	0.378	0.240	0.458
Olympic			0.075	0.283	0.548	0.510	0.304	0.653
Simpson-Calif.						0.423	0.373	0.445
L.P.-Calif.						0.611	0.470	0.630
Coos Bay						0.530	0.141	0.580
Siuslaw						0.460	0.037	0.378
Siskiyou						0.375	0.375	0.316
Wen-USFS					1.000	0.672	0.567	0.814
Wen-NACASI						0.474	0.439	0.722
Eugene West						0.447	0.111	0.539
Eugene East				0.214	0.000	0.450	0.056	0.186
Warm Springs								0.820

^aCompiled from progress reports and unpublished data provided by researchers from September to November 1992. Fecundity was defined as the number of female young produced per female owl per year. A 50:50 sex ratio was assumed for juveniles. Study areas are described in Appendix 5-A.

Table 5-6. Estimates of crude density (# of individuals/km²) of adult and subadult owls on 12 density study areas within the range of the northern spotted owl.^a

Study area	Year							
	1985	1986	1987	1988	1989	1990	1991	1992
Willow Cr	0.232	0.233	0.233	0.246	0.257	0.267	0.243	0.274
H.J. Andrews				0.197	0.200	0.200	0.217	0.223
Medford								
Butte Falls						0.103	0.093	0.084
Evans Cr						0.107	0.095	0.104
Elk Cr						0.264	0.253	0.245
Williams							0.148	0.159
Roseburg								
Drain			0.090	0.122	0.112	0.140	0.140	0.137
Cow Cr						0.114	0.108	0.106
Siuslaw N.F.						0.071	0.084	0.087
Olympic			0.051	0.068	0.070	0.070	0.076	0.068
Eugene BLM						0.078	0.076	0.063
Wenatchee N.F. ^b							0.117	0.112
Simpson-Calif.								0.252

^a Summarized from annual reports and unpublished data provided by researchers from September to November 1992.

^b Not initially designed as a density study area but minimum density is presented to indicate comparatively high densities in this area even without complete surveys.

Table 5-7. Rates of removal of owl habitat on five study areas within the range of the northern spotted owl. All area measurements in hectares (1 hectare = 2.471 acres)

	Willow Creek	Medford ^a	Roseburg ^b	Andrews	Olympic ^c
Density areas					
Total Area	30302	36949	45914	30490	29761
Years examined	82-92	79-92	79-91	82-92	82-92
Starting habitat	12058	19411	28032	18013	14651
Current habitat ^d	10606	11085	23419	15245	12202
Hectares harvested	1453	8326	4613	2768	2449
Percent change	12.05	42.89	16.46	15.36	16.71
Avg. annual loss(%)	0.86	3.06	1.27	1.40	1.52
Buffer areas^e					
Starting habitat		86,511		16823	8127
Current habitat		43,259		15120	6965
Hectares harvested		43,252		1704	1162
Percent change		50.00		10.13	14.30
Avg. annual loss		4.55		0.92	1.30

^a Summarized from harvest records provided by the Forest Service and Bureau of Land Management. Estimates of rates of removal apply to lands managed by the Forest Service and BLM.

^b Summarized from harvest records provided by the Bureau of Land Management. Estimated rates apply to lands managed by the BLM.

^c Estimates apply only to lands managed by the Forest Service.

^d Estimated by multiplying area of study area by the estimated proportion of study area currently covered by owl habitat.

^e Width of buffer areas was scaled to correspond to the average diameter of a home range within the study area. Widths were: Andrews = 4.0 km, Medford = 5.6 km, Olympic = 7.2 km.

Table 5-8. Rates of removal of owl habitat on three study areas within the range of the northern spotted owl, 1977 to 1988. Estimates based on Landsat imagery. All area estimates in hectares (1 hectare = 2.471 acres).

	Study area		
	Medford	Roseburg	Andrews
Density Areas			
Size (ha)	90911	105304	30490
Habitat ^a in 1977	45142	48148	16025
Habitat in 1988	18242	42375	13457
total % loss	59.59	11.99	16.02
annual % loss ^b	5.42	1.09	1.46
Buffer areas			
Size (ha)	144195	94031	32262
Habitat in 1977	61095	34893	19449
Habitat in 1988	28955	22383	16054
total % loss	52.61	35.85	17.46
annual % loss	4.78	3.26	1.59

^aHabitat was classified as mature and older, closed-canopy forest as identified from Landsat imagery.

^bWidth of buffer areas was scaled to correspond to the average diameter of a home range within the study area. Widths were: Andrews = 4.0 km, Roseburg = 4.8 km, Medford = 5.6 km.

Table 5-9. Numbers of spotted owl pairs located within the range of the northern spotted owl^a.

Area	USFS ^c	BLM ^c	Private	State or Province	Nat'l Parks	Tribal Lands	Total
California	471	17	414 ^a	14	1 ^c	37	954
Oregon	1,164	608	128 ^b	33	8 ^b	36	1,977
Washington	486		45 ^b	33	64 ^c	32	660
Canada				14			14
Totals	2,121	625	587	94	73	105	3,605

^a Summarized from personal communications with state biologists and with Fred Seavey of the U.S. Fish and Wildlife Service Northern Spotted Owl Recovery Team.

^b Five-year survey period = 1988-1992

^c Five-year survey period = 1987-1991

Appendix 5-A. Description of banding/demographic studies being conducted on the northern spotted owl. As of the end of the 1992 field season, a total of 4,066 adults/subadults and 2,784 juveniles had been banded.

OREGON

H.J. Andrews - Meslow/Miller/Swindel/DeStefano

A cooperative study between the Oregon Cooperative Wildlife Research Unit and the Pacific Northwest Forest and Range Experiment Station. This study was initiated in 1987. It includes a 116 mi² (300 km²) density study area encircled by a 655 mi² (1,696 km²) general study area that includes most of the Blue River and McKenzie Ranger Districts of the Willamette National Forest. The study area includes a variety of forest age classes and landscapes typical of lands managed by the Forest Service on the west slope of the Cascades, including a portion of the Three Sisters Wilderness. A total of 306 adults/subadults and 228 juveniles were banded as of 1992. This was one of the five areas described in the Anderson and Burnham report (1992).

Eugene BLM - Western Side - Thrailkill and Meslow

A cooperative study between the BLM and the U.S. Fish and Wildlife Service Oregon Cooperative Wildlife Research Unit. This study officially started in April 1990. However, BLM personnel had already banded about 40 owls in 1989 before the formal study began. This study includes a 178 mi² (461 km²) density study area called the "Wolf Creek Density Study Area", as well as a 540 mi² (1,399 km²) general study area that encompasses the west half of the Eugene District of the BLM (Coast Range and South Valley Resource Areas). The Wolf Creek Density Study Area is included in the general study area. A total of 92 adults, 12 subadults, and 64 juveniles were banded as of 1992.

Eugene BLM - East Side - Irwin/NACASI

A cooperative study between BLM and the National Council for Air and Stream Improvement. This was initially started as a habitat use study in 1988. Following completion of the habitat use study in 1991, the scope of the project was expanded to include a demographic study on private lands and those managed by BLM. The study area includes the east half of the Eugene District, as well as adjacent private lands. A total of 94 adults, 9 subadults, and 23 juveniles were banded as of 1992.

Coos Bay BLM - Pacific Southwest Forest and Range Experiment Station - Noon/Zabel/Brown

A cooperative study between BLM and the Pacific Southwest Forest and Range Experiment Station in Arcata, CA. This study was initiated in 1990 on the Coos Bay District of the BLM. However, small samples of owls were also banded on the district from 1986 to 1989, before the formal study began. The study area includes the entire Coos Bay District and intervening private lands. Total area is approximately 400 mi² (1,036 km²). The study is designed to examine population growth rates from mark-recapture analyses. Although it does not include a density study area, conversations with Barry Noon and Mark Brown indicate that most of the study area is being thoroughly searched for owls. A total of 248 adults/subadults and 153 juveniles were banded as of 1992.

Siskiyou National Forest - Noon/Zabel/Pacific Southwest Forest and Range Experiment Station

A cooperative study between the Chetco Ranger District of the Siskiyou National Forest and the Pacific Southwest Forest and Range Experiment Station at Arcata, CA. Initiated in 1990, this mark-recapture study includes a general study area that encompasses the Chetco Ranger District. It does not include a density study area. A total of 66 adults, 8 subadults, and 30 juveniles was marked as of 1992. The study will likely be discontinued after 1992 because of lack of funding (Zabel pers. comm.).

Siuslaw National Forest - Pacific Northwest Forest and Range Experiment Station - Forsman/Loschl/Forson

A cooperative study between the Siuslaw National Forest and Pacific Northwest Forest and Range Experiment Station. Initiated in March 1990. Includes 1) a 261 mi² (676 km²) density study area that encompasses the north half of the Mapleton Ranger District, and 2) a general study area that includes the entire Siuslaw National Forest. This study encompasses a broad range of landscapes typical of the Oregon Coast Ranges. A total of 132 adults, 17 subadults, and 62 juveniles was banded as of 1992.

Roseburg BLM - Forsman/Reid/Mires/Oliver/Witt/Foster/Lint/etc.

A cooperative study between BLM and the Pacific Northwest Forest and Range Experiment Station. This mark-recapture study was initiated in 1985 and includes the entire Roseburg District of BLM as well as interspersed private lands (roughly 1,700 mi² or 4,403 km²). It includes a 390 mi² (1,010 km²) density study area that encompasses most of the Drain Resource Area. Another 190 mi² (492 km²) density study area was added in 1991 on the Dillard Resource Area. Includes landscapes typical of three geographic provinces, the Coast Ranges, Western Cascades, and Klamath Mountains. A total of 438 adults, 117 subadults, and 453 juveniles was banded as of 1992. This was one of the five areas described in the Anderson and Burnham report (1992). In addition to banding studies, 37 juvenile owls were fitted with 6 gram tail-mount transmitters on this area in 1991 and 1992 to examine survival rates and dispersal.

Medford BLM - Wagner/Meslow/Harper/Wright/etc.

A cooperative study between BLM, the U.S. Fish and Wildlife Service Oregon Cooperative Wildlife Research Unit, and several National Forests. This mark-recapture study was initiated in 1985. Initially it included only a portion of the Medford District of BLM, but in 1990 it was expanded to encompass most of the Medford District as well as portions of the Winema, Umpqua, Siskiyou and Rogue River National Forests. The study includes four density study areas (Butte Falls = 120 mi² (311 km²), Evans Creek = 126 mi² (326 km²), Elk Creek = 105 mi² (272 km²), Williams = 119 mi² (308 km²)). The general study area covers approximately 4,050 mi² (10,490 km²). A total of 803 adults, 108 subadults, and 564 juveniles was banded as of 1992. This was one of the five areas described by Anderson and Burnham (1992).

Salem BLM - Logan/England/Hopkins/Licata

This mark-recapture study was initiated in 1986. It includes a general study area that encompasses the entire Salem District of BLM. It includes two density study areas. Although a few spotted owl responses have been heard in the Nestucca density study area, no owls have been visually located or banded

there in three years of surveys (1990-1992). The Nestucca density study area is covered by young and mid-aged forests and cutover areas. A new density study area was initiated in 1992 on Mill Creek, just south of the Nestucca density study area. Both density study areas are located in the Oregon Coast Ranges. The Nestucca density study area will probably be dropped in 1994 assuming that no owls are found there in 1993 (W. Logan pers. comm.). A total of 154 adults/subadults, and 100 juveniles was banded on the district as of 1992.

Warm Springs Indian Reservation - AG Crook Company

The tribe hired the AG Crook Consulting company to mark owls on the reservation in 1992. A total of 47 adults, 4 subadults, and 14 juveniles was banded.

WASHINGTON

Olympic Peninsula - Forsman/Moorehead/Seaman/Anthony

This mark-recapture study was initiated by the Pacific Northwest Forest and Range Experiment Station in 1987 and focuses primarily on Olympic Peninsula lands managed by the Forest Service. Since that time, the Olympic National Park and the Washington Department of Natural Resources have joined in the banding effort, expanding the coverage to portions of the Olympic National Park and to State lands. While the general study area includes the entire Olympic Peninsula, large areas of the Olympic National Park and privately owned forest lands are not surveyed. A 137 mi² (355 km²) density study area is located on the south half of the Quinault Ranger District of the Olympic National Forest on the west side of the Peninsula. The total study area is roughly 965 mi² (2,500 km²). As of 1992, a total of 226 adults, 43 subadults, and 223 juveniles were banded. In addition, a sample of 18 juveniles was marked with tail-mount radio transmitters in 1991 and 1992 to examine survival rates and dispersal patterns. This was one of the five study areas examined by Anderson and Burnham (1992).

Wenatchee National Forest - Forsman/Sovern/Taylor/Pacific Northwest Forest and Range Experiment Station

A cooperative study between the Pacific Northwest Forest and Range Experiment Station and the Wenatchee National Forest. Initiated in 1989 on the Cle Elum Ranger District of the Wenatchee National Forest, the study started as a habitat use study and then continued as a demographic study after the habitat use study was completed in 1991. The study includes a 76 mi² (197 km²) density study area in the Swauk Valley, and a general study area that includes the entire 696 mi² (1,803 km²) Cle Elum Ranger District and adjacent private lands. The Cle Elum study area includes extensive areas that have been selectively logged or burned during the last 80 years. As of 1992, a total of 121 adults, 26 subadults, and 168 juveniles was banded. In addition, 29 juveniles were radio-marked with tail-mount transmitters in 1991 and 1992 to determine survival rates and dispersal patterns.

Wenatchee National Forest - Irwin/Flemming/Martin/NACASI/Pacific Northwest Forest and Range Experiment Station

A cooperative study between the National Council For Air and Stream Improvement and the Pacific Northwest Forest and Range Experiment Station in Wenatchee. Initiated in 1990, this mark-recapture study includes most of the Wenatchee

National Forest, with the exception of the Cle Elum Ranger District. It does not include a density study area. A total of 173 adults, 21 subadults and 170 juveniles was marked as of 1992. This study was designed to compare demographic parameters of owls living in managed and unmanaged habitats.

Yakima Indian Nation - Eric Hanson

This study was initiated in 1991 as a habitat use study but also includes a sample of banded owls. The study area includes the forested portions of the Yakima Indian Reservation on the east slope of the Washington Cascades. This study abuts the demographic studies that are being conducted on the Wenatchee National Forest. A total of 26 adults, 2 subadults, and 13 juveniles was banded as of 1992.

CALIFORNIA

Willow Creek Study - Franklin/Gutierrez/Noon

A cooperative study between Humboldt State University, the California Department of Fish and Wildlife, and the Pacific Southwest Forest and Range Experiment Station at Arcata, CA. This mark-recapture study was initiated in 1985 on the Six Rivers National Forest in northwestern California. It includes a 113 mi² (293 km²) density study area on Willow Creek as well as a series of smaller density study areas distributed in a satellite network around the Willow Creek area. The study area includes landscapes typical of the Six Rivers National Forest. A total of 254 adults/subadults and 276 juveniles was banded as of 1992. This was one of the five areas examined by Anderson and Burnham (1992).

Simpson Timber Company - Lowell Diller

This study was started as a habitat use study in 1989, then continued as a mark-recapture demographic study after the habitat use study was completed in 1991. The 300 mi² (777 km²) study area includes primarily Simpson Timber Company lands within the redwood belt of northwestern California. Although not designed as a density study per se, an area of approximately 220,608 acres (893 km²) had been surveyed well enough to estimate minimum density of owls as of 1992. The study area includes mostly young-growth and mid-aged redwood forest and areas that have been recently clearcut. A total of 250 adults, 62 subadults, and 197 juveniles was banded as of 1992.

Louisiana Pacific Timber Company - Malcom Pious

This study was started in 1990 as a mark-recapture study. The study area covers approximately 650 mi² (1,683 km²) of predominantly private land along the northern California coast. Much of which is covered by young to mid-age redwood forest. A total of 154 adults/subadults and 35 juveniles was marked as of 1992.

Hoopa Valley Indian Reservation - Mark Higley

This study was started in 1991 by the Hoopa Valley Tribal Council in mixed-conifer forests in northwestern California. A total of 47 adults, 6 subadults, and 11 juveniles was banded in 1991-92.

Appendix 5-C. Anderson and Burnham Report. Demographic Analysis of Northern Spotted Owl Populations. Reproduced here as it appeared in Appendix C of the U.S. Fish and Wildlife Service's Draft Recovery Plan (USDI 1992).

Appendix 5-B

Annotated Bibliography

Scientific Analysis Team

Annotated Bibliography of Recent Research Information on Northern Spotted Owls

This annotated bibliography contains references on selected scientific studies that have been published or are still unpublished since the completion of the Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests. References contained within this bibliography became generally available between January 1992 and November 1992. Because additional studies may be in an unpublished form and therefore not readily available, it is probable that some literature relating to this subject and completed within the dates given were not included in this annotated bibliography. Some of the unpublished literature is still in draft form and not ready for public distribution. The Scientific Analysis Team was permitted to review these drafts for the purpose of assessing new data since the ISC report.

The major conclusions of the ISC Report regarding spotted owl biology, demography and habitat use have not changed substantially after a review of the literature included here. Research on spotted owl habitat use, particularly for northern California and the east slope of the Washington Cascades should continue to add to the existing information. The review of new studies and the incorporation of information into habitat management planning should continue through accepted scientific research processes, including publication peer review.

This appendix is divided into two sections. The first section is a list of studies that have been published since the Final Environmental Impact Statement. In the second section, unpublished references available since completion of the Final Environmental Impact Statement are listed. For most references, in addition to the literature citation, the abstract is included when available. For annotations which come from author written abstracts, summaries, and conclusions, an index code of (A) is given at the end of the quote. For compiler generated annotations, an index code of (C) is found at the end of the paragraph.

Appendix B

Published Literature

Anderson, D.R.; Burnham, K.P. 1992. Demographic analysis of northern spotted owl populations. Pages 319-328 in: USDI Fish and Wildlife Service Recovery Plan for the Northern Spotted Owl, Appendix C.

"The 1990 Status Review Northern Spotted Owl (USDI 1990) provided estimates of the rate of population change for populations of northern spotted owls in northern California (Willow Creek and surrounding regional study area) and southern Oregon (the Roseburg study area). The population of resident female owls in these areas was shown to be declining at a significant rate. By the fall of 1991, there were 2 additional years of capture-recapture data on these two populations, and three new areas (Medford in southern Oregon, H.J. Andrews near Corvallis, Oregon and the Olympic Peninsula in northwestern Washington) had sufficient years of capture-recapture data to warrant an intensive analysis (Table C.1). More than 2,000 owls had been marked and the resighting probability for adult females was approximately 0.8 to 0.9 percent."

"This appendix provides estimates for the rate of population change of resident, territorial females in these five large study areas. Analysis methods (e.g., model building, model selection, tests of model fit, parameter estimation, and inference procedures concerning the rate of population change) are those used in USDI (1990) with some extensions. The key references on methodology are Burnham and Anderson (In Press) and Lebreton et al. (In Press). The analyses of data were done during September-October, 1991, during one intensive workshop held in Ft. Collins, Colorado. The analyses were completed by six biologists working on the northern spotted owl - two French scientists, two professors from Colorado State University with special expertise in the analysis of capture-recapture data, and two U.S. Fish and Wildlife Service employees from the Colorado Cooperative Fish and Wildlife Research Unit." (A)

Bart, J.; Forsman, E.D. 1992. Dependence of northern spotted owls *Strix occidentalis caurina* on old-growth forests in the western USA. *Biological Conservation* 1992. (62):95-100.

Abstract. "Habitat requirements of northern spotted owls *Strix occidentalis caurina* have become the focus of a major controversy over how much old-growth forest in the western United States should be preserved. Analysis of three large data sets showed that the subspecies was rare or absent in areas with little older (i.e. > 80-year-old) forest but with extensive stands nearing harvest age. The owls were also rare in areas with the small amount of old-growth typically left after harvest operations. Old-growth stands in Wilderness Areas supported sparse populations of northern spotted owls, and their reproductive success was only about half that of owls outside Wilderness Areas. The results indicate that timber harvest operations, as currently practiced, lead to declines in numbers of northern spotted owls, and that currently protected old-growth stands are unlikely to provide enough high-quality habitat to maintain self-supporting populations of northern spotted owls." (A)

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

"Abstract: Habitat requirements of spotted owls (*Strix occidentalis*) are controversial, particularly with respect to private lands. Therefore, we studied the distribution and roosting and nesting habitat of California spotted owls (*S. o. occidentalis*) throughout a 355-km² study area in the central Sierra Nevada, Eldorado and Placer counties, California, from May to August 1986 and 1987. Fewer ($P \leq 0.001$) owls were detected on private land than expected from its relative land area. Slope; total canopy closure; number of possible nest trees; maximum shrub height; basal areas of old-growth, medium, pole and live trees; percent ground cover by litter; and small and large dead or dying woody vegetation were different ($P \leq 0.05$) between public and private land. Habitat types of mixed-conifer, large-tree successional stage, with $\geq 70\%$ total canopy closure were most abundant (38.1%) on public land; whereas mixed-conifer, pole-medium successional stage with $\geq 70\%$ total canopy closure habitat types dominated private land (44.1%). Roost sites occurred in habitats with relatively greater total canopy closure, and basal areas of snags, medium, and old-growth trees than found in the abundance of habitat. Twenty-six of 29 observed roosts (89.7%) and all 11 owl nests were on public land. Our results provide forest managers with a direction towards appropriate silvicultural and logging practices for the conservation of California spotted owl roost and nest habitats. These include adequate representation of all tree size classes, especially mature and old-growth, combined with essential habitat elements (e.g., nest trees)." (A)

Blakesley, J.A.; Franklin, A.B.; Gutierrez, R.J. 1992. Spotted owl roost and nest site selection in northwestern California. *Journal of Wildlife Management*. 56(2):338-392.

"Abstract: We directly observed roost and nest site selection in a population of northern spotted owls (*Strix occidentalis caurina*) in northwestern California during 1985-89. Because of potential biases caused by use of radio telemetry in previous studies, we examined habitat use relative to habitat availability at a level not previously reported for spotted owls. Spotted owls selected coniferous forest characterized by trees >53.3 cm in diameter more often ($P < 0.05$) than it was available. Hardwood stands and coniferous forest dominated by smaller trees were used less than ($P < 0.05$), or in proportion to, their availability. The owls selected forests at 300-900 m elevations for roosting ($P < 0.05$), selected the lower third of slopes within a specific drainage ($P < 0.05$), and avoided the upper third for both roosting and nesting ($P < 0.05$). These observations support the findings of earlier workers who used radio telemetry and to assess habitat selection in the northern spotted owl" (A)

Carey, A.B.; Horton, S.P.; Biswell, B.L. 1992. Northern spotted owls: influence of prey base and landscape character. *Ecological Monographs*. 62(2):223-250.

"Abstract. We studied prey populations and the use and composition of home ranges of 47 Northern Spotted Owls (*Strix occidentalis caurina*) over 12 mo in five landscapes in two forest types in southwestern Oregon. We measured 1-yr home ranges of 23 owl pairs, 2-yr home ranges of 13 owl pairs, and 3-yr home ranges of 3 pairs. The landscapes differed in the degree to which old forest had been fragmented by wildfire and logging. Prey populations were measured at 47 sites in southwestern Oregon. Further data on prey populations were gathered on 14 sites on the Olympic peninsula in northern Washington, where owls use larger ranges than in Oregon."

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Carroll, J.E.; Lamberson, R.H. 1992. [In press]. The owl's odyssey. A continuous model for the dispersal of territorial species. Society of Industrial and Applied Mathematics Journal of Applied Mathematics. 52(6).

"Abstract. In this paper, a composite model is developed that consists of a continuous model for dispersal set within a difference equation model for the life history of territorial species. Two dispersal models are considered: one that assumes that suitable habitat is uniformly or randomly distributed throughout the range of the population, and one that assumes that home ranges are concentrated in clusters of suitable habitat. These models explicitly consider the cost of dispersal by including ongoing rates of mortality due to predation and starvation while birds search for a territory. The cluster model also differentiates between mortality within and outside of clusters. An analysis of the difference equation model demonstrates a threshold for density of suitable habitat below which the population must decrease to extinction, and above which the population tends monotonically to a stable positive equilibrium size. In addition, it is established that the equilibrium size of the population can be increased by consolidating the reserves of suitable habitat into larger clusters." (A)

Dunbar, D.L.; Booth, B.P.; Forsman, E.D., [and others]. 1991. Status of the spotted owl, *Strix occidentalis*, and Barred owl, *Strix varia*, in southwestern British Columbia. Canadian Field Naturalist. 105(4):464-468.

Abstract. "Calling surveys were used to assess the relative abundance and distribution of Spotted and Barred owls in southwestern British Columbia from 1985 to 1988. Spotted Owls were located at 14 sites, including pairs at 7 sites and single birds at 7 sites. One Spotted Owl nest was located. Barred Owls were located at 57 sites, including pairs at 14 sites and single birds at 43 sites. The average number of individuals responding per km of survey transect was 0.04 and 0.15 for Spotted and Barred Owls, respectively. The low response rate for Spotted Owls indicates that the species is rare in British Columbia. We estimated the population at not more than 100 pairs. Although the Spotted Owl has probably never been abundant in British Columbia, we hypothesize that the population has declined because of habitat loss and displacement by the Barred Owl." (A)

Foster, C.C.; Forsman, E.D.; Meslow, E.C., [and others]. 1992. Survival and reproduction of radio-marked adult spotted owls. Journal of Wildlife Management. 56(1):91-95.

"Abstract: We compared survival, reproduction, and body mass of radio-marked and non-radio-marked spotted owls (*Strix occidentalis*) to determine if backpack radios influenced reproduction or survival. In most study areas and years, there were no differences ($P < 0.05$) in survival of males and female or in survival of radio-marked versus banded owls. There was no difference ($P = 0.31$) in mean mass of owls before and after they had worn radio transmitters. Radio-marked owls produced fewer ($P < 0.01$) young than did owls that were not radio-marked. Because of the possible relationship between lower productivity and large (> 19 -g) backpack style transmitters, we recommend that researchers consider the use of smaller transmitters mounted on the tail." (A)

- Franklin, A.B. 1992. Population regulation in northern spotted owls: theoretical implications for management. Pages 815-827 in: McCullough, D.R. and R.H. Barrett, eds. Wildlife 2001: Populations. Elsevier Applied Science; London, England. 1163 p.

"Abstract. A marked population of northern spotted owls was examined within a bounded, 292 km² study area in northwestern California over a six-year period (1985-1990). Observed and predicted finite rates of population change (λ) for males spotted owls were significantly stable. Predicted λ for females indicated a significant decline even though observed λ indicated stability. Observed stability in numbers of territorial males was maintained by recruitment, whereas stability in numbers of females was maintained by immigration. Most recruits did not become territory holders until several years after their birth. I hypothesized that the study area population was regulated by territorial behavior. Under this mechanism, spotted owl populations may be declining even though observed numbers of territorial birds appear to be stable. Using a computer model, I examined the effects of "floaters" on the stability of territory holders, and suggest warning signals which may predict imminent instability for the population." (A)

- Ganey, J.L. 1992. Food habits of Mexican spotted owls in Arizona. The Wilson Bulletin. 104(2):321-326.

"Results. - Between May 1984 and August 1990, I identified 1434 prey items from pellets or kills of 34 pairs of spotted owls. The diet included at least 19 species of mammals, seven species of birds, two species of reptiles and an unknown number of insect species. Vertebrates dominated the diet in all five regions, comprising 84-96% of total prey and 99% of prey biomass (Table 1). Mammals accounted for 73-96% of total prey and 91-99% of prey biomass. Owls consumed prey ranging in mass from beetles (Coleoptera) and moths (Lepidoptera) (ca 1 g) to adult cottontail rabbits (*Sylvilagus* spp; ca 650 g). Mean prey mass ranged from 63-118 g in various regions."

"Woodrats, white-footed mice (*Peromyscus* spp.), and voles (*Microtus* spp.) accounted for 61-83% of the total prey and 59-88% of total biomass in various regions (Table 1). Cottontails and pocket gophers (*Thomomys* spp.) accounted for another 3-14% of total prey and 7-36% of total biomass. Birds and reptiles contributed little to prey numbers or biomass except in Southeast Arizona. Insects were relatively common in the diet (3-16% of total prey) but contributed little to prey biomass. Diurnally active mammals such as squirrels and chipmunks (*Sciuridae*) accounted for <3% of total prey or biomass." (A)

- Ganey, J.L., Duncan, R.B., Block, W.M. 1992. Use of oak and associated woodlands by Mexican spotted owls in Arizona. Pages 125-128 in: Proceedings of the symposium: Ecology and management of oak and associated woodlands: perspectives in the southwestern United States and northern Mexico. 1992 April 27-30; Sierra Vista, AZ. General Technical Report. RM-218. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 224 p.

"Abstract - Although the spotted owl is often associated with coniferous forests, oak and associated woodlands also provide habitat for spotted owls. In Arizona, Mexican spotted owls are year-round residents in Madrean oak-pine forests, encinal woodlands, and

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ponderosa pine-Gambel oak forests, while some spotted owls winter in pinyon-juniper woodlands. Oak and associated woodlands present unique management challenges to resource managers charged with maintaining viable populations of Mexican spotted owls." (A)

Johnson, D.H. 1992. Spotted owls, great horned owls, and forest fragmentation in the central Oregon Cascades. Corvallis, OR: Oregon State University. 138 p. M.S. thesis.

"Nocturnal surveys were conducted in February - May 1989 and January - May 1990 to locate great horned owls (*Bubo virginianus*) and northern spotted owls (*Strix occidentalis caurina*) throughout the range of forest fragmentation levels in the Central Cascades of Oregon. Forest fragmentation levels ranged from landscapes (≥ 500 ha in size) containing intact stands of mature/old-growth forest (0% fragmentation) to landscapes containing younger stands with no mature/old-growth forest (100% fragmentation). Six survey visits were made to each of 469 calling stations located along 28 roadside survey routes. Total length of survey routes was 535.8 road km; relative abundance for great horned owls and spotted owls was 0.069 and 0.139 owls/road km, respectively. Owl response rates were examined for differences 1) during the night, 2) by moon phase, and 3) by month during the survey period. Great horned owls responded less than expected before midnight and more than expected after midnight, less than expected during full moon and more than expected during new moon phases, and less than expected during January and April of the survey period. Spotted owls responded more than expected from 1800-1959 hr, more than expected during full moon phases, and generally more than expected during May of the survey period."

"Thirteen habitat/landscape variables within 500-ha circular landscape plots surrounding 77 great horned owl, 103 spotted owl, 70 no-owl and 70 random points were assessed. Significant differences existed between great horned and spotted owl landscapes for 6 variables: great horned owl landscapes contained more shrub/forb and shelterwood, less mature/old-growth and interior habitat, had a higher linear edge-to-mature/old-growth area ratio, and were higher in elevation than spotted owl landscapes. The amount ($\bar{x} \pm \text{SE}$) of mature/old-growth forest was $48\% \pm 2\%$ around great horned owls, $60\% \pm 2\%$ around spotted owls, $53\% \pm 3\%$ around no-owl points, and $53\% \pm 2\%$ around random points. The greatest number of great horned owl responses were associated with landscapes containing 10-20% old forest. Great horned owl responses generally declined with increasing amount of old forest, and few (11%) great horned owls were detected in landscapes containing $\geq 70\%$ old forest. The majority (62%) of spotted owls were detected within landscapes containing $\geq 60\%$ old forest. Spotted owl responses generally declined with declining amounts of old forest, and few (7%) spotted owls were detected within landscapes containing $\leq 20\%$ old forest."

"The spatial distribution of old forest stands was compared to dispersed (checkerboard) and clumped landscapes; 95% of great horned owl, 88% of spotted owl, 89% of no-owl, and 86% of random landscapes were classified as dispersed. Clearly, the forests of the Central Cascades are very highly fragmented. A method for linking owl biology and landscape level plot size is described." (A)

Johnson, D.H.; Miller, G.S.; Meslow, E.C. 1992. Appendix C. Edge effects and the northern

spotted owl. Spotted owls, great horned owls, and forest fragmentation in the central Oregon Cascades. Corvallis, OR: Oregon State University. 138 p. M.S. thesis.

"Distance-to-edge measurements derived from 1,159 telemetry locations and 51 nest sites indicated that owls avoided young stands and preferentially selected locations within old forest stands. Owl telemetry and nest locations were consistently farther into old forest stands than were randomly selected points ($P \leq 0.01$). Although owls may forage up to an edge, they prefer areas ≥ 90 [m] from an edge during the night. For daytime roost locations and nest sites, owls have indicated a decided preference for location ≥ 100 m from an edge into old forest stands. Based on determinations presented here, researchers and managers concerned with edge should use an "edge effect " distance of ≥ 100 m for northern spotted owls." (A)

LaHaye, W.S., Gutierrez, R.J., Call, D.R. 1992. Demography of an insular population (*Strix occidentalis occidentalis*). Pages 803-814 in: McCullough, D.R. and Barrett, R.H., eds. Wildlife 2001: Populations. Elsevier Applied Science; London, England. 1163 p.

"Abstract. We studied the dynamics of an insular California spotted owl (*Strix occidentalis occidentalis*) population in the San Bernardino Mountains of southern California, USA. We located owls at 128 sites and banded 367 individuals between 1987-1990. We captured and color banded at least 70 percent of the territorial spotted owls in the mountain range. We measured territory occupancy, social status, nesting rate, fledging rate, fecundity, territory turnover and replacement rates, and survivorship. California spotted owls in the San Bernardino Mountains had variable annual reproduction. Survival rates were the lowest yet reported for a spotted owl population. We calculated $\lambda=0.769$ using a two stage Leslie projection matrix and this value was significantly different than 1.0. In this paper we assess the effect of sample size on the estimates of vital rates of this owl population. We discuss the relevance of insular studies of spotted owl populations to the understanding of the demographics of continuous spotted owl populations." (A)

McKelvey, K. 1992. Appendix 4-P. A spatially explicit life-history simulator for the northern spotted owl. USDI Bureau of Land Management Eugene District Resource Management Plan and Environmental Impact Statement. Eugene, OR: USDI Bureau of Land Management, Region 1. 33 p. 2 vol. 4 maps.

"A spatial model was created to simulate the impact of forest management on populations of the northern spotted owl. The basic premise of the model is that an organism's survival and reproduction can be linked explicitly to its immediate habitat and that habitat's context within the larger landscape. That is, a population's rates of survival and fecundity will vary based on map configuration. In addition, the model allows for habitat areas that are unsuitable or marginally suitable for nesting. Lastly, the model assumes that each organism must search the landscape to find a mate."

"The model is a single-organism simulator. Each organism is born, moves, attempts to find a mate and breed, and dies. This format allows the behavior of each individual to be simulated by following a series of probabilistic rules rather than through the abstraction of an equation set. The model is flexible, allowing for the analysis of

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individual characteristics as well as population dynamics. The average distance moved by individual birds before death or pairing, for example, can be output, and thus compared with data from banding or telemetry studies to determine if the simulated movement produces a path-length similar in magnitude to the observed behavior." (A)

National Forest Products Association and American Forest Council. 1992 [Revised January 1992]. A multi-resource strategy for the conservation of the northern spotted owl. Compiled by the Spotted Owl Subgroup of the Wildlife Committee of the National Forest Products Association and the American Forest Council. 60 p. 1 map.

"This strategy is offered as a management alternative that we believe can safeguard the long-term survival of the northern spotted owl (*Strix occidentalis caurina*) while simultaneously allowing the sustained yield of forest products. It combines several approaches and defines both public and private landowner roles for the conservation of the northern spotted owl."

"Our strategy was developed to provide technical input to the various processes (critical habitat proposals, recovery plan development, state regulations, etc) surrounding the management of the northern spotted owl in the Pacific Northwest. We relied heavily on the summary of biological information presented in Thomas et al. (1990) and employed many of the same key biological principles (such as a system of protected habitat for multiple pairs and provisions for connectivity between them). We also incorporated new survey and research information that has become available in the last two years."

"By studying the most recent available data, including land use classification, suitable habitat maps, and owl locations (provided by the U.S. Forest Service and other agencies), we developed a concept that will specify a zone of owl habitat that stretches from British Columbia to northern California." (A)

Murphy, D.D.; Noon, B.R. 1992. Integrating scientific methods with habitat conservation planning: reserve design for northern spotted owls. *Ecological Applications*. 2(1):4363-4378.

"Abstract. To meet the requirements of Congressional legislation mandating the production of a 'scientifically credible' conservation strategy for the threatened Northern Spotted Owl (*Strix occidentalis caurina*), the Interagency Spotted Owl Scientific Committee employed scientific methods to design a habitat reserve system. Information on the current and historical distributions of the owl and its habitats was reviewed in light of economic, political, and legal constraints; results were used to develop a preliminary reserve system of habitat 'polygons'. A map representing these polygons and their attendant properties served as a set of hypotheses that were tested. Statistical analyses of empirical data, predictions from ecological theory, predictions from population dynamics models, and inferences drawn from studies of related species were used to test properties of the preliminary map, including the number and sizes of habitat conservation areas (HCAs), their distribution, configuration, and spacing, and the nature of the landscape matrix between HCAs. Conclusions that failed to confirm specific map properties were used to refine the reserve system, a process that continued iteratively until all relevant data had been examined and all map properties had been tested. This conservation planning process has proven to be credible, repeatable, and scientifically

defendable, and should serve as a model for wildlife management, endangered species recovery, and national forest planning." (A)

Simpson Timber Company. 1992. Habitat conservation plan for the northern spotted owl on the California timberlands of Simpson Timber Company. Arcata, CA: Simpson Timber Company. 323 p. 7 p. Addendum.

"Simpson Timber Company (Simpson), a privately held corporation, is seeking a permit from the U.S. Fish and Wildlife (USFWS) for the incidental take of northern spotted owls (*Strix occidentalis caurina*) in connection with timber harvesting on the properties of its California subsidiaries, Arcata Redwood Company and Simpson Redwood Company. This habitat conservation plan (HCP) has been prepared as part of the application for that permit, pursuant to Section 10(a)(1)(B) of the federal Endangered Species Act (ESA) of 1973 as amended. Upon approval of the permit, the plan also will be used to demonstrate compliance with the current spotted owl provisions of California's Forest Practice Rules." (A)

Thomas, J.W.; Verner, J. 1992. Accomodation with socio-economic factors under the Endangered Species Act - more than meets the eye. Transactions of the 57th North American Wildlife and Natural Resource Conference. 627-641 p.

"We intend to explore myths and realities about how much attention is paid to socio-economic consequences when applying the Endangered Species Act (ACT) of 1973 (U.S. Laws, Statutes, etc. Public Law 93-205). We will examine the circumstances surrounding the development and adoption of a conservation strategy for the northern spotted owl (*Strix occidentalis caurina*) and other activities, including the listing of the subspecies as "threatened," delineation of critical habitat, development of a recovery plan, development of Habitat Conservation Plans (HCPs) and other actions (Corn and Baldwin 1990). Our objective is to point out that what is perceived by many as relentless and inexorable process solely based on biology to protect imperiled species without consideration of socio-economic impacts is, in fact, a procedure subject to repeated accomodation between the listed species welfare and the associated socio-economic consequences."

"This analysis is based on our experiences as members of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl (ISC)." (A)

USDA Department of Agriculture. 1992. Final environmental impact statement on management for the northern spotted owl in the national forests. Portland, OR: USDA Forest Service. 2 vol. 15 maps.

"The Forest Service has prepared an environmental impact statement to disclose the environmental consequences of five different management alternatives to provide habitat for the northern spotted owl in National Forests. Four of these alternatives would amend the Regional Guides and approved Forest Plans for the Pacific Northwest Region and the Pacific Southwest Region of the Forest Service."

Appendix B

"The proposed action is to manage National Forests within the range of the northern spotted owl in accordance with the Interagency Scientific Committee's report "A Conservation Strategy for The Northern Spotted Owl". This proposed action would apply only to lands administered by the Forest Service" (A)

USDI Bureau of Land Management. 1992. Coos Bay district resource management plan and environmental impact statement. Coos Bay, OR: USDI Bureau of Land Management, Region 1. 2 vol. 4 maps.

"Abstract: This Draft Resource Management Plan/Environmental Impact Statement addresses resource management on 329,583 acres of Federal land and 12,152 acres of reserved mineral estate administered by the Bureau of Land Management in its Coos Bay District. Seven alternatives including no action (no change in the existing plan) are analyzed. These alternatives range in emphasis from high production of timber and economically important values to management and enhancement of values such as biological diversity, spotted owl habitat, old-growth forests, dispersed recreation opportunities, and scenic resources. The preferred alternative would: provide for a planned annual timber sale level of 20.1 MMCF (124 MMBF) from 309,000 acres of commercial forest land; maintain air quality, water quality, and long term soil productivity; retain 52,400 acres of old-growth forest; provide habitat to support a carrying capacity of 16 to 24 pair of northern spotted owls and provide for protection of other federally listed animal species; designate eight new Areas of Critical Environmental Concern on 7,490 acres; provide opportunities to develop 27 recreation areas/sites or trails; designate five Back Country Byways; provide for visual resource management on 7,200 acres; and provide for mineral exploration and development on 322,200 acres. No rivers would be found suitable for designation under the Wild and Scenic Rivers Act. Long term management (100 years) under the Preferred Alternative would increase the amount of old-growth to 56,300 acres and increase the carrying capacity for the northern spotted owl to between 41 and 58 pair." (A)

USDI Bureau of Land Management. 1992b. Eugene district resource management plan and environmental impact statement. Eugene, OR: USDI Bureau of Land Management, Region 1. 2 vol. 4 maps.

"Abstract: This Draft Resource Management Plan/Environmental Impact Statement addresses resource management on 316,592 acres of Federal land and 1,299 acres of reserved mineral estate administered by the Bureau of Land Management in its Eugene District. Seven alternatives including no action (no change in the existing plan) are analyzed. These alternatives range in emphasis from high production of timber and economically important values to management and enhancement of values such as biological diversity, spotted owl habitat, old-growth forests, dispersed recreation opportunities, and scenic resources."

"The Preferred Alternative would: provide for a planned annual timber sale level of 19.9 mmcf (119 mmbf, Scribner Short Log) while maintaining water quality in all watersheds. Old-growth forest acreage would be reduced by about 2,700 acres (7 percent) in the short-term, five additional Areas of Critical Environmental Concern (ACECs) would be

designated, and three segments of river would be found suitable for designation under the Wild and Scenic Rivers Act." (A)

USDI Bureau of Land Management. 1992c. Medford district resource management plan and environmental impact statement. Medford, OR: USDI Bureau of Land Management, Region 1. 2 vol. 4 maps.

"Abstract. "This Draft Resource Management Plan/Environmental Impact Statement addresses resource management on 866,300 acres of Federal surface estate and approximately 4,700 acres of reserved mineral estate administered by the Bureau of Land Management in its Medford District. Seven alternatives including the No Action alternative (no change from the existing plan) are analyzed. These alternatives range in emphasis from high production of timber and other commodity values to management and enhancement of values such as biological diversity, spotted owl habitat, old growth forests, dispersed recreation opportunities, and scenic resources. The Preferred Alternative would provide for a planned annual timber sale level of about 18 mmcf (105 mmbf) on a sustained yield basis while maintaining water quality in all watersheds and long-term biological diversity. Old growth forest acreage would be increased by about 4,000 acres (4 percent), 22 additional areas of critical environmental concern would be designated, and 5 stretches of river would be found suitable for designation under the Wild and Scenic Rivers Act." (A)

USDI Bureau of Land Management. 1992d. Roseburg district resource management plan and environmental impact statement. Roseburg, OR: USDI Bureau of Land Management, Region 1. 2 vol. 4 maps.

"Abstract: This draft resource management plan/environmental impact statement addresses resource management on 419,400 acres of federal land administered by the Bureau of Land Management in its Roseburg District. Seven alternatives including no action (no change in the existing plan) are analyzed. These alternatives range from management of timber and other resources vital to the economy, to management and enhancement of values such as biological diversity, spotted owl habitat, old-growth forests, recreation opportunities, and scenic resources. The preferred alternative would provide a planned annual timber sale level of 16.3 mmcf (105 mmbf), while meeting established water quality criteria in all watersheds. Also, 91,700 acres of old-growth forest would be retained at the end of the first decade; three additional areas of critical environmental concern would be designated; and no river segments would be found suitable for designation under the Wild and Scenic Rivers Act." (A)

USDI Bureau of Land Management. 1992e. Salem district resource management plan and environmental impact statement. Salem, OR: USDI Bureau of Land Management, Region 1. 2 vol. 4 maps.

"Abstract: This draft resource management plan/environmental impact statement addresses resource management on 393,600 acres of federal land and 27,800 acres of reserved mineral estate administered by the Bureau of Land Management in its Salem District. Seven alternatives including no action (no change in the existing plan) are

Appendix B

analyzed. These alternatives range from management of timber and other resources vital to the economy, to management and enhancement of values such as biological diversity, spotted owl habitat, old-growth forests, recreation opportunities, and scenic resources. The preferred alternative would provide a planned annual timber sale level of 21.5 mmcf (136.5 mmbf), while meeting established water quality criteria in all watersheds. Also, 28,000 acres of old-growth forest would be retained at the end of the first decade; seven additional areas of critical environmental concern would be designated; and two river segments would be found suitable for designation under the Wild and Scenic Rivers Act.

" (A)

USDI Fish and Wildlife Service. 1992a. Recovery plan for the northern spotted owl - DRAFT. Portland, OR: USDI Fish and Wildlife Service, Region 1. 678 p.

"The northern spotted owl draft recovery plan provides a comprehensive basis for management actions to be undertaken by forest landowners and wildlife agencies to alleviate conditions threatening the species. Primary actions will be taken by federal land management agencies in the Pacific Northwest – the U.S. Forest Service, the U.S. Bureau of Land Management, and the National Park Service. The U.S. Fish and Wildlife Service will oversee implementation of the plan through its authorities under the Endangered Species Act."

"State forest management and wildlife agencies in Oregon, Washington, and California also will take actions that contribute to recovery under the plan. These state agencies have an important role in managing state forests and in regulating forest practices on private land within their jurisdiction. Contributions from habitat on Indian lands also were considered in formulating the draft plan." (A)

USDI Fish and Wildlife Service. 1992b. Endangered and threatened wildlife and plants: determination of critical habitat for the northern spotted owl; final rule. Washington, D.C.: Federal Register. 50(17):1795-1838. 137 p.

"The Fish and Wildlife Service (Service) designates critical habitat for the northern spotted owl (*Strix occidentalis caurina*), a subspecies federally listed as threatened under the Endangered Species Act of 1973, as amended (Act). The northern spotted owl, referred to herein as spotted owl or owl, is a forest bird that inhabits coniferous and mixed conifer-hardwood forests over a range that extends from southwestern British Columbia through western Washington, western Oregon, and northwestern California south to San Francisco Bay."

"This critical habitat designation provides additional protection requirements under section 7 of the Act with regard to activities that are funded, authorized, or carried out by a Federal agency. As required by section 4 of the Act, the Service considered the economic and other relevant impacts prior to making a final decision on the size and scope of critical habitat. The Service excluded some areas from designation due to economic and other relevant information. Final critical habitat units are designated solely on Federal lands." (A)

USDI Fish and Wildlife Service. 1992c. Protocol for surveying proposed management activities that may impact northern spotted owls. 2d ed., revised. Portland, OR: USDI Fish and Wildlife Service, Region 1. 17 p.

"The enclosed protocol was designed for surveying areas where Federal or non-Federal activities may remove or modify northern spotted owl habitat. The U.S. Fish and Wildlife Service (Service) endorses the use of this protocol for gathering information on spotted owl occupancy in proposed project areas for assessing affects of the proposed actions. Note that any information on owl presence within and/or adjacent to the proposed planning or activity areas is important, even if it does not meet the guidelines described below. However, if the only information available for a particular activity was acquired through less intensive surveys, the Service must conservatively assess (i.e. a worse-case analysis) the impacts of the action on northern spotted owls. It is always useful to document reasons for not adhering to the recommended protocol."

"This protocol is based on several existing protocols and, when implemented, should serve two primary purposes: (1) provide adequate coverage and assessment of the area for the presence of spotted owls, and (2) ensure a high probability of locating resident spotted owls and identifying owl territories that may be affected by a proposed management activity, thereby minimizing the potential for unauthorized incidental take. It is not appropriate to use this protocol to monitor yearly trends of spotted owls or for many other research applications."

"In this document, management activities are defined as those activities which may impact northern spotted owls. The most common activity is harvest or modification of spotted owl habitat. Also included under management activities are various types of disturbance not necessarily associated with timber harvest activities."

"This protocol was peer-reviewed by scientists, biologists, and managers who work on various issues pertinent to the ecology and management of northern spotted owls." (A)

Zabel, C.J.; Steger, G.N.; McKelvey, K.S., [and others]. 1992. Home-range size and habitat-use patterns of California spotted owls in the Sierra Nevada. USDA Forest Service General Technical Report. PSW-GTR-133. 141-155 p.

"Estimates of home range size among California spotted owls are extremely variable. All available data indicate that they are smallest in habitats at relatively low elevations that are dominated by hardwoods, intermediate in size in conifer forests in the central Sierra Nevada, and largest in true fir forests in the northern Sierra Nevada." (A)

Unpublished Literature

Anderson, D.R.; Burnham, K.P. 1992. [In press]. Model building and statistical inferences for adult female northern spotted owls. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28. Seattle, WA.

"Inference concerning population parameters of the northern spotted owl from capture-recapture data rests on the proper analysis of multiple data sets. The primary methodological issue is one of intense model building and model selection. Given a model, maximum likelihood provides a framework for optimal inference, at least for large samples."

"This paper stresses the importance of a global model for the analysis of capture-recapture data. Akaike's Information Criterion (AIC) provides a useful method for proper selection within the Principle of Parsimony. Goodness-of-fit must be evaluated and quasi-likelihood methods are often used to obtain good estimates of sampling variances and covariances."

"An example is given for the northern spotted owl whereby 64 interrelated models are considered for the analysis of female data collected on five large study areas. The paper emphasizes analysis philosophy, model selection and statistical inference." (A)

Anthony, R.G.; Desimone, S.E.; Apfelbeck, K., [and others]. October 1991. [Annual report]. Patterns of distribution and abundance of small mammals in old- and second-growth Douglas-fir forests in the Central Cascades. Pages 1-4 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Compare small mammal abundance in old- and second-growth Douglas-fir forests. b. Describe the population dynamics of flying squirrels in old-growth Douglas-fir forests. c. Relate spotted owl reproduction to prey abundance. d. Collaborate with other researchers in the spotted owl RD&A Program in synthesizing the results of the owl prey ecology studies across the Pacific Northwest." (A)

Anthony, R.G. 1992. Single-species versus ecosystem management: lessons for the future. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"The spotted owl/old-growth issue has often been portrayed by the news media as owls versus people or jobs versus conservation of older coniferous forests. Actually, the spotted owl serves as an indicator species for late-successional forests to many environmentalists and managers. However, we know from basic ecological principles that different species occupy different ecological niches, therefore a single species can not possibly represent all the requirements of a host of other species. Such is true for the spotted owl."

"The Northern Spotted Owl Recovery Team was charged with considering other species and older-forest ecosystems in developing a recovery plan for the northern spotted owl."

In fulfilling this charge, we emphasized species that were listed federally as threatened or endangered, candidates for federal listing, state sensitive or species of special concern, and those associated with older forests. A list of 350+ species of plants and animals that occur within the range of the northern spotted owl was assembled. This list is comprised of 24 species of birds, 18 mammals, 26 amphibians and reptiles, 28 fish, 58 mollusks, 59 arthropods, 144 vascular plants, and 8 fungi and lichens. Five species are listed federally as threatened or endangered, and 155 species are candidates for federal listing. At the state level, over 100 species are listed as threatened or endangered, or designated as sensitive or species of special concern. More than 100 species are narrowly or broadly endemic to the Pacific Northwest and 190+ are associated with older forests. This effort also substantiated the importance of riparian ecosystems as approximately one third (130+) of the species are associated with riparian areas. In addition, the 28 species of fish include approximately 800 stocks that are considered at risk and may become candidates for listing. Eighteen priority species were identified, of which the marbled murrelet and the numerous fish stocks were considered the highest priority."

"Information on the distribution, biology, and habitat relationships of the priority species and the ecology of riparian ecosystem were used to influence the location of some of the conservation areas for the owl. However, the extent to which this exercise could be carried out was influenced by economics and the preponderance of non-biologists on the recovery team. Consequently, the recovery plan for the northern spotted owl can not be portrayed as a conservation plan for late-successional forests in the Pacific Northwest."
(A)

Bart, J.; Holthausen, R. 1992. Listing, critical habitat designation, and development of the northern spotted owl recovery plan. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"The northern spotted owl (*Strix occidentalis caurina*) was listed as a threatened species by the U.S. Fish and Wildlife Service in 1990. Following the listing, the Fish and Wildlife Service, acting under court order, designated critical habitat for the species."

"Concurrently, the Department of the Interior named a team to begin work on a Recovery Plan for northern spotted owls. This Recovery Plan was published as a draft in May 1992, and a final is expected in early 1993. The basic principles underlying the Plan are based on the 1990 report of the Interagency Scientific Committee. It recommends the establishment of 196 Designated Conservation Area (DCAs) on federal lands, and contains guidelines for silviculture and salvage operations within those DCAs. It also contains a series of recommendations to provide dispersal habitat in the federal forest matrix between DCAs. It recognizes the contribution that can be made to recovery by private lands, and suggests ways for the contribution to be made more effective."

"Major issues that must be dealt with before publication of the final Plan includes: (1) a consideration of demographic data which indicate an accelerating decline in the spotted owl population; (2) a review of models that might be used to evaluate the Recovery Plan and other options; and (3) a detailed description of the procedures that could be used to continually update the Plan based on new information. Success of the final Plan will depend on close coordination among federal and state agencies." (A)

Buchanan, J.B.; Irwin, L.L. 1992. Variation in spotted owl nest site characteristics within the Wenatchee National Forest. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Spotted Owls (*Strix occidentalis caurina*) nest in a broad range of forest stand conditions in the Wenatchee National Forest (WNF). Nearly half of the known nests occur in evenaged patches or stands 65-135 years old, and 21% of the nest sites were partially harvested several decades prior to our study. A predictive model developed to distinguish between nest and random sites at the stand level correctly identified 70% of the study sites. Diagnostic evaluation of the model indicated that the low classification rate reflected variation in habitat conditions with the WNF. To identify factors that could improve the model, we developed pairs of predictive models based on north- and south-facing slopes and on sites with and without evidence of previous partial harvest. The aspect and harvest models correctly classified 65-93% of the sites; however, none of the models were stable, as determined by cross-validation. Following this we examined variation among nest sites within the WNF by comparing mean habitat values among 4 of the 5 Fire Management Analysis Zones (FMAZ) identified by the U.S. Forest Service for fire control purposes. The FMAZ areas were defined primarily in terms of topography, annual precipitation, and estimates of fuel loading and fire frequency. We found significant differences among the FMAZ for nearly half of the 60 habitat features we compared at nest sites. It may be possible to develop predictive models within each FMAZ using the original or other models. For example, the harvest model (with a larger sample) may be useful to researchers and managers who wish to conduct adaptive management experiments in stands managed for timber and/or fire protection. The use of such models within the FMAZ framework would likely be more powerful and allow better management throughout the region." (A)

Carey, A.; Biswell, B.; Brown, B., [and others]. October 1991. [Annual report]. Patterns of spotted owl prey abundance in the Oregon Coast Ranges and Western Washington. Pages 5-9 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Determine pattern of abundance of flying squirrels and woodrats in the types of forest stands found within the home ranges of spotted owls, particularly young Douglas-fir stands, old-growth Douglas-fir stands, and riparian hardwood or mixed hardwood and conifer stands. b. Determine structural features of the environment that account for significant amounts of the variation in flying squirrel and woodrat abundance within and among stands. c. Determine seasonal changes (fall vs. spring) in patterns of flying squirrel and woodrat abundance. d. Relate flying squirrel patterns of abundance to spotted owl foraging (as measured in a companion study) and relative abundance to spotted owl reproductive efforts (as measured in a companion study of owl demographics). e. Determine the patterns of abundance exhibited by ancillary prey species, especially deer mice and red-backed voles. f. Explore additional techniques to study the abundance and habitat use patterns of bushy-tailed and dusky-footed woodrats." (A)

Carey, A.B.; Miller, R.E.; Wunder, L., [and others]. October 1991. [Annual report]. Experimental manipulation of managed stands to provide habitat for spotted owls and to enhance plant

and animal diversity. Pages 10-11 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Determine the feasibility of accelerating development of spotted owl habitat in managed forests, by increasing plant and animal diversity, and the abundance of spotted owl prey. b. Determine if populations of flying squirrels can be increased by increasing the number of cavities available. c. Determine if thinning can increase the abundance and diversity of food available to flying squirrels." (A)

Carey, A. 1992. Prey ecology and northern spotted owl diet. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Mammals constitute 90% of the spotted owl's diet; diets vary locally and seasonally, but are consistent annually at larger geographic scales. *Glaucomyx sabrinus* (GLSA) is the single most important prey, accounting for 16-46% of the prey items consumed. GLSA is the only species to occur with frequency of >15% in all parts of the owl's range. In western hemlock and Douglas-fir forests, GLSA constitutes 47-58% of the biomass consumed. In fall and winter, GLSA comprises 60-72% of biomass consumed. *Peromyscus* spp. and juvenile lagomorphs are 12-18% and 7% respectively, of summer diets. In mixed-conifer forests in the southern part of the owl's range, *Neotoma fuscipes* may be up to 70% of the biomass consumed, and GLSA as little as 14%. Other species (% items consumed) are important locally: *Phenacomys longicaudus* (0-25%), *Neotoma cinerea* (0-15%), *Lepus americanus* (0-10%), *Clethrionomys* spp. (0-21%), *Peromyscus* spp. (5-31%), and *Thomomys mazama* (0-10%). There appears to be definite selection of prey based on (1) nocturnality - otherwise *Tamiasciurus* and *Tanias* would be common prey; (2) mass of 100-400g-adult - lagomorphs are generally not taken and shrews, voles, and mice are low in frequency in diets relative to their abundance in forest; (3) arboreality - GLSA is arboreal, *Neotoma* spp. are semi-arboreal, and *Phenacomys longicaudus* (27 g) is strictly arboreal and more frequently taken when available than the semi-arboreal *Peromyscus* (20 g) and the terrestrial *Clethrionomys* (23 g); arboreality probably relates to detectability of the prey; and (4) social behavior - the colonial *N. fuscipes* is locally concentrated in large numbers whereas the funle-harem *N. cinerea* is locally concentrated in small numbers; *P. longicaudus* is also colonial, whereas *Peromyscus*, *Clethrionomy*, and GLSA are not. These characteristics seem to outweigh abundance: GLSA densities (mean number per ha $\pm$ standard error) in old growth are 0.21 ± 0.09 in the North Cascades of Washington, 0.5 ± 0.2 on the Olympic Peninsula, 2.3 ± 0.3 in the Western Cascades in Oregon, and 1.9 ± 0.1 in the Oregon Coast Ranges and Klamath Mountains, yet GLSA constitutes a greater percentage of the diet in Washington than in southwestern Oregon. But GLSA is probably the most consistently available nocturnal species weighing 100-300g in old-growth western hemlock and Douglas-fir forests. GLSA reaches its highest densities in old growth (3.7/ha) and is more than twice as abundant in old forest than other types in Washington and southwestern Oregon. The amount of old forest encompassed by spotted owls in their home ranges reflects the biomass of the medium-sized prey (GLSA and *Neotoma* spp.) in old growth. Spotted owls can depress GLSA population densities by almost 50% in areas intensively used for foraging." (A)

Diller, L.V. 1992. A private landowner's habitat conservation plan: the Simpson Timber Company HCP. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"In July, 1990 the listing of the northern spotted owl (*Strix occidentalis caurina*) as threatened under the federal Endangered Species Act prohibited "taking" of the species. In response to this listing, the California Board of Forestry adopted regulations to avoid a take of the owls. Among other things, these regulations required retention of 500 acres of spotted owl habitat within a 985-acre (0.7-mile) circle centered on a known pair. High densities of owls (gross density approximately 1 pair/1000 acres) in and adjacent to a situation in which continuing timber harvest and avoiding a take were not possible. This prompted Simpson to seek a permit from the U.S. Fish and Wildlife Service to allow take of spotted owls incidental to its timber harvest operations. As part of the permit application, the company draft a Habitat Conservation Plan (HCP) for the owl."

"Intensive surveys and analysis of nesting sites and stands indicated that spotted owls on and adjacent to Simpson property were recolonizing and successfully reproducing in stands as early as 35-45 years following harvest. The results of these studies were used to project future owl habitat and develop the major premise of the HCP: that even when timber harvest was accounted for, potential owl habitat would more than double over a 30-year planning period. In addition, the plan included several other conservation strategies including setting aside 39 areas totalling 13,000 acres where timber harvest would not occur, establishing a 35,000 acre 'Special Management Area' that would maintain at least 20 pairs of owls and where 'no take' of owls would occur, continuing the spotted owl research program, and managing stands to accelerate the development of future owl habitat." (A)

Dippon, D. 1992. Linking the BLM's RMP planning process with a spatial demographics model for the northern spotted owl. 26 p.

"While the Noon/McKelvey Owl Model is at the heart of the BLM's analysis of alternatives, the development of the necessary input data can be just as important to the model's simulations. Spatially accurate renditions of the expected vegetation dynamics associated with any given plan must be projected if the model is to perform properly."

"This information memorandum will focus on the procedure used to project the pattern of habitat change as input to the Noon/McKelvey Owl Model used in the BLM's analysis of effects." (A)

Folliard, L.B.; Diller, L.V.; Reese, K.P. 1992. Occurrence and nesting habitat of northern spotted owls in managed young-growth forests in northwestern California. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"From 1989 through 1992, approximately 120,000 ha of managed, young-growth forests were surveyed for northern spotted owls (*Strix occidentalis caurina*) in coastal northern California. To date, 169 owl sites have been identified and over 500 birds banded (including 197 juveniles). The relative density of owl sites was greatly influenced by

the amount of acreage of forest greater than 45 years old. The region with the highest density (about 0.46 owl sites/km²) had 37% of the landscape in this older age class. Habitat analysis of 60 nesting pairs revealed that owls nested in stands that varied from pure conifer to those dominated by hardwoods, with no apparent selection for a particular cover type. The median nest stand age was 59 years, with 83% of pairs nesting in stands 35-80 years old. On average, conifer nest stands were dominated by trees 53-90 cm dbh in size. Although the density was low, there was a higher density of large (greater than 90 cm dbh) conifers ($P = 0.010$) in nest stands in comparison with randomly selected stands. In general, hardwood nest stands had smaller trees than conifer stands. In comparison with old-growth forest structure, the most distinctive difference was the low density of trees greater than 90 cm dbh in these managed stands. Favorable conditions in the redwood (*Sequoia sempervirens*)/Douglas-fir (*Pseudotsuga menziesii*) coastal region such as rapid tree growth rates and an abundant prey base, make these second-growth forests suitable spotted owl habitat at an early age. Development of spotted owl habitat in this region can occur at an accelerated rate following timber harvest in comparison with other regions of the species' range." (A)

Forsman, E.D. 1992a. [In press]. Life history characteristics of the spotted owl. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"The Spotted Owl is a medium-sized Strigid that occupies forested areas along the Pacific Coast, the southwestern United States, and Mexico. This paper describes the life history characteristics of the species, focusing primarily on the northern subspecies, which occupies coniferous forests from southwestern British Columbia south to northwestern California."

"Spotted Owls are unique in that they occupy very large home ranges, and show little fear of humans. They nest primarily in trees in either large cavities or on platforms. They typically lay 2 eggs (range = 1-4). Nesting is sporadic, and is not synchronous across the range. The young leave the nest in May or early June, and are fed by the adults until August or September. The young disperse in the fall (September-November). Most do not disperse more than 40 km, although distances up to 120 km have been recorded. Subadults may breed at 1 year of age, although most do not breed until they are 2-3 years old."

"The diet of the northern spotted owl is dominated by medium-sized arboreal mammals, especially Flying Squirrels and Woodrats. Other prey include a variety of small mammals, birds, and insects." (A)

Forsman, E.D.; Maurice, K.; Otto, I., [and others]. 1992b. [In press]. Demography of spotted owls on the Olympic Peninsula, Washington. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"A capture-recapture study of spotted owls was conducted on the Olympic Peninsula in 1987-1991. The study population included owls located on commercial forest lands, wilderness areas, and the Olympic National Park. The sample of owls marked during the study period included 182 adults (89 males, 93 females), 39 subadults (13 females, 26

males) and 156 juveniles. Sex and age-specific models indicated no significant differences in male and female survival rates. Analysis of time-specific models indicated little annual variation in survival rates, and a slight time effect on recapture probabilities. The selected time-specific model (ϕ , P_t) produced survival rates of 0.8820 (s.e. = 0.033) for females, 0.9351 (s.e. = 0.02410) for males, and 0.9124 (s.e. = 0.0197) for both sexes combined. Juvenile survival rates could not be estimated because of low recapture rates. Average fecundity was 0.344 (s.e. = 0.086) for adult females and 0.134 (s.e. = 0.009) for subadult females. Mean life span for adults was 10.6 years, conditional on surviving to age 1."

"Estimated population growth rate (λ) was 0.-. This estimate was based on the assumption that juvenile survival rates were comparable to rates in our other study area in Oregon, where $\lambda = 0.-$, s.e. = 0.-) This estimate also assumed that subadults and adults had similar survival rates. Although our analysis indicated a declining population, we are concerned that our estimate of the rate of decline may be biased. Until we obtain better estimates of juvenile and subadult survival rates, and assess the impact of emigration on adult and subadult survival rates, we feel that our analysis should only be used to indicate the direction of the population growth rate rather than an exact estimate." (A)

Forsman, E.D. 1992c. Demographic studies of northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Between 1985 and 1987, 5 different demographic studies were initiated to determine population parameters of northern spotted owls. These studies include the Willow Creek Study in northwestern California, Medford BLM Study in southwestern Oregon, Roseburg BLM and H. J. Andrews Studies in western Oregon, and the Olympic Peninsula Study in western Washington. All five studies used mark-recapture techniques to assess age and sex-specific survival rates. Fecundity was assessed by counting the numbers of young that left the nest. Population growth rates (λ) were calculated based on birth and death rates of females." (A)

"Estimates of λ indicated that populations in all 5 study areas were declining. Furthermore, a meta-analysis in which estimates from all 5 areas were examined together, indicated a decreasing trend in annual adult female survival. This suggested that the rate of population decline was accelerating."

"Although the results of these analysis are alarming, I believe that they should be viewed with caution. A number of potential biases exist that could make things look worse than they really are. Probably the biggest concern is that survival rates may be underestimated if significant undetected emigration occurs. Emigration is probably most problematic with respect to juvenile survival estimates because juveniles disperse considerable distances from their natal sites. It is also likely that some emigration of adults and subadults occurs as well."

"To better understand population trends of spotted owls, we need more years of data and we need to develop methods to test the magnitude of possible biases in mark-recapture estimates. One way to determine the extent of undetected emigration is

to compare survival estimates from radio-marked and color-banded samples. This will be very expensive and time-consuming as it will involve radio-marking large samples of owls." (A)

Forsman, E.D.; Forson, R.; Hearty, M.; Loschl, P. October 1991a. [Annual report]. Demographic characteristics of spotted owls on the Siuslaw National Forest, 1991. Pages 45-54 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): Elucidate the population ecology of the spotted owl on the Siuslaw National Forest, to include population age structure, and age and sex specific birth and death rates." (A)

Forsman, E.D.; Forson, R.; Grayson, S., [and others]. October 1991b. [Annual report]. Habitat use and home range characteristics of spotted owls on the Olympic Peninsula, Washington. Pages 12-16 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Determine characteristics of spotted owl home ranges, including total area, seasonal changes, and amount of overlap between paired individuals and their neighbors. b. Compare home range characteristics of nesting and non-nesting owls. c. Describe the diet of the radio-tagged owls. d. Determine types of vegetation structure selected for foraging and roosting. e. Describe foraging behavior (frequency of foraging by type of stand, distance traveled to forage, etc.) and changes in foraging behavior with breeding status and season. f. Explore the usefulness of a variety of home range and habitat selection models for evaluating home ranges and habitat use. g. Relate owl use of home range and stand types to information collected in prey base studies." (A)

Forsman, E.D.; Lowell, R.; Maurice, K., [and others]. October 1991c. [Annual report]. Demographic characteristics of spotted owls on the Olympic Peninsula, Washington, 1987-1991. Pages 17-23 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Elucidate the population ecology of the spotted owl on the Olympic Peninsula, to include population age structure, and age specific birth, death, and reproductive rates. b. Compare survival and reproductive rates of color-banded and radio-tagged owls." (A)

Forsman, E.D.; Reid, J.; Horn, R., [and others]. October 1991d. [Annual report]. Demographic characteristics of spotted owls on the Roseburg District of the Bureau of Land Management, Roseburg, Oregon: 1985-1991. Pages 33-44 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objectives: a. Elucidate the population ecology of the spotted owl in the Oregon Coast range, to include population age structure, and age specific birth, death,

and reproductive rates. b. Compare survival and reproductive rates of color-banded and radio-marked owls." (A)

Forsman, E.D.; Sovern, S.; Taylor, M., [and others]. October 1991e. [Annual report]. Habitat use and home range characteristics of spotted owls on the east slope of the Cascade Range, Washington. Pages 22-26 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Determine characteristics of spotted owl home ranges in forests on the east slope of the Cascade Range, including home range area, seasonal changes, and amount of overlap between paired individuals and their neighbors. b. Determine forest types selected for foraging and roosting, c. Describe the diet of radio-tagged owls, to include seasonal changes in diet." (A)

Forsman, E.D.; Sovern, S.; Taylor, M., [and others]. October 1991f. [Annual report]. Demography of spotted owls on the east slope of the Cascade Range, Washington. Pages 27-32 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): Determine demographic characteristics of spotted owls in forests on the east slope of the Cascade Range." (A)

Franklin, A.B. 1992a. [In press]. Future direction in spotted owl population biology. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"Sampling of northern spotted owl populations has increased substantially since the inception of the 5 study areas discussed in this symposium. It is critical that future study designs incorporate the lessons learned from previous research. We discuss considerations in designing studies, the need for integrating demography and population ecology, and the need for understanding how spotted owl populations are regulated. We also discuss important features of spotted owl population biology which we feel should be emphasized in future studies." (A)

Franklin, A.B.; Ward, J.P. 1992b. Density of northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Density is a useful measure for estimating population size, monitoring spatial and temporal population trends, and examining mechanisms of population regulation. We examined density estimates for northern spotted owls from 10 study areas on public lands distributed throughout northern California, Oregon and Washington. Density was estimated based on banded individuals on these study areas which ranged from 300 to 1000 km² in size. Densities on individual study areas were measured over periods ranging from 2 to 8 years. Crude density (number of owls/km² of total area) ranged

from 0.067 to 0.250 owls/km². We tested hypotheses concerning temporal and spatial trends in density estimates. Trends in density appeared stable while there appeared to be geographic differences. We also evaluated density estimates from public lands with those from private land managed for timber production. We discuss the problems inherent in estimating density and the utility of density in monitoring programs. We also discuss considerations for estimating density such as sampling design, study area size, and survey effort." (A)

Franklin, A.B.; Ward, J.P.; Gutierrez, R.J. 1992c. [In press]. Demography of spotted owls in northwestern California. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"A central question in management of northern spotted owl populations concerns the current stability of these populations. We tested the null hypothesis that local and regional populations are stable by 1) estimating age- and sex-specific survival and fecundity rates, 2) incorporating these estimates in a modified Leslie matrix to estimate the finite rate of population change (λ) and 3) testing against population stability ($\lambda = 1$). Based on this analysis, we found that females were significantly declining ($\lambda = 0.9146$, s.e. = 0.0374) whereas males were not ($\lambda = 0.9938$, s.e. = 0.0472). We further examined demographic parameters in terms of factors such as age-structure and movements to evaluate whether key parameters such as juvenile and adult survival were adequately estimated." (A)

Fredrickson, R.J.; Seaman, D.E.; Moorehead, B.B.; Houston, D.B. 1992. [Progress report]. Northern spotted owl inventory and monitoring in Olympic National Park. Port Angeles, WA: USDI National Park Service, Olympic National Park. 7 p.

"Progress is reported on northern spotted owl (*Strix occidentalis caurina*) inventory and monitoring in Olympic National Park during 1992. Field work was completed in Year 1 of a 3-Year research project to estimate spotted owl densities in the park. Intensive surveys were conducted by a crew of 17 persons on off-trail transects that were established across 5 randomly located census blocks (totalling 4947 ha) in the park interior. Thirty-four "historic" sites where owls had previously been banded elsewhere in the park were also monitored."

"A total of 96 spotted owls were detected, including 28 pairs, 15 single birds, and 29 juveniles. Forty owls were also newly banded. Eight owl pairs, 5 single birds and 4 juveniles were found within the census blocks. Crude density estimates in the census blocks suggested a mean pair density of 0.18 owl pairs/km² and a mean total density (pairs and single birds) of 0.49 owls/km². Such estimates are preliminary, representing only 1 year of data and a portion of the habitat that will be surveyed during the project. A reproduction rate of 0.50 female offspring per adult or subadult female spotted owl was estimated for 28 pairs that were located. Twenty-two barred owls (*S. varia*) were also detected, including 8 birds in the census blocks."

"A separate technical report is also in preparation for a peer-review of the project's research design and methods by an independent panel of experienced research scientists

in December 1992. A number of timely administrative recommendations are proposed for future project work (see pp. 11-12)." (A)

Ganey, J.L.; Balda, R.P. 1992. Habitat selection by Mexican spotted owls in northern Arizona. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Although the Spotted Owl (*Strix occidentalis caurina*) has been the object of considerable attention in the Pacific Northwest, little is known about the habitat requirements of the Mexican Spotted Owl (*S. o. lucida*). We compared use of broad habitat types to availability of those types within the home ranges of eight radio-tagged Mexican Spotted Owls in northern Arizona. When all habitat types were considered, no owls used these types in proportion to availability. Use patterns differed among individuals and by activity type. All owls roosted primarily in virgin mixed-conifer and ponderosa pine (*Pinus ponderosa*) forests and less than expected in managed forests. Mature forests appear to be important to Spotted Owls in this region and different forest types may be used for different activities. Consequently, managers should retain virgin stands of both mixed-conifer and ponderosa pine forest where these owls occur, to provide both roosting and foraging habitat." (A)

Hamer, T.E.; Forsman, E.D.; Fuchs, A.D.; Waters, M.L. 1992. Hybridization between barred and spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"We present the first records of interspecific hybridization between the Northern Barred Owl (*Strix varia varia*) and Northern Spotted Owls (*S. occidentalis caurina*). Two hybrid owls in Washington and two in Oregon were confirmed during 1989-92. One of the hybrids paired with a Barred Owl and produced young in 1990 and 1991. In addition, we confirmed the pairing of a female Barred Owl to a one-year-old male Spotted Owl, which produced at least one young in 1992. Hybrids were identified by their unique plumage, unusual vocalizations, and morphological measurements. All three adult hybrids had similar plumage characteristics and vocalizations. Body measurements of hybrids were intermediate between Barred and Spotted Owls, and sonograms of vocalizations displayed attributes of both species. Although genetic comparisons have not yet been conducted, we believe the three adult specimens we observed were all F1 crosses between Barred and Spotted Owls. Hybridization between these species and successful back-crossing by hybrids indicates that the designation of the Barred and Spotted Owl as a superspecies is appropriate." (A)

Hessburg, P.F.; Everett, R.L. 1992. [Draft]. Forest pathogens as catalysts of change in fire-restricted northern spotted owl landscapes. Wenatchee, WA: USDA Forest Service, Pacific Northwest Region, Forestry Sciences Laboratory. 66 p.

"Conclusions. Landscape-level analysis, planning, and management are needed to diminish the risk of catastrophic fire to spotted owl landscapes. This analysis and planning would strive to determine the amount of current risk, and the amount and distribution of stand-level fire risk that is manageable through time. Such analyses may

well reveal that there is a greater probability of achieving the goal of maintaining viable owl populations in perpetuity when current owl population levels and current habitat abundance or quality are somewhat reduced. Future success in providing suitable habitat on a sustainable basis will likely be the result of interdisciplinary planning and active management of habitats as dynamic and movable locations within the forest, rather than the result of long term protection strategies." (A)

Irwin, L.L. March 1992. [Unpublished]. Relations among suitable habitat, fire management analysis zones, and demographic patterns of northern spotted owls on the east slope of the Cascade mountains, Washington. Corvallis, OR: NCASI. 11 p.

"Summary- An updated analysis is reported for habitat conditions at 84 Spotted Owl sites where data on owl occupancy and reproduction are available." (A)

Irwin, L.L. 1992. Management activities on private timberlands and industry-supported research on northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Private timberlands owners in the Pacific Northwest and northern California have developed various approaches to managing their lands relative to legal obligations and voluntary contributions for protecting the northern spotted owl as a federally listed threatened species. Such activities depend upon the size and community of the private forests as well as the owner's objectives. Many private owners contract for annual surveys to locate owls, and some companies evaluate nest-site conditions and monitor reproduction success on their lands. Such activities may be used to schedule timber harvests to avoid locations with owls, or they may support development of habitat conservation plans or HCP's. For example, one company in northern California (Simpson) recently had an HCP approved by the Fish and Wildlife Service for operations on their lands. Another company maintains a computerized database of the status of all owls on their lands or on adjacent lands that may affect their operations. The same company is developing a GIS-based process for predicting other owl locations based upon conditions of known sites in managed forests. In many other cases, private companies survey their lands to determine if planned timber operations do not contain spotted owls. Several private companies support research on their lands to learn more about owl habitat requirements, and some have implemented case-history experiments with innovative forestry practices or special techniques (e.g. nest boxes) that may accommodate owls. In addition, a consortium of companies that purchase federal timber support cooperative research on owl populations and habitat relationships. The goal of much of the industry supported research is to develop new technology that may support forest management alternatives that account for habitat needs of the owl while minimizing costs to wood production. Examples of topics that are being investigated in cooperation with federal agencies will be presented." (A)

Irwin, L.L.; Martin, S.K.; Fleming, T.L.; Buchanan, J.B. March 1992. Demography of spotted owls in managed and unmanaged forests on the east slope of the Cascades Mountains, Washington. 1991 Annual Report. Corvallis, OR: NCASI. 34 p.

"We describe demographic information and habitat relations in 1990 and 1991 for Northern Spotted Owls (*Strix occidentalis caurina*) on the eastern slope of the Cascade mountains in Washington. Over the 2 years 125 Spotted Owl sites were examined for occupancy and reproduction by owl pairs. Field crews located 93 pairs, 55 of which produced young. Of the 125 sites, 92 were surveyed sufficiently to determine occupancy by owls in both 1990 and 1991. Of the 92 sites, 84 were occupied by at least 1 owl (91.3%), and 71 were occupied by pairs (77.2%) at least 1 of the 2 years. Forty-five sites contained pairs both years, 19 of which (27% of all pairs) produced young both years. In 1990, 32 (55.2%) of the 58 pairs produced and fledged 55 young (0.95 fledglings/pair), for a rate of 1.72 fledglings per reproductive pair. In 1991 44 (55%) of 80 pairs reproduced and fledged 71 young (0.89 fledglings/pair), for a rate of 1.61 fledglings per reproductive pair. Reproductive rates did not differ ($P < 0.05$) between years or between managed forests and reserved locations (wilderness, National Parks, roadless area, etc.). Occupancy by a pair in one or both years was correlated with acreage of suitable habitat within 0.5-, 1.0-, 1.5-, and 2.1 miles of a nest- or site-center. Reproductive success was not correlated with acreage of suitable habitat. Partial-correlation analysis revealed that the number of young produced declined with increasing latitude and with increasing distance from the crest of the Cascades, after effects of suitable habitat were removed. Field observations indicated that reproduction was generally highest on the Naches District, which is located in the southern- and western most part of the study area. Since 1989 field crews have banded 112 Spotted Owls, including 51 in 1991." (A)

Johnson, D.H. 1992. Predators, competitors, and mobsters: interspecific interactions involving northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Interactions, between spotted owls and other wildlife species can be placed into four main groups: prey, predators, competitors, and species which are involved in mobbing behaviors ("mobsters"). This presentation offers a review of the latter three groups and offers results of my recently completed study on spotted owls, great horned owls, and forest landscape patterns in the Central Oregon Cascades."

"Predators on spotted owls include the great horned owl, goshawk, red-tailed hawk, and common raven. Although cooper's hawks have been observed in unsuccessful predation attempts, it seems possible that juvenile owls may be taken. Spotted owl mortality caused by avian predation is significant: a query of researchers has indicated that 40% of 91 adult/subadult and 25% of 60 juvenile radio-marked spotted owl deaths were attributable to avian predation; an additional 25% of adult/subadult and 37% of juvenile owls died of undetermined causes; it seems likely that avian predation was involved in at least some of these deaths as well."

"The primary competitor with spotted owls is the barred owl. The barred owl outcompetes spotted owls in several different ways. For example, barred owls are slightly heavier in body mass than spotted owls, take a wider variety of prey, have smaller home ranges which they defend more rigorously, and are more diurnal in their activity patterns. Barred owls seldom "lose" in territorial interactions with spotted owls. Barred owls have continued to expand their range in the Pacific Northwest and now can be found in several hundred locations in Washington, some 260 locations in Oregon, and 17 locations in California."

"A wide range of species have been observed to mob spotted owls. Mobbing species may frequently make physical contact with spotted owls, ruffling the owl's feathers or, in some instances, knocking spotted owls from their perches. The following species have been observed to mob spotted owls: hermit thrush, Swainson's thrush, varied thrush, Cooper's hawk, black-capped and mountain chickadees, red-breasted nuthatch, rufous hummingbird, dark-eyed juncos, hermit warbler, golden-crowned kinglet, Steller's jay, gray jay, northern pygmy owl, and sharp-shinned hawk. The latter four species have more commonly been observed making physical contact with spotted owls."

"Great horned owls have been identified as the primary predator of spotted owls. As old-growth forests become fragmented through logging or natural processes, it is hypothesized that great horned owls become established and increase in numbers as this new niche is created. I conducted a nocturnal survey in 1989 and 1990 to locate great horned owls and spotted owls throughout the range of forest fragmentation levels in the Central Cascades of Oregon. Forest fragmentation levels ranged from landscapes (≥ 500 ha in size) containing intact stands of mature/old-growth forest (0% fragmentation) to landscapes containing younger stands with no mature/old-growth forest (100% fragmentation). Six survey visits were made to each of 469 calling stations located along 28 roadside survey routes. Relative abundance for great horned owls and spotted owls was 0.069 and 0.139 owls/road km, respectively. Thirteen habitat/landscape variables within 500-ha circular landscape plots surrounding great horned owl, spotted owl, and random points were assessed. Significant differences existed between great horned owl and spotted owl landscapes for six variables: great horned owl landscapes contained more shrub/forb and shelterwood, less mature/old-growth and mature/old growth interior habitat, had a higher linear edge-to-mature/old growth area ratio; and were higher in elevation than spotted owl landscapes. The greatest number of great horned owl responses were associated with landscapes containing 10-20% old forest. Great horned owl responses generally declined with increasing amounts of old forest, and few (11%) great horned owls were detected in landscapes containing $\geq 70\%$ old forest. The majority (62%) of spotted owls were detected within landscapes containing $\geq 60\%$ old forest. Spotted owl responses generally declined with declining amounts of old forest and few (7%) spotted owls were detected within landscapes containing $\leq 20\%$ old forest."

(A)

Lehmkuhl, J.F.; Raphael, M.G. October 1992. [Revised draft]. Habitat pattern around northern spotted owl locations on the Olympic Peninsula, Washington. Submitted to Journal of Wildlife Management.

"We compared owl habitat pattern around northern spotted owl (*Strix occidentalis caurina*) locations with owl habitat pattern around random locations and in owl home ranges to assess the impact of habitat fragmentation on owl habitat selection and reproductive performance. Owls were located at 78 sites, and their reproductive status determined by standard call-survey protocol on the Olympic National Forest (ONF), Washington. Owl locations and 100 random locations were mapped across the ONF on owl habitat maps. Habitat pattern attributes were measured in concentric circles of 813, 3,253, and 7,320 ha around each owl and random location. Owl habitat pattern in 6 home ranges of owl pairs was also measured. Values of most pattern attributes in random circles differed ($P < 0.05$) with circle size, or measurement scale. Owl habitat area was greater and some attributes of fragmentation lower in circular areas around owl

locations than around random circles ($P \leq 0.05$). Pattern did not differ in areas around single vs. paired owls. Owl habitat pattern in home ranges was comparable to that in paired 3,253-ha owl circles. Principal components analysis of habitat pattern in 3,253-ha areas around owl locations showed that owl habitat area and variation in patch sizes accounted for 52% of the variation in habitat pattern. We suggest the percentage of area in owl habitat, an isolation index, and the CV of patch area are useful measures of owl habitat pattern in spotted owl home ranges. Our results support the use of circular areas on the order of 3,200 ha for assessment of northern spotted owl habitat on the Olympic Peninsula." (A)

Lint, J.R. 1992. Inventorying and monitoring programs for northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"The annual inventory and monitoring of northern spotted owls has become a tradition for many wildlife biologists working for federal and state agencies, universities, private consultants and private timber companies in the Pacific Northwest. Current survey programs are founded on the efforts of biologists that began the search for owls over two decades ago. Pioneer work by Eric Forsman in Oregon and Gordon Gould in California was instrumental in developing and refining standard survey techniques essential to conducting an inventory."

"In the 1970s, the Forest Service and Bureau of Land Management took the inventory lead by surveying for spotted owl occurrence on lands they administered. This provided the first operational extension of the work of Forsman and Gould. Through the 1970s and early 1980s, agency surveys focused on locating territorial owls to provide basic information for planning timber sales and making land use planning decisions. Survey work for the 1980s decade turned to monitoring owl response to land use decisions and incremental inventory of lands not previously surveyed. During this time period, the use of offered prey called "mousing" and the implementation of banding added new dimensions to the inventory and monitoring program."

"The listing of the spotted owl as a federal threatened species in 1990 accentuated the importance of ongoing work and set in motion intensive efforts by government and private interests to inventory proposed timber sale areas to ensure compliance with the Endangered Species Act. Through inventory and monitoring, knowledge has been gained on the distribution of owls, the relationship of occurrence to forest condition, dispersal movements and reproductive success. The programs, although productive, were not without shortcomings. Some local programs were keyed to finding owls, but lacked clear objectives and plans for data analysis. On a regional scale, poor coordination between agencies, lack of a central data storage and retrieval system and inconsistent formats for data recording were detractions. Fortunately these problems have been identified. The future affords the opportunity to learn from past experience and to establish a single, cooperative spotted owl inventory and monitoring program with common goals and objectives." (A)

McKelvey, K. June 1992. [Unpublished]. A spatially explicit life-history simulator for the northern spotted owl. Arcata, CA: USDA Forest Service, Pacific Southwest Experiment

Station, Redwood Sciences Laboratory. 55 p.

"A spatial model was created to simulate the impact of forest management on populations of the northern spotted owl." (A)

McKelvey, K.; Noon, B.R.; Lamberson, R.H. 1992. [In press]. Conservation planning for species occupying fragmented landscapes: The case of the northern spotted owl. Arcata, CA: USDA Forest Service, Pacific Southwest Experiment Station, Redwood Sciences Laboratory. 50 p.

"In the case of the northern spotted owl, concerns over the reduction and fragmentation of habitat were translated into a specific plan for the subspecies conservation (Thomas et al. 1990). In this paper we report some of the models that were used to guide decisions and thinking about the size and geometry of the proposed reserve design. We would like to emphasize that we are reporting only a small fraction of the studies and analyses that have been pursued to help maintain spotted owl populations, and that our results represent the synthesis of a massive team effort." (A)

Meslow, E.C. 1992. [In press]. Northern spotted owl management, 1972-1992. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"The top level administrators of the responsible Federal Agencies were made aware of the potential impact of the Northern Spotted Owl (*Strix occidentalis caurina*) on timber harvest in 1972. This paper traces the succession of spotted owl management plans/proposals that have evolved in the ensuing 20 years. Current direction continues to emphasize management of the spotted owl rather than the old-growth forests of the Pacific Northwest for which it is the surrogate." (A)

Meslow, E.C.; Bruce, C.R.; Marcot, B. 1992. History of conservation planning for the northern spotted owl. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Conservation planning for the Northern Spotted Owl began in 1973 when the bird was given top priority by the newly formed Oregon Endangered Species Task Force. In 1977 the Task Force recommended maintaining 400 pairs on public lands in the state with 300 acres of old forest reserved per pair. Washington (1978) and California (1981) joined in conservation planning efforts. While the acreage reserved per owl pair increased with time, the operative paradigm remained focused on 1-3 pair management units until 1988. In 1989, the Interagency Spotted Owl Scientific Committee was jointly established by the directors of the four federal wildlife/land managing agencies and charged with developing a scientifically credible Northern Spotted Owl management plan. The committee's product provided for a series of 20 pair conservation areas spaced to facilitate dispersal, with intervening "forest matrix" lands managed to provide habitat sufficient to support dispersal. The draft Northern Spotted Owl Recovery Plan utilizes the same basic construct." (A)

Meslow, E.C.; Forsman, E.D.; Swindle, K.A., [and others]. October 1991. [Annual report]. The ecology of spotted owls on the Willamette National Forest: habitat use and demography. Pages 55-61 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Elucidate the population biology of the spotted owl on a portion of the Willamette National Forest by banding adult and fledgling owls, and documenting age-specific reproductive parameters. b. Determine home ranges and habitat use by spotted owls, using radio-telemetry. c. Determine the diet and prey preferences of spotted owls by collecting and analyzing regurgitated pellets. d. Determine patterns of abundance of primary prey species using live-trapping and other techniques as appropriate (see companion report on prey ecology study). e. Relate owl foraging behavior and reproduction to prey abundance. f. Collaborate with other researchers in the Spotted Owl RD&A Program in synthesizing the results of the owl ecology studies across the Pacific Northwest." (A)

Meslow, E.C.; Forsman, E.D.; Thrailkill, J., [and others]. October 1991. [Annual report]. Demographic characteristics of spotted owls on the Eugene BLM District, Central Coast Range, Oregon. Pages 62-68 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study objective(s): a. Satisfy Eugene BLM District spotted owl monitoring needs (Coast Range province). b. Elucidate the population ecology of the spotted owl on the Eugene BLM District (Coast Range province), to include population age structure and age specific birth, death, and reproductive rates. c. Determine total density of adult/subadult spotted owls within an intensive study area." (A)

Meslow, E.C.; Wagner, R.; Bennett, G., [and others]. October 1991. [Annual report]. Spotted owls in managed forests: identification and evaluation of non old-growth cover types for use in habitat management on the Medford District of the Bureau of Land Management, Oregon. Pages 69-75 in: Wildlife habitat relationships in western Washington and Oregon. USDA Forest Service, Pacific Northwest Research Station. Wildlife Ecology Team. 119 p.

"Study Objective(s): a. Describe habitat use by spotted owls - especially the use of non old-growth cover types. b. Determine population parameters of spotted owls, including comparative density and annual rates for occupancy, turnover, and productivity. c. Identify and evaluate potential management options which utilize non old-growth cover types within spotted owl habitat management." (A)

Meyer, J.S.; Irwin, L.L.; Boyce, M.S. January 1992. [Progress report]. Influence of habitat fragmentation on spotted owl site location, site occupancy, and reproductive status in western Oregon. Corvallis, OR: NCASI. 165 p.

"Our objectives were to (1) estimate several habitat indices, including measures of forest fragmentation, at known Spotted Owl sites; (2) test the null hypothesis of no difference between habitat indices at randomly-selected landscape locations; and (3) test the null

hypothesis of zero correlation between habitat indices and occupancy or reproduction at Spotted Owl sites for which adequate occupancy surveys were conducted for 5 years from 1985 to 1989." (A)

Miller, G.; Forsman, E.D.; Johnson, D.H. 1992. Dispersal and survival of juvenile northern spotted owls. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"With the federal listing of the spotted owl as a threatened species, highlighted by the Interagency Scientific Committee's Conservation Strategy for the Northern Spotted Owl and the Spotted Owl Recovery Planning process, the importance of juvenile dispersal information has become much more apparent. Prior to 1982, information on the dispersal ecology of juvenile northern spotted owls was limited. Since that time, three general 'sources' of study can be identified that have addressed the dispersal topic. (1) In 1982, radio-telemetry studies, using back-pack transmitters, were initiated in Washington, Oregon and California to gather information on juvenile dispersal. Between 1982 and 1985, 6 juveniles in Washington, 32 in Oregon and 23 in California were followed during dispersal. A summary of first-year survival, distance dispersed, and habitat use is provided. (2) Between 1985 and 1987, intensive banding studies were initiated in Washington, Oregon and California, providing the opportunity to band several hundred juvenile spotted owls. A summary of dispersal distances and survival estimates obtained from the band return (resighting) data is also provided. (3) In 1991, a new radio-telemetry study, using tail-mounted transmitters, was initiated in Oregon and Washington to provide additional information on juvenile survival estimates. Preliminary results from that study for 1991 and 1992 are reported. A comparison of the three sources of information is discussed."

"An overview of how all the information on juvenile dispersal and survival has been incorporated into the Interagency Scientific Committee's Conservation Strategy for the Northern Spotted Owl and the Northern Spotted Owl Recovery Planning process is also discussed." (A)

Miller, G.S.; DeStefano, S. 1992a. [In press]. Field and analysis methods for spotted owl demographic studies. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society: 1992 June 22-28; Seattle, WA.

"Spotted Owls were located on each study area using calling surveys (vocal imitations and playback) conducted both during the day and at night. Spotted owls were captured using a noose or snare pole and banded with USFWS lock-on bands and a colored plastic leg band. Reproductive status was determined by mousing the birds. Sites where spotted owls had been banded in previous years were resurveyed each year to confirm bands and band new birds. Capture history arrays of 1's and 0's were developed for all banded birds, where a 1 indicated that a marked bird was seen ≥ 1 times during the year and a 0 indicated that the individual was not observed for that year. Survival estimates and resighting probabilities were calculated using capture-recapture methodology. We used programs RELEASE and SURGE for data summarization, model selection and fit, and parameter estimation." (A)

Miller, G.S.; DeStefano, S.; Brown, M.T., [and others]. 1992b. [In press]. Demography of spotted owls in the central Cascades, Oregon. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"Demographics of the northern spotted owl were studied in the central Cascades of western Oregon between 1987 and 1991. A total of 358 individual owls were banded over the 5-year period with yearly surveys conducted to re-sight marked birds. Re-sighting rates were high, especially for the adult age class. Mean fecundity for adult females was 0.30. Survival was higher for adults than juveniles and for adult males vs. adult females. The rate of change in territorial adult females/year was calculated, with λ significantly less than 1. Population dynamics and the significance of the λ calculation are discussed." (A)

Montgomery, C.A.; Brown, G.M.; Adams, D.M. ca. 1992. [Draft]. The marginal cost of species preservation: the northern spotted owl. Missoula, MT: University of Montana, School of Forestry. 35 p.

"Because species survival is not certain, the decision to "save " a species is not an all-or-nothing choice but rather a marginal one. The appropriate unit for both benefit and cost functions is like the likelihood of survival and the appropriate question is how certain we want to be of species survival. The intensity of the species preservation debate is also fired by strong equity concerns. We illustrate these points for the case of the northern spotted owl by constructing a marginal cost curve for its survival and by disaggregating welfare loss by region and by market level." (A)

Reid, J.A.; Forsman, E.D.; Lint, J.B. 1992. [In press]. Demography of spotted owls in west central Oregon. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"A capture-recapture study of northern spotted owls (*Strix occidentalis caurina*) began on the Roseburg District of the Bureau of Land Management in west-central Oregon in 1985. The study area is commercial forest land of alternating sections of federal and private ownership. The sample of marked owls included 469 adult/subadults (207 females, 262 males) and 239 juveniles. Sex and age specific models indicated similar survival rates of males and females. The preferred model produced a survival estimate of 0.857 (s.e. = 0.021) for females and 0.846 (s.e. = 0.017) for males. Juvenile survival varied depending on the model used. The preferred model produced a juvenile survival estimate of 0.405 (s.e. = 0.136). There was no time effect on survival or recapture probabilities for either females or juveniles. The preferred model indicated a time dependence on survival rates for males. An average fecundity rate was 0.330 (s.e. = 0.039) for adult females and 0.094 (s.e. = 0.055) for subadult females. Mean lifespan for adults/subadults was 6.5 years contingent upon the individual reaching one year of age."

"Estimated population growth rate (λ) was 0.0964 (s.e. = 0.037). This indicates a declining population of resident owls. However, the estimate of λ is not significantly different from 1 ($p = 0.168$). Future years of study will provide more precise estimates." (A)

Rinkevich, S.E. 1992. Distribution and habitat characteristics of Mexican spotted owls in Zion National Park, Utah. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Distribution, habitat characteristics, and food habits of the Mexican spotted owl (*Strix occidentalis lucida*) were investigated in Zion National Park. Two hundred and twenty-nine surveys were conducted in canyon and plateau habitat between May-August 1989 and April-August 1990. I located owls in nine different locations; each owl was associated with narrow canyons, "hanging" canyons, and cliff sites. The minimum estimated density in Zion National Park was 0.02 owls/km² in 1989 and 0.03/km² in 1990. Spotted owls were widely distributed and coincident with discontinuous habitat within the park."

"I used stepwise discriminant analysis to examine the habitat differences between (1) observed owl microsites and available microsites and (2) observed owl canyon habitat and available canyon habitat. Spotted owl microsites had higher humidity, more vegetation strata, narrower canyon widths, and higher percentage of ground litter than available microsites. Habitat within owl use canyons had higher humidity and higher total snag basal area than available canyon habitats. Owls may be selecting canyon habitat not only for the structural habitat features but also for the microclimate. The presence of canyons and cliffs may provide necessary refuge from high daytime temperatures that occurred in the study area. Mexican spotted owls do not appear to depend on extensive stands of old-growth forests as do northern spotted owls (*S. occidentalis caurina*) because this type of habitat is lacking in Zion Park. Seventy-one prey items were identified from 60 pellets collected from two owl territories. Mammals comprised 99.9% of estimated biomass and 80.3% of the total diet composition. Bushy-tailed woodrats (*Neotoma cinerea*) were the primary prey taken by owls. They comprised 67.3% of the estimated biomass and 40.3% by frequency of the diet. Further studies are needed to investigate the habitat requirements of spotted owls in the northern region of its range." (A)

Rowland, M.J. 1992. Northern spotted owl litigation review. Proceedings of the spotted owl symposium: Raptor Research Foundation 1992 Annual Meeting; 1992 November 11-15; Bellevue, WA.

"Principal court cases affecting the northern spotted owl will be reviewed. These cases include: Northern Spotted Owl v. Hodel: A suit against the US Fish and Wildlife Service for failure to list the spotted owl under the Endangered Species Act (ESA) and failure to designate critical habitat for the owl. The agency was ordered to reconsider its failure to list the owl, and the owl ultimately was listed. The court also ordered the agency to designate critical habitat."

"Seattle Audubon Society v. Robertson: A suit challenging the US Forest Service's spotted owl management plan for failure to comply with the National Forest Management Act (NFMA) and the National Environmental Policy Act (NEPA). The court ruled that the Forest Service's plan did not meet the requirements of either law, ordered the agency to prepare another plan, and enjoined further timber sales in spotted owl habitat until a legally adequate plan is in place."

"Bureau of Land Management v. US Fish and Wildlife Service: A petition by the Bureau of Land Management (BLM) for an exemption for 44 timber sales in Oregon from the requirements of the ESA. The Endangered Species Committee granted an exemption for 13 of the sales, the first exemption ever granted under the ESA after a full hearing."

"Portland Audubon Society v. Bureau of Land Management: A suit against the BLM for failure to follow NEPA requirements in managing the spotted owl. The court found that the BLM had violated NEPA and enjoined timber sales in spotted owl habitat pending the agency's compliance with NEPA." (A)

Steger, G.N.; Munton, T.E.; Verner, J. ca. 1992. [Draft]. Preliminary results from a demographic study of spotted owls in Sequoia and Kings Canyon National Parks, 1990-1991. Proceeding of the National Park Service Fourth Conference on Research in California's National Parks. San Francisco, CA: USDI National Park Service.

"In a study area of approximately 343 km² (132 mi²) in Sequoia and Kings Canyon National Parks, 54 adult and subadult and 21 fledgling California spotted owls were located in 1990 (crude density = 0.157 owls per square kilometer). Comparable numbers in 1991 were 60 adults and subadults and one fledgling (crude density = 0.175 owls per square kilometer). Thirteen of 22 pairs in 1990 were found with young and one of 23 pairs was found with young in 1991. The reproductive rate (the proportion of pairs checked for reproduction that fledged young) was 0.88 in 1990 and 0.08 in 1991; the combined turnover rate for 1990 and 1991 was 19.5%." (A)

Timber Association of California. n.d. [Interim report]. California timberland wildlife habitat study. Redding, CA: Vestra Resources, Inc. 51 p.

"The WHS uses state of the art capabilities in terms of data collection, computer generated mapping, and management prescription information to analyze the status of wildlife habitat in all of California's forests."

"At present this interim report covers the presumed range of the northern spotted owl." (A)

USDA Forest Service. September 1991. 1991 annual report spotted owl inventory and monitoring program. San Francisco, CA: USDA Forest Service, Pacific Southwest Region. 24 p.

"This report summarizes Spotted Owl (*Strix occidentalis*) survey and inventory data collected during 1991 on U.S. National Forest Service lands in the Pacific Southwest Region of the Forest Service (hereafter Region 5). For the purposes of this report, the Region has been divided into three provinces: the Klamath Province in northern California, the Sierra-Nevada Province spanning the length of the Sierra-Nevada mountain range, and the Southern California Province. In Region 5, there are 18 National Forest units, and survey or inventory data were reported from each of the 18 units in 1991."

Region of the Forest Service (hereafter Region 5). For the purposes of this report, the Region has been divided into three provinces: the Klamath Province in northern California, the Sierra-Nevada Province spanning the length of the Sierra-Nevada mountain range, and the Southern California Province. In Region 5, there are 18 National Forest units, and survey or inventory data were reported from each of the 18 units in 1991. "

"In Region 5, the populations of the Northern Spotted Owl are found on the Klamath, Mendocino, Modoc, Shasta-Trinity, and Six Rivers National Forests, as well as the portion of the Lassen National Forest north of the Pit River." (A)

Wagner, F.F.; Meslow, E.C.; Bennett, G.M.; Small, S. 1992. [In press]. Demography of spotted owls in southern Cascades and Siskiyou Mountains, Oregon. Proceedings of the symposium: 62nd Annual Meeting of the Cooper Ornithological Society; 1992 June 22-28; Seattle, WA.

"We estimated the finite rate of population change for northern spotted owls in the southern Cascades and the Siskiyou Mountains of Oregon for the period 1985 through 1991. Survival probabilities were estimated with capture-recapture methods by annually resighting uniquely color-banded spotted owls. We used programs RELEASE for data summary and goodness-of-fit tests and SURGE for model selection and fit. Fecundity was estimated annually according to a standardized field protocol. The finite rate of annual population change indicates that the population of resident females declined significantly over the observed time period." (A)

Young, K.E.; Franklin, A.B.; Ward, J.P. 1992. Infestation of northern spotted owls by Hippoboscids (Diptera) flies in northwestern California. 17 p.

"ABSTRACT - Hippoboscids flies were found on 62 (16.7%) of 382 northern spotted owls (*Strix occidentalis caurina*) captured between April and September, 1986 through 1990. Two species of hippoboscids were identified: *Icosta americana* and *Ornithomya anchineuria*. Male and female adult spotted owls had similar prevalences and relative densities of hippoboscids flies. Juvenile owls had lower prevalences and relative densities than adults. There were no significant differences in mean intensity of hippoboscids on adult male, adult female and juvenile spotted owls. Relative densities of flies infesting adult owls were significantly greater during years of increased fall temperatures. " (A)

Zabel, C.; McKelvey, K.; Paton, P., [and others]. July 1992. [In preparation]. Home range size and habitat use patterns of northern spotted owls in northwestern California and southwestern Oregon. 40 p.

"Abstract - Home range sizes were estimated for northern spotted owls at 3 study sites in northwestern California and southwestern Oregon. We found significant positive correlations between the number of days an owl was radio tracked and home range size, indicating home ranges may shift or expand over time. Differences in home range sizes corresponded to differences in the primary prey of owls in different locations. We tested whether owls used habitat types within their home range in proportion to availability, and determined which habitat types were used more or less than expected. Patterns of

selectivity were similar to those found in earlier studies on spotted owls , but our results were weaker. We suggest that it is difficult to show selection for mature trees when most of the available habitat consists of mature trees. Our study areas were located where higher proportions of the landscape were mature forest compared to earlier studies. Use of suitable/unsuitable edges by owls was examined by comparing distance distributions of radio locations from the nearest edge to random locations. Where owls were preying predominantly on woodrats, they showed a preference use of edges. Where owls were preying predominantly on northern flying squirrels, they showed neither preference nor avoidance for edges. We tested the hypothesis that owls use suitable or unsuitable habitat exclusively within their home ranges and that the pattern we observed were due to telemetry error. Random points were displaced from either habitat type by distances equal to our estimated telemetry error. Distributions between displaced random points and owl locations differed significantly, indicating the patterns we observed could not be produced by our error distribution. Power of Chi-square tests of habitat selection is present, and factors that influence power are discussed." (A)

Zabel, C.J.; Noon, B. 1992. [Draft Annual Report 1992]. Demographic parameters of the northern spotted owl on the Coos Bay BLM district and Siskiyou National Forest, southwestern Oregon. Arcata, CA: USDA Forest Service, Pacific Southwest Region. 9 p.

Tables on survival and reproductive rates of populations of spotted owls on the Coos Bay BLM District and Siskiyou National Forest in Oregon. (C)

CHAPTER 6

ASSESSMENT OF EFFECTS ON OLD-GROWTH FOREST SPECIES

Scientific Analysis Team

CHAPTER 6

ASSESSMENT OF EFFECTS ON OLD-GROWTH FOREST SPECIES

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CHAPTER 6

ASSESSMENT OF EFFECTS ON OLD-GROWTH FOREST SPECIES

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CHAPTER 6 OTHER SPECIES

INTRODUCTION

Court Order

This document addresses the portion of the United States District Court order dealing with evaluation of habitat planning for the northern spotted owl on National Forests as affecting viability of other old-growth associated species. Specifically, our task was: (1) to determine if the northern spotted owl conservation alternatives as presented in the Final Environmental Impact Statement (FEIS), and especially the conservation strategy adopted in the Record of Decision, would result in the extirpation or extinction of any of the 32 vertebrate species associated with old-growth forest on national forests within the range of the northern spotted owl, as identified in the FEIS and in the Judge's order; and (2) if analyses indicate low viability ratings for other old-growth species, as a result of the proposed Forest Service actions, to propose appropriate mitigating options (USDA Forest Service letters of direction dated 30 July 1992 and 28 August 1992).

Framework for Assessment

Our evaluation of old-growth species entailed three phases:

- a) identify species closely associated with old-growth forests and components of old-growth forests;
- b) evaluate viability effects on each species under each of the five alternatives in the Northern Spotted Owl FEIS, including estimating the likelihood of extirpation from planning areas within the range of the northern spotted owl; and
- c) identify mitigation options to ensure likelihood that species will not be extirpated from planning areas within the range of the northern spotted owl as a result of Forest Service actions.

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

Extirpation and viability effects were judged on the basis of individual planning areas, defined as individual National Forests within the range of the northern spotted owl. In estimating influences on other old-growth species, the team was not expected to conduct a formal viability assessment for every species. Rather, our assessment team was to use common sense and expert judgment, and to explicitly display and discuss the process used for establishing viability ratings (USDA Forest Service letter of direction dated 28 August 1992).

METHODS

Description of Northern Spotted Owl FEIS

Viability of old-growth forest species was evaluated under each of the five planning alternatives presented in the FEIS. These alternatives were:

- A - Spotted Owl Habitat Areas
- B - Interagency Scientific Committee (ISC) Conservation Strategy
- C - ISC Strategy plus USDI Fish and Wildlife Service's critical habitat designated for the northern spotted owl
- D - ISC Strategy plus all additional northern spotted owl habitat
- E - The Multi-Resource Strategy

Standards and Guidelines of the Selected Alternative

The selected alternative in the FEIS was Alternative B, the ISC Conservation Strategy. This strategy entailed designation of Habitat Conservation Areas (HCA's) to encompass nesting, roosting, and foraging habitat for the northern spotted owl throughout its range on National Forests.

In addition, the "forest matrix" lands between the HCA's are to be managed to provide for Spotted Owl dispersal habitat. Management guidelines for providing dispersal habitat are termed the "50-11-40 rule." This is defined as providing, on each quarter-township outside of HCA's on National Forests within the range of the northern spotted owl, 50 percent of the forested land base in forest stands averaging at least 11 inches diameter (DBH, diameter at breast height) and at least 40 percent canopy closure.

In addition, the ISC Conservation Strategy assumes that other land allocations still apply that also provide for old-growth forest cover, as identified in each National Forest land management plan.

Old-Growth Species Identified in the FEIS

The FEIS identified 32 species of terrestrial (non-fish) vertebrate wildlife that are closely associated with old-growth forests or components of old-growth forest (see FEIS, Volume 1, p. 3&4-136, Table 3&4-30, "Species closely associated with late-successional forest"). Our analysis has refined the basis for evaluating the degree of association of these species with late-successional forest, and has expanded the evaluation to include plants, invertebrates, and fish, as well as all terrestrial vertebrates (amphibians, reptiles, birds, and mammals).

Why Evaluate All Species Groups?

We considered a a wider range of plant and animal species than presented in the FEIS for three main reasons. First, selecting and implementing a spotted owl habitat management plan is best conducted from a base of full disclosure and knowledge of all species effects. 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 fuller method of ecosystem management. On this last point, identification of impact effects and

mitigation options for individual species is still but one step in ecosystem planning. We do not intend this assessment to substitute for a complete ecosystem analysis; it is one vital and major step toward such an analysis.

As well, 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 2 July 1992). The present project was conducted to help the Forest Service determine the point at which future security of late-successional species occurring within Northern Spotted Owl habitat would be safeguarded.

Identification of Old-Growth Species

"Long lists" of species that use mature and old-growth forest. First, we identified all plant and animal species that might find optimal habitat within mature or old-growth forests on 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. We also accessed unpublished studies and data, existing Forest Service data bases (ecology data bases), and used professional knowledge to compile the long lists of plants. The technical and scientific literature contains many references on species occurring in old-growth forest (see citations in Appendices 6-A and 6-C). We did not attempt to review every existing piece of literature; rather, we focused on the major syntheses of old-growth species lists most often cited and used by resource managers and biologists.

We compiled a composite list of all species that were depicted in these references as using late-successional forests (mature or old growth) 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 6-A for long list of terrestrial vertebrate species). A long list of some 214 fish species and stocks also was considered by the fish experts.

"Short lists" of species highly 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 6-1). Not all old-growth species on the long list from the first step are primarily associated with old-growth forests; some species also occur commonly in early successional stages and in young-growth forests, or in other special habitat conditions. The criteria we developed helped identify those species notably correlated with old forest stages and old forest components such as large snags and large down logs, and those species with state or federal proposed or actual listing status. The criteria helped produce a "short list" of species likely to be highly associated with old-growth forests or components of old-growth forests (Appendices 6-B, 6-C, 6-D).

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 of dead vegetation and wood on the forest floor. We explored species' use of old-growth forest components, as these are elements of old-growth forest ecosystems that possibly could be

provided outside old-growth forests per se by use of innovative silvicultural prescriptions. These old-growth elements are key to the dispersal and distribution of some wildlife species across the general forest matrix landscape.

Table 6-1. Criteria for developing the list of species highly associated with old growth ("short list").

-
- I. Criteria for assigning species to old-growth associated list
(a species is included in the list of species highly associated with late-successional or old-growth forests if it meets one or more of the following 4 criteria)
- A. species is significantly more abundant (based on field study or collective professional judgment of Scientific Analysis Team) in late-successional forest than in mid-successional forest, in any part of its range
 - B. species shows association with late-successional forest (may reach highest abundance there, but not necessarily statistically so) and species requires habitat elements that are contributed by late-successional forest (based on field study or collective professional judgment of Scientific Analysis Team)
 - C. species is associated with late successional forest (based on field study) and is on Federal (USFWS) or State T&E List, on USFWS Candidate Species List, USFS R-5 or R-6 Sensitive Species List, or listed by WA, OR, or CA as species of special concern or sensitive species
 - D. field data are inadequate to measure strength of association, and the species is listed as Federal (USFWS) T&E, and SAT suspects that it is associated with late-successional forests
- II. Specific factors from above list of criteria, to denote for each terrestrial vertebrate species (herps, birds, mammals) as used in Appendix 6-A.
- A. field data: species is significantly more abundant in late-successional forest than in mid-successional forest based on field data
 - A. SAT judgment: species is significantly more abundant in late-successional forest than in mid-successional forest based on collective professional judgment of Scientific Analysis Team
 - C. association with late-successional forest: species is associated with late-successional forest (may reach highest abundance there, but not necessarily statistically so)
 - D. requires late-successional forest elements: species requires habitat elements that are contributed by late-successional forest (based on field study or collective professional judgment of Scientific Analysis Team)
 - E. Federal USFWS T&E: species is on Federal (USDI Fish and Wildlife Service) List of Threatened or Endangered Species
 - F. Federal USFWS Candidate: species is on Federal (USFWS) Candidate Species List
-

Table 6-1 continued

-
- G. USFS Sensitive Species: species is on USDA Forest Service Region 5 or 6 Sensitive Species List
 - H. State list: species is on state list (T&E, sensitive, special concern) in WA, OR, or CA
 - I. Inadequate field data: unaware of adequate field data by which to measure (quantify) strength of association with late-successional forest
- III. Relating factors to criteria -- Species qualifies as a "short list" species under a given criterion if it strictly meets the following factor conditions:
- A. Meets Criterion 1 if meets: A) factor A or B
 - B. Meets Criterion 2 if meets: A) factor C and D
 - C. Meets Criterion 3 if meets: A) (factor A or C) and (E or F or G or H)
 - D. Meets Criterion 4 if meets: A) factor I and E 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, and complicating, cumulative effects of other biological and nonbiological factors. Our evaluation of potential viability effects on old-growth species is not a quantitative population viability analysis, as we mostly lack data and specific models of habitats and populations by which to quantify likelihoods of extirpation and continued existence. Our emphasis was on habitat amount and distribution provided under planning alternatives. Although, given more time, we could have tapped into additional literature on some species, this would not alleviate the lack of basic scientific studies on many species and ecological conditions in many geographic areas.

Our assessment considered effects on species viability, but we did not evaluate dynamic aspects of ecosystem process and function, such as by analyzing the type, frequency, and potential effects of disturbance events (for example, fires, wind storms, and natural succession). Thus, the viability evaluations presented in this report 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.

Ecological characteristics of species. Life history and 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 short list species 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 overlaid over maps of reserved areas (such as

Wilderness) and designated habitat areas under each of the five planning alternatives in the FEIS. This analysis helped determine the general extent of the distributional range of each short list species that would be protected by designated spotted owl habitat plus reserved area under each alternative, as well as the acreage of forest outside of designated areas classified as suitable for timber harvest. All of this information was used in evaluating potential viability effects.

Effects of forest 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 FEIS alternatives and as influenced by individual Land Management Plans (LMP's) 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 old-growth maps"). We also used the current land management allocations (full timber production, partial timber production, and no timber production allocations) from individual LMP's from National Forests in Washington and Oregon as affecting the PMR old-growth categories (large old growth, small old growth, and other conifer) on each National Forest. Such data, along with maps of PMR old growth throughout the region and maps of each National Forest's LMP, helped us discern the potential amount and arrangement of old forest cover at present and over time that would be provided by individual forest plans above and beyond that provided under each planning alternative presented in the FEIS.

Expert panel evaluations. To evaluate viability risks of each species, we convened a set of five expert panels to evaluate the "short lists" of old-growth species. The panels evaluated viability risk for each species by planning alternative from the Northern Spotted Owl FEIS. Five panels each consisted of seven to eight recognized experts in (1) fungi and nonvascular plants, (2) vascular plants, (3) amphibians and reptiles, (4) birds, and (5) mammals (Appendix 6-E).

In their viability evaluations, the panels considered information on ecological characteristics of each species (including information in Appendix 6-D), 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 a 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 viability risks in each area. The viability ranking system used by the panels is presented in Table 6-2.

Table 6-2. Species and population viability ranking scale. The following 5-class ranking scale was to be 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 (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 on 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 on 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 similar likelihood of widespread or complete extirpation. 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. 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. There is no latitude for natural catastrophes and uncertainties in knowledge.

Identification of viability risk species. For each species we identified two levels of viability risk. **High viability risk species** are those that were generally ranked by the panels as less than "high" or "medium high" viability over an approximately 50-year period under at least one alternative. We felt that such a risk category roughly corresponded to the population viability criteria presented in the Regulations (36 CFR 219.19) implementing the National Forest Management Act of 1976. A 50-year time period was chosen as representing a median duration over which adverse viability effects as well as any significant modification of old-growth forest habitats, particularly timber harvesting, would occur.

Extirpation risk species are those that were generally ranked by the panels as "medium low" or "low" viability over an approximately 50-year period under at least one alternative. 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. The

exception to this may be local endemic species such as stock of anadromous salmonids, which are either entirely or largely restricted to areas managed by the USDA Forest Service.

Extirpation risk species are of greater concern for potential loss of a species within one or more planning areas (National Forests) over an approximately 50-year period. The panel experts provided professional advice for use in our evaluation; the Scientific Analysis Team, however, made the final interpretations on viability. Overall, both levels of viability risks were identified for all species except for invertebrates and fish stocks. Ecological associations and geographic distributions of invertebrates are very poorly known, and viability of each of these species could not be evaluated for each alternative at the present time.

Assessment of the probability of the proposed measures for maintaining and restoring habitat for at-risk stocks of anadromous salmonids (Nehlsen et al. 1991) was done for all 112 stocks rather than for individual stocks. Habitat degradation, which includes loss of or a decrease in the quality of freshwater habitat, contributed to the demise 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 to changes in habitat conditions resulting from land-management activities may also vary (Reeves et al. in press). Whereas habitat requirements vary, all species are dependent on the same suite of processes and elements to structure and maintain habitat. We therefore assumed that the proposed mitigation actions were sufficiently robust to address the processes and elements that influence fish habitat and would result in the creation and maintenance of a range of conditions conducive for supporting all species and stocks.

All aspects of the viability assessments were conducted in close coordination with the Northern Spotted Owl Recovery Team, USDI Fish and Wildlife Service.

The following specific methods were used to evaluate viability of each species group.

Fungi and Nonvascular Plants. An assessment of fungi, lichen, and nonvascular plants was led by a Forest Service ecologist, under the guidance and oversight of the Scientific Analysis Team. Because much of the expert knowledge of these species was with academic experts in the Pacific Northwest, contracting and review outside of 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. The ecologist also worked with the expert panel to evaluate potential viability concerns under each FEIS alternative and to identify mitigation options to help ensure high viability.

Vascular Plants. Vascular plants were assessed with the help of a Forest Service core team of plant experts, under the guidance and oversight of 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, the Forest Service Region 5 and 6 Ecology data bases, 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 Diversity Data Base, and California Native Plant Society.

The core team sought analysis and evaluation help from Forest Service professional botanists and ecologists and from outside state and academic experts. The team also worked with the expert panel to evaluate potential viability concerns and to identify mitigation options.

Invertebrates. As a starting point in evaluating effects on invertebrates associated with old growth, the Scientific Analysis Team relied on earlier assessments provided to USDI Fish and Wildlife Service, Northern Spotted Owl Recovery Team, under the direction of Jon Bart, Recovery Team Leader, and Robert Anthony, Group Leader. The previous reports included those by Frest and Johannes (1991) and Lattin and Moldenke (1992). These previous assessments were reviewed under contract for the Scientific Analysis Team as follows.

The work on mollusks (Frest and Johannes 1991) was reviewed by Ingrith Deyrup-Olsen, an academic expert in the field (see Appendix 6-E for reviewers' affiliations) (letter to Scientific Analysis Team from Deyrup-Olsen dated 6 November 1992). The review focused on evaluating the content and conclusions of the previous report.

The work on arthropods (Lattin and Moldenke 1992) was reviewed under contract with The Xerces Society in Portland, Oregon, a professional society established for the study and conservation of invertebrates of the Pacific Northwest. The contract resulted in a second report (Olson 1992) which reviewed the content and conclusions of the previous work and included a qualitative evaluation of how the five FEIS alternatives might affect arthropods.

Fish. Evaluation of the effects of the various alternatives on habitat of potentially threatened and endangered stocks of anadromous salmonids on National Forests within the range of the northern spotted owl was derived from ongoing evaluations of anadromous fish (USFS 1992a). The assessment for these stocks was on habitat conditions and not populations. Refer to Appendix 6-K for justification of assessing the effects on habitat.

Each alternative was evaluated in terms of: (1) the probability of maintaining or restoring riparian zones and their ecological functions and processes; (2) the presence and components of a watershed restoration program; and (3) the fraction of the landscape, particularly that contained within key watersheds (Johnson et al. 1991), covered by owl reserves. All alternatives lacked riparian management standards and a watershed restoration component. We assumed that Forest Plan riparian zone management standards and guides would apply. Emphasis was on the fraction of key watersheds contained within owl reserves.

Key watersheds had previously been identified as part of an evaluation of alternatives for management of late-successional forests Johnson et al. (1991). These were watersheds that either currently contained good 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 Region 5 Fish and Watershed Work Group, which did so as part of assignment to

develop a strategy for managing fish habitat and riparian ecosystems for the Six Rivers, Mendocino, Klamath, and Shasta-Trinity National Forests. Some original watersheds were removed and others added. The key watersheds evaluated in this this exercise included these changes.

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

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 viability expert panels helped to identify mitigation options for habitat conditions conducive to providing for high viability, for those species that ranked less than high or medium high in viability. Mitigation options included general qualitative and, where available, quantitative management standards that would provide needed habitat conditions, such as provision of components of old-growth forests outside Habitat Conservation Areas (HCA's) 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, the results of the fish assessment team, and additional supplementary information on fish, Northern Goshawks, Marbled Murrelets, Marten, Lynx, and other species.

To combine mitigation options among all viability risk species under Alternative B, we used the following step-wise process. In each step in the process, the habitat needs of additional old-growth species were provided in a cumulative fashion. To ensure the needs of all species, the mitigations resulting from all steps would need to be adopted.

1. Standards and guidelines from existing Land Management Plans of National Forests within the range of the Northern Spotted Owl. This step entailed simply accepting the standards and guidelines in the existing National Forest Land 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 such standards and guidelines for forest management. This step entailed identifying which species would and would not be provided under existing standards. We assumed for this assessment that existing management direction corresponded to Alternative A in the FEIS.

2. Standards and guidelines for habitat management under Alternative B. We identified the standards and guidelines for habitat management under Alternative B in the FEIS. This established the extent and locations of HCA's

and management guidelines for provision of dispersal habitat in the forest matrix between HCA's, as per guidelines from the Interagency Scientific Committee's report on the Northern Spotted Owl. In this step, we identified the species that would and would not be provided by the combination of the standards and guidelines from national forest Land Management Plans and from Alternative B of the FEIS.

3. Recommended additions to HCA's on national forests. We identified additions to HCAs within national forests needed as mitigation for reduced spotted owl viability associated with Bureau of Land Management's habitat management guidelines (see Chapter 4).

4. Mitigations for fish habitat and riparian-dependent species. We then applied standards and guidelines for the 112 fish stocks at risk. This step provided a substantial increase in the distribution and extent of existing and potential old forest cover for a wide variety of species. We listed the species likely benefited by the conservation of watershed and riparian protection areas.

5. Mitigations for Marbled Murrelet. Next, we applied standards and guidelines for the Marbled Murrelet. This accounted for additional forest areas conserved within proximity to marine environments. We identified other species likely benefited by the combination of guidelines for the Watershed Protection Areas and for the Marbled Murrelet.

6. Mitigations 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.

7. Additional mitigations for other species in the upland forest matrix. Finally, we identified any other species not included in the first four 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 the first 6 steps.

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 on 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 on National Forests alone. For example, to restore viability to many fish stocks at risk would also entail addressing problems outside National Forests, including effects of water impoundments and harvesting. 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 the species' reliance on old-growth forest habitats on National Forests over time. These are significant factors to consider in a viability analysis. A reevaluation of our recommendations may be warranted if future viability analyses incorporate these factors as new information becomes available.

Also, management of old forest habitats (late-successional forests and Northern Spotted Owl habitat) on other lands, such as on Bureau of Land Management lands in southwest Oregon, can influence the distribution and abundance of many old-growth wildlife species on 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 identified mitigation options in coordination with USDA Forest Service regional offices, drawing on management standards and guidelines in preparation but not yet in effect, or under development. This was useful in particular for identifying needs for Marbled Murrelet, Northern Goshawk, and Marten, and for coordinating with ongoing management efforts.

RESULTS

Identification of Old-growth Species

We evaluated well over a thousand plant and animal species (including fish stocks and other species in portions of their ranges; hereafter, collectively "species or ranges") for their association with old-growth forests of the Pacific Northwest within the range of the northern spotted owl ("long list" of species; see Appendix 6-A for long list of terrestrial vertebrates). These species included nearly 700 species of plants and fungi, 214 fish stocks, and 224 terrestrial (non-fish) vertebrates. In addition, our contractors considered hundreds of invertebrate species. Of these totals, 312 plants, 149 invertebrates, 112 fish stocks, and 90 terrestrial vertebrates were found to be closely associated with undisturbed or old-growth forest conditions ("short list" species). A smaller subset of these species were found to be viability concerns under each alternative, as discussed below, except for the fish stocks and invertebrates, which were treated as viability concerns under all alternatives.

Assessments by Species Groups

Fungi and Nonvascular Plants. A total of 42 fungi species (mostly mushrooms) and 148 nonvascular plant species (lichens, liverworts, and mosses) were evaluated for viability effects under each of the five FEIS alternatives (Appendix 6-H). Collectively, fungi and nonvascular plants are vital elements of forest ecosystems. They play central roles in nutrient cycling and uptake by conifers and other commodity tree species, 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 (mycorrhizae) are essential symbionts for assisting coniferous trees to absorb nitrogen; their abundance, distribution, and sensitivity to changes in old-growth forest conditions directly influence forest health. Lichens are used elsewhere as indicators of air quality. And 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.

Although many of the fungi and nonvascular plants are poorly known ecologically -- some 60 species substantially lack scientific information and could be rated only with great uncertainty, if at all (Appendix 6-J) -- viability assessments could be made for many other species. Under each of the five FEIS alternatives, the number of species with high viability risk (viability was less than high or medium high) ranged from 19 under Alternative D to 147 under Alternative E. The number of species with extirpation risk (risk of loss from one or more planning areas) ranged from 4 under Alternatives B, C, and D, to 82 under Alternative E.

Under Alternative B -- the selected alternative (Interagency Scientific Committee Conservation Strategy) -- 38 species showed high viability risk. The 38 species or ranges included 18 fungi, 2 lichens, 6 liverworts, and 12 mosses. The 4 species showing extirpation risk under Alternative B included 1 fungus species and 3 mosses.

Vascular Plants. A total of 122 species or ranges of vascular plants were evaluated for viability effects (Appendix 6-H). Vascular plants include a wide variety of life forms, some of which are economically important to the economy of 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 soil (such as the serpentine barren species of Klamath Mountains in southwestern Oregon and northwestern California) and forest structure.

Under each of the five FEIS alternatives, the number of species or ranges with high viability risk ranged from none under Alternative B to 5 under Alternative E. Only one species (Pacific yew) showed extirpation risk, only under Alternative E. Still, scientific information was lacking for at least 49 species; this applies to all alternatives.

Under Alternative B, none of the vascular plant species showed either high viability risk or extirpation risk.

Invertebrates. A total of 149 species of invertebrates were evaluated, including 58 mollusks and 91 arthropods (Appendix 6-F). Reliable data on distribution are available for only a few hundred species of old-growth associated invertebrates, out of an estimated regional list of more than 7,000 species (Olson 1992).

Because of a lack of scientific data, invertebrates were not evaluated for specific viability influences from each of the planning alternatives. However, the contract reports consistently underscored the following themes. Invertebrates are little studied in the Pacific Northwest. Many species play crucial and diverse ecological roles in old 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. Many of the arthropods can serve as biological indicators of forest health (Lattin and Moldenke 1992, Asquith et al. 1990).

Olson (1992) concluded that, under Alternative B, HCAs would not be numerous enough or correctly located to capture the full invertebrate diversity. In particular, in the coming century, if the only remaining tracts of old-growth forest are located within the HCAs and Critical Habitat Areas designated in Alternatives B and C in the EIS, "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). Populations of the less vagile species remaining within HCAs 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 further below.

We identified 79 invertebrate species as closely associated with riparian habitats (stream- and river-side vegetation) (Appendix 6-F). Many of these species would likely benefit from increased riparian protection, as discussed further below.

Fish. Some 112 stocks of potentially threatened and endangered stocks of anadromous salmonids (Nehlsen et al. 1991), representing seven species, were found on National Forests covered by this exercise. Twenty-three other stocks identified in areas downstream from National Forests would be affected by activities on National Forests. Additionally, four species of other fish that are currently recognized as being in various stages of decline (Williams et al. 1989), including bull trout which are being considered for Threatened Status, were found on the Forests covered. (Numbers of stocks of fish are based on current knowledge, and are likely to change over time as work progresses.)

None of the five FEIS alternatives provided a high probability of maintaining or restoring fish habitat for potentially threatened and endangered anadromous salmonid stocks through time. The FEIS did not specify any riparian management zone standards; nor were HCAs delineated based on riparian zones or watersheds. Standards and guidelines for riparian management areas varied substantially among National Forests, from good on the Willamette National Forest to poor on the Gifford Pinchot. Overall they were rated as fair because of the relatively small width in fish bearing streams, generally <200 feet, the absence or small size of riparian management areas in intermittent streams, and the amount of activity allowed within riparian management areas along fish bearing streams.

Additionally, among the five FEIS alternatives, a relatively small fraction (generally <25%) of the key watersheds were contained within habitat designated for the northern spotted owl. This varied with Alternative and Province. It was estimated that more than 50% of the area of key watersheds and other streams on the Forests were covered in Alternative D. It rated only a moderate probability of maintaining and restoring anadromous fish habitat because of the fair rating given to Forest Plan riparian management standards and guidelines and the absence of a watershed restoration program. Other alternatives rated lower than did Alternative D because of the lower percent of coverage of key watersheds and other streams.

Amphibians. A total of 21 species or ranges of amphibians were evaluated for viability effects. Some of the salamander species are locally endemic to small geographic ranges in the Pacific Northwest.

The number of amphibian species or ranges with high viability risk ranged from 8 under Alternative D to 20 under Alternatives A and E. The number of amphibian species or ranges showing extirpation risk ranged from 6 under Alternative D to 18 under Alternative E. Scientific information was extremely scant for at least 5 species or ranges.

Under Alternative B, 11 species or ranges showed high viability risk and 7 showed extirpation risk. The 11 species or ranges included 10 salamanders and the tailed frog. One species, Van Dyke's salamander, was considered in two

parts of its overall range, and each part was rated as both high viability risk and extirpation risk under Alternative B. Most of the 11 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 old growth association (Appendix 6-A). None of these species were deemed to be highly associated with old-growth forest conditions (Appendix 6-A). Thus, no further viability assessments were conducted on reptiles. However, some reptile species do require 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 watershed 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 FEIS alternatives, the number of species with high viability risk ranged from 6 under Alternative D to 17 under Alternatives A and E. The number of extirpation risk species ranged from 1 under Alternatives B, C, and D, to 6 under Alternative E. Scientific information was scant for at least 7 other species.

Under Alternative B, 9 species rated as high viability risk and one species as extirpation risk (marbled murrelet). The high viability risk species 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 high viability risk birds more within the range of the northern spotted owl and more associated with spotted owl habitat per se were northern goshawk, flammulated owl, and great gray owl.

Mammals. A total of 31 species or ranges of mammals were evaluated for viability effects. Mammal species included furbearers (including fisher, marten, lynx, and others), bats, rodents, and other species groups.

Under each of the five FEIS alternatives, the number of species or ranges with high viability risk ranged from 6 under Alternative D to 12 under Alternatives A and E. The number of extirpation risk species or ranges measured from 1 under Alternatives D, to 9 under Alternative E. Scientific information was scant for 11 species.

Under Alternative B, 8 species or ranges rated as high viability risk and 5 as extirpation risk. Marten ranked high viability risk in three portions of its range and extirpation risk in two of those three. Fisher ranked as a high viability risk in two portions of its range and extirpation risk in one of those two. Both species of red tree vole (prey species of the northern spotted owl) rated as both high viability risk and extirpation risk. Lynx -- which occurs on the edge of its range within the range of the northern spotted owl -- rated as a high viability risk but not an extirpation risk.

Summary of Viability Risk Species

Appendix 6-H presents an overall list of species of all taxonomic classes showing high viability risk or extirpation risk under at least one of the five FEIS alternatives. (Note that, by definition, all species listed as extirpation risk are also listed as high viability risk under at least one alternative.)

The number of species or ranges (excluding invertebrates and fish) with high viability risk totaled as low as 41 under Alternative D and as high as 201 under Alternative E. Alternative E had the greatest number of species with high viability risk in part because it does not provide for old-forest Spotted Owl habitat conservation areas in the Olympic Peninsula or in the northern Oregon Coast Range, and it provides for substantially less (in total amount and distribution) elsewhere as well. Alternative A also had high numbers of species with viability concerns because its Spotted Owl Habitat Areas (SOHAs) provide for substantially smaller old forest conservation areas than do Alternatives B, C, and D. Alternatives B, C, and D progressively provide for greater numbers of species or ranges. Under Alternative B, 67 total species or ranges (excluding invertebrates and fish) were ranked high viability risk and 17 were ranked extirpation risk. With invertebrates and fish, these tallies were 328 and 278, respectively.

The 32 Old-Growth Species Listed in the FEIS

The FEIS listed 32 wildlife species associated with old-growth forests. All 32 species were included in this report's short lists of species closely associated with old-growth. Of the 32 species, under Alternative B, 25 species are not a viability concern in our current analysis, 3 species are a high viability risk, and 3 species were considered an extirpation risk. In addition, one species (Olympic Salamander) is considered in this report as a (newly defined) complex of four species, one of which is a high viability risk and three of which are an extirpation risk. Another species (Red Tree Vole) is also considered in this report as a (newly defined) complex of two species, both of which are extirpation concerns. And one species (fisher) is considered in this report in two portions of its range, one portion of which is a high viability concern and the other of which is an extirpation concern (Appendix 6-I). This accounts for all 32 species originally considered in the FEIS.

Mitigation Options for Species With Viability Risk 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 6-3) listed as high viability risk or extirpation risk under Alternative B (also see below for lists of species accommodated under each step in the process).

Table 6-3. Number of species, stocks, and species ranges identified as viability concerns under FEIS Alternative B, that are protected by the cumulative mitigation steps discussed in the text.

Mitigation Step	1. Nat'l Forest plann. standrd and guideln	2. Altern. B FEIS standrd and guideln	3. Recom- mended addition t Alt. B HCAs	4. Species benefitd by Watershd Protectn Areas	5. Species benefitd by Marbled Murrelet protectn	6. Mitigatn for rare and locally endemic species	7. Addit'l mitigatn for upld forest matrix	TOT (All mit' ste
Nonvascul Plants	35	95	0	5	19	14	0	168
Vascular Plants	100	4	0	0	0	0	0	104
Invertebrates	(Not rated by alternative)							
Fish	0	0	0	112	0	0	0	112
Amphibian	1	8	0	7	1	3	1	21
Reptiles	0	0	0	0	0	0	0	0
Birds	21	8	1	3	2	0	4	39
Mammals	7	4	0	6	2	0	0	19
TOTAL	164	119	1	133	24	17	5	463
Cumulative Guideline that apply	1	1-2	1-3	1-4	1-5	1-6	1-7	
Cum spp. totals	164	283	284	417	441	458	463	

Our step-down mitigation procedure described in the methods section of this report resulted in identifying the following sets of species requiring management standards and guidelines beyond those in Alternative B of the FEIS. These steps are additive; each new species or set of species considered in a step assumes that mitigation activities apply for all the species in the sections listed above it in previous steps. Also, a few species occur in several steps; mitigation of each step is cumulative. The following section lists species under each of the steps, in the same order as presented in the methods section above.

1. Standards and guidelines from existing Land Management Plans of National Forests within the range of the Northern Spotted Owl. Standards and guidelines influencing the management of old-growth forests and components of old-growth forests are described in individual Land Management Plans of 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 forest plan standards and guidelines, include all of the "short list" old-growth species listed in this report that were not identified as viability concerns under Alternative A (current management condition). (Complete lists of all species evaluated are available from the authors upon request.)

2. Standards and guidelines for habitat management under Alternative B. This step essentially entailed reviewing the standards and guidelines for management of habitat for Northern Spotted Owls under Alternative B in the Final EIS. The species that immediately benefitted by this alternative is, of course, the Northern Spotted Owl, provided that the Interagency Scientific Committee guidelines are followed on all federal lands. In addition, other old-growth species provided for by application of Alternative B that are not included in the first mitigation step above, are those species that were assessed to be of viability risk under Alternative A (current condition) but not of viability risk under Alternative B. Implementation of Alternative B would reduce the number of viability-risk species or ranges from 499 to 380.

3. Recommended additions to HCA's on national forests. This step entailed reviewing the additions to the HCA's on national forests as stipulated in Chapter 4 of this report, under the assumption that USDI Bureau of Land Management would not follow the Interagency Scientific Committee guidelines. Without adjustment of HCA's on national forests, viability of the Northern Spotted Owl would rate low under their currently approved plans (the "ODFW Agreement Areas"), and moderate under their preferred alternatives in the current draft Resource Management Plans. With addition of 410,000 acres to HCA's on national forest, the owl then rated high in viability (see Chapter 4). The addition of 410,000 acres will contribute to viability of a number of additional species. However, these additional acres were not specifically 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 BLM. For this reason, we did not tie the viability assessment of any other species to this acreage.

4. Mitigations for Fish Habitat and Riparian-Dependent Species.

The Watershed Protection Area (WPA) Designation

The WPA size and management varies depending on stream type and aquatic ecosystem type as outlined in Table 6-4. WPA widths for streams are horizontal distances and are measured **on each side** from the edge of the active 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. WPA distances 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 from the maximum pool elevation.

Table 6-4 lists interim WPA widths that will be in place until a watershed analysis is completed. A watershed analysis consists of a systematic examination of WPAs to characterize watershed history, processes, and landforms and conditions. The result is the identification of parts of the landscape that influence the creation and maintenance of fish habitat and riparian species habitat. Boundaries of WPAs may be altered after completion of the watershed analysis. See Appendix K for more detail.

Table 6-4 Widths of Watershed Protection Areas Delineated Along Water Bodies

Water Bodies	Interim Width of Watershed Protection Area (feet) ^a
Fish Bearing Streams	300
Perennial, non-fish bearing	150
Lakes, ponds, reservoirs, wetlands >1 acre	150
Intermittent and ephemeral streams and wetlands <1 acre and landslides and landslide-prone areas	100

^a Distances are horizontal, and are to be measured from each side of stream.

Within the Watershed Protection Area, 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 (see Appendix K) were developed to guide land management activities within WPAs.

See Appendix 6-K for specific standards and guidelines for establishing Watershed Protection Areas and regulating activities therein.

Other Species Benefited by Mitigations for Watershed Protection Areas

The following species of viability concern under Alternative B are likely to not be viability concerns after application of the mitigations for watershed protection.

Nonvascular plants:

Usnea longissima - Lichen; found in both hardwoods and softwoods in riparian fog belts. This species requires broad riparian buffer strips and riparian corridors, and is maintained by protecting riparian habitats, especially by controlling upstream timber harvesting. These needs are likely met by the watershed protection guidelines.

Metzgeria conjugata - Liverwort; occurs in fog areas of coastal forests and requires stream side protection with wide stream and riparian buffers. These needs are likely met by the watershed protection guidelines. Associates of Metzgeria conjugata that are endemic to the west coast, that occur in the same habitats, and that would also benefit from the watershed protection guidelines include Radula bolanderi and Ulota obtusiuscula.

Dicranella palustra - Moss; occurs in first-order streams in coniferous forest and is sensitive to siltation. This species is a west coast endemic and needs adequate stream buffer retention of 150 ft. minimum. It also needs protection for non-anadromous streams and upstream protection from logging and road building. Mitigations include preventing 1st-order (4th class) smaller streams from siltation and piling of logging debris, and maintaining a component of coarse woody debris for substrate needs. These needs are likely met by the watershed protection guidelines.

Hygrohypnum bestii - Moss; this species is included in the species group with Dicranella palustra, above, with the same conditions and mitigations.

Mythicomycetes corneipes - Mushroom (fungus); this species occurs in low moist humus soils with mosses and old-growth conifer stands throughout the range of the Northern Spotted Owl from sea level to 4000 feet elevation. Mitigation measures include maintaining moist conifer forest habitats. These needs are likely met by the watershed protection guidelines.

Amphibians:

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. Under the combination of Alternative B and watershed protection standards, buffered habitats (Watershed Protection Areas) along headwater streams and riparian areas will provide needed protection for this species and we foresee no critical needs for further protection.

Olympic Salamander complex -

Olympic Torrent Salamander (Rhyocotriton olympicus) - Olympic Peninsula
Columbia Torrent Salamander (R. kezeri) - Coastal Oregon (northern) and Washington (southern)

Cascade Torrent Salamander (R. cascadae) - Cascades, 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 (8° - 12° C in summer) streams, especially in mossy gravel or splash zones of rocky, tumbling brooks. They are very sensitive to increased temperature and sedimentation. Therefore, the central mitigation for this group is protection of small streams, including headwaters, through buffers on each side of designated sites.

Tailed Frog - Tailed Frogs, like Olympic Salamanders, occur in small, cold streams and are very sensitive to temperature. Primary mitigation for this species is protection of headwater streams through buffers on each side of designated streams. Buffers provided under the watershed analysis program will maintain cool temperatures and will reduce sedimentation. Such buffers would provide adequate mitigation for this species.

Birds:

Bufflehead - Buffleheads nest in 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 watershed protection areas, will likely lead to long term maintenance of nesting and foraging habitat.

Harlequin Duck - Harlequin Ducks are primarily associated with high elevation mountain streams. They are sensitive to human disturbance and water quality. Watershed protection, in conjunction with large areas protected in Wilderness and HCA's, 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 should be developed and implemented.

Northern Goshawk - Watershed protection will contribute to nesting and foraging habitat on the Olympic Peninsula and Cascades of Oregon and Washington. However, additional protection is needed to ensure high viability. We recommend completion and implementation of the Region 6 management direction and inventory protocol for Northern Goshawk currently in preparation (USFS 1992b). The purpose of the direction is to protect known active nest sites until USDA Forest Service, working with other agencies, can determine the species' actual habitat requirements (letter dated October 1, 1992, from USDA Forest Service Region 6 Regional Directors of Fish, Wildlife, and Botany, and Timber Management, to Forest Supervisors). In addition, the bird viability 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 HCA's, 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. (Also see additional notes for Northern Goshawk management below under marbled murrelet protection.)

Mammals:

Marten (Oregon Cascades) - Martens use riparian areas for foraging and for selection of nesting sites in large standing trees or in piles of woody

debris. Watershed protection buffers will protect potential habitat along riparian zones and will contribute to long-term provision of snags and logs. In conjunction with Alternative B, watershed protection will be particularly important in the Coast Range and Cascades of Oregon.

Fisher (populations in California and southern Oregon, and northern Oregon and Washington) - Fishers use a wider range of habitats than those used by martens and are able to forage in early seral 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 d.b.h.) are important as maternal den sites. The Watershed Protection Areas will likely provide cover and large snags in the forest matrix between HCA's and will thus substantially enhance the distribution of Fisher habitat.

Red Tree Voles (Phenacomys longicaudus and P. pomo) - The 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. 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 riparian areas under the watershed protection guidelines should alleviate much of this potential concern by providing connectivity between HCA's and other reserves. Maintain forest corridors of stands averaging at least 11 inches DBH and at least 40 percent canopy closure, between Watershed Protection Areas and across ridgetops, to facilitate dispersal between watersheds. Additional surveys should be conducted to document colony sites and identify remaining areas where dispersal may be inhibited. Additional studies are needed to better understand distribution, dispersal, demography, and habitat ecology.

Lynx - Lynx are rare within the range of the Northern Spotted Owl, occurring primarily in the Okanogan area of Washington. Its three primary habitat components 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 <5 acres), and (3) dispersal/travel cover (variable in vegetation composition and structure). Alternative B, as well as existing higher elevation reserves, will provide denning habitat within protected forest stands in juxtaposition with early seral vegetation in the forest matrix. Connectivity between many of the denning patches will be provided by the network of buffers along streams under the Watershed Protection Areas. Thus, the combination of standards and guidelines from Alternative B (and its modification) and from the watershed protection areas should provide for habitat needs of this species.

5. Mitigations for Marbled Murrelet.

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 judgement, which in turn is based on consultation with the few recognized experts on the species and the very limited published information relevant to marbled murrelets.

We anticipate that ongoing planning 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 supercede these interim standards. Our intent is to preserve options for management of marbled murrelet habitat until these plans are in place.

HABITAT

(1) All suitable 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 in Washington should be identified. 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 suitable habitat, is of primary concern and is defined as old-growth conifer forest stands, or mature forest stands with an old-growth component. Stand size is not an issue in this definition. The survey protocols developed by the Pacific Seabird Group (Ralph and Nelson 1992) should be consulted for more specific descriptions of suitable habitat. Inasmuch as the definition for suitable habitat is broad and for some forests habitat remains unmapped, it is therefore essential to complete the following tasks:

- * Personnel on each National Forest within the range of the marbled murrelet shall assign staff to map suitable marbled murrelet habitat on that Forest.

- * The above definition must be refined for each National Forest within the range of the marbled murrelet in cooperation with 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.

(2) Stop all activities involving ongoing projects under contracts or other legally binding agreements that may affect suitable murrelet habitat. This cessation of activity shall continue until completion of Section 7 consultation between the Forest Service and the Fish and Wildlife Service. Projects shall then be modified as indicated by that consultation. Such consultation may result in cancellation of some projects.

(3) In the case of all other ongoing or proposed projects or activities, avoid removal or modification of the tree canopy due to any activity in suitable habitat until a Conservation Strategy and/or Recovery Plan is implemented.

(4) 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 in 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 on National Forests and contribute to viability) would be provided.

It seems logical to assume that nesting habitat may well be a factor that limits marbled murrelet populations. Therefore, it seems 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 currently known. The Scientific Analysis Team concludes that precise standards for selection of replacement habitat are not available at this time given the current state of knowledge. In the standards and guidelines presented below, we have provided estimates of adequate standards and guidelines for the interim period. 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 available to develop into nesting habitat are protected.

The intent of the standards and guidelines for delineating recruitment habitat stands 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. The Scientific Analysis Team concluded that it is neither possible or prudent, given the present state of knowledge, to provide standards and guidelines that address site specific variation in arrangements and quality of younger stands. It is expected that stands that best meet the intent of the standards and guidelines will be selected and delineated where these standards and guidelines cannot be applied exactly as outlined. Such selection shall be made with interagency participation and cooperation.

a. Amounts of habitat recruitment stands equivalent to 50% of the total amount of existing suitable habitat outside Category 1 and 2 HCAs (as described in the ISC Conservation Strategy) and Wilderness areas will be delineated outside Category 1 and 2 HCAs and Wilderness areas. For example: if on a National Forest 60,000 acres of the existing suitable habitat for marbled murrelets occurs outside Wilderness areas and category 1 and 2 HCAs, then 30,000 acres of habitat recruitment stands will be delineated outside category 1 and 2 HCAs and Wilderness. All younger forest stands inside Category 1 and 2 HCAs and Wilderness areas within the range of the marbled murrelet are already protected and have the potential to develop into nesting habitat.

Habitat recruitment stands should be contiguous as possible and where the stands exist, 100 acres or more in size, and be distributed across the landscape.

b. First priority shall be given to stands adjacent to suitable habitat with known occupancy by marbled murrelets.

c. After considering first the priority for 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 FWS 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 (Hamer and Cummins 1990). The 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 distribution and quality of nesting habitat for marbled murrelets.

d. Priority for selection of habitat recruitment stands between various aged stands shall be given to 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.

e. 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.

f. 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 have been met, it will be necessary to delineate additional buffers. Such buffers shall consist of stands where the average dbh is greater than 10 inches. For stands of existing suitable habitat greater than 100 acres in size the buffer should be at least 300 feet wide. Where the stands of existing suitable habitat is less than 100 acres, the buffer shall be at least 600 feet wide. In as much as possible, buffers should surround the suitable habitat. Modification of the buffers shall be avoided until a recovery plan or a conservation strategy for marbled murrelets is implemented.

SURVEY

(1) 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.

(2) 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 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 closer to marine environments to ascertain the actual range and distribution of marbled murrelet habitat. If marbled murrelets are detected then the area described in number 1 above should be expanded accordingly. If murrelets are not detected it may be appropriate to redefine the range.

SEASONAL RESTRICTIONS

Restrictions on activities that, although they may not affect suitable habitat, have the potential to disturb nesting activity of marbled murrelets should be implemented based on the following:

(1) Management activities within a 1/4-mile radius of known occupied sites should be restricted for the period 1 April to 15 September 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, road rights-of-ways, felling in forest stands not suitable for nesting by marbled murrelets, road construction or reconstruction, yarding, operation of heavy equipment, and mining operations.

(2) 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 of suitable habitat unless absence of marbled murrelets has been determined.

ADAPTIVE MANAGEMENT

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

(2) 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 it becomes available.

Other species benefited by mitigations for Marbled Murrelet.

The following species of viability concern under Alternative B are likely to not be viability concerns if they occur within areas protected under the Watershed Protection Area or Marbled Murrelet guidelines. It seems likely that much of the distribution of these species are included in such protected areas. However, additional surveys are still needed for some species, particularly the nonvascular plants, to determine the extent to which their distributions occur outside Watershed Protection Areas or habitats protected by Marbled Murrelet guidelines. Once located from surveys outside such areas, defer vegetation management or other activities in conflict with the retention of suitable habitat characteristics or maintenance of current population levels.

Nonvascular plants:

Teloschistes flavicans - Lichen; only one site is known for this species, at Cape Lookout, Oregon, off National Forest land. It occurs in coastal fog belt and large, old, coastal Sitka spruce forest. It may occur on National Forests but surveys are needed.

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 if found. Other liverwort species associated with the same habitats and ranges as Herbertus sakuraii, and likely to be equally benefited by mitigations for marbled murrelet, include Iwiatsukella leucotricha, Radula brunnea, Tritomaria quinquedentata, and Apometzgeria pubescens.

Bartramiopsis lescurii - Moss; this species occurs in low to mid elevations on the west slopes of the Olympic Mountains on wet organic soils. It is extremely rare. There is a need to protect known sites and additional sites as found. As an interim measure, mitigations for marbled murrelet will help protect known sites for this species.

Pleuroziopsis ruthenica - Moss; this species is included in the species group with Bartramiopsis lescurii above, with the same conditions and benefits from mitigation for marbled murrelet.

Collybia racemosa - Mushroom (fungus); this species is rare, known from 6 sites in 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. As an interim measure, mitigations for marbled murrelet will help protect known sites for this species.

Albatrellus caeryliopus - Mushroom (fungus); this species 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 mitigations 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, Gomphus kauffmannii, and Phaeocollybia kauffmanii. Additional surveys for all of these species would better define their distribution and the need for any additional protection. However, as an interim measure, mitigation for marbled murrelet can help protect known sites for these species.

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 under mitigations for marbled murrelets, Watershed Protection Areas, the FEIS Alternative B, and existing forest plan standards and guidelines for management of logs will likely provide sufficient habitat to assure well-distributed viable populations of this species on national forests within the range of the northern spotted owl.

Birds:

Northern goshawk - Although some protection for northern goshawk habitat is afforded by the watershed protection mitigations discussed above, additional protection is needed to help ensure viability throughout its range within the range of the northern spotted owl. Under the interim marbled murrelet standards and guidelines, a majority of mature or old-growth forest on the Olympic Peninsula that is unprotected outside of HCAs under Alternative B will be protected. Therefore, nearly all potential nesting habitat on the Olympic Peninsula will be protected from timber harvest. The Olympic Peninsula is an area of particular concern because northern goshawk are relatively isolated there, they occur in low numbers, and their habitat requirements have not been well documented although experts strongly suspect that old-growth habitat is vital for nesting habitat. Protection of habitat under the combinations of Alternative B, watershed protection, and marbled murrelet guidelines provides broad latitude for natural catastrophes and uncertainties in knowledge.

Mammals:

Marten (populations in Olympic Peninsula and Oregon Coast Range) - As with northern goshawk, although protection for marten is afforded by the watershed protection mitigations discussed above, additional protection is needed for marten to help ensure viability throughout its range within the range of the northern spotted owl. Marbled murrelet protection on the Olympic Peninsula will also provide substantial benefit to protection of marten habitat on the Olympic Peninsula, especially in combination with Alternative B and watershed protection. Murrelet protection (plus watershed protection) will also contribute to marten viability within the range of murrelets on the Oregon Coast Range.

Mitigations 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 not be viability concerns under Alternative B if they occur within areas conserved by Alternative B of the FEIS, Watershed Protection Areas, or areas covered under the Marbled Murrelet mitigation guidelines. However, if they are located outside of such areas, additional mitigation measures would be needed to avoid increasing viability risk. These measures are discussed, by species, below.

Nonvascular plants:

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. Mitigations include finding locations and associated maintaining stands of overmature 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.

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 of distribution patterns are disjunct and highly localized. Defer timber harvest or other activities which would not maintain desired habitat characteristics and population levels.

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

Buxbaumia piperi, Buxbaumia 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 on the Olympic National Forest and in Washington Cascades. Mitigations include surveying to determine presence and distribution; and, where located, maintaining decay class 3, 4, and 5 logs and >70% closed-canopy forest habitats for shade. Shelterwood and thinning prescriptions for timber harvest will cause their demise, as logs dry out.

Aleuria rhenana - Mushroom (fungus); this species 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 not compatible with maintaining characteristics of suitable habitat.

Otidea leporina, Otidea onotica, and Otidea smithii - Mushrooms (fungus); these species occur in conifer duff, and are widespread in distribution but uncommon. They are dependent on older age forests. Specific mitigations include protecting older forests where the species are located.

Polyozellus multiplex - Mushroom (fungus); ecologically, this species 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 mitigations. However, Polyozellus multiplex 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. It is a mycorrhizal species important to forest health, and, like its group associates, it is a good indicator of old-growth forests.

Sarcosoma mexicana - Mushroom (fungus); this species 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.

Invertebrates:

Although lack of scientific 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. 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 are centers of invertebrate biodiversity. In addition, some species are poor dispersers or rely on special habitats including decaying wood or aquatic environments.

Olson (1992) also noted that small fragments of primary forest might serve as 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 a combination of the Watershed Protection Areas and Marbled Murrelet mitigations. 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 mitigations 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, which shall be pursued.

Amphibians:

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. Current sites are included within boundaries of protected areas, so emphasis should be to survey additional sites in the matrix along the Columbia River gorge. Key habitat is mossy talus protected by overstory canopy. Protection in the matrix is to avoid any ground disturbing activity that would disrupt the talus layer where this species occurs. Sites must be identified based on fall surveys conducted using a standardized protocol. Once sites are identified, maintain 40 percent canopy closure of trees within a buffer of at least the height of one overstory 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.

Siskiyou Mountain Salamander - This species occurs within an extremely narrow range on the Rogue River and Klamath National Forests. Its range does not lie within any HCAs in Oregon. Additional surveys, conducted using a standardized protocol, must be undertaken to delineate range and identify subpopulations. All known and future populations must be protected by avoiding disturbance of talus, especially on moist, north-facing slopes, particularly in Oregon where HCAs do not incorporate species' range. Because this species seems to require cool, moist conditions, a buffer of at least the height of one overstory 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.

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 an HCA under Alternative B. It occurs in association with limestone outcrops, protected by an overstory canopy. All known and future localities must be protected from timber harvest, mining, quarry activity, and road building within a buffer of at least the height of one overstory site-potential tree or 100 feet horizontal distance, whichever is greater, surrounding the outcrop. Additional surveys, conducted using a standardized protocol, must be undertaken to identify all occupied sites within the species' potential range.

8. Additional mitigations for other species.

As with the above sets of species, the following species of viability concern under Alternative B are likely to not be viability concerns if they occur within areas conserved by Alternative B of the FEIS, Watershed Protection Areas, or areas covered under the Marbled Murrelet mitigation guidelines. However, if they are located outside of such areas, additional mitigation measures would be needed to avoid increasing viability risk. These measures are discussed, by species, below.

Amphibians:

Del Norte Salamander - This species occurs in talus slopes protected by overstory canopy to maintain cool, moist conditions in the ground. The species is a slope-valley inhabitant, and sometimes occurs in high numbers near riparian areas. Watershed protection practices, in combination with HCAs and other reserves, will offer protection to the species but significant numbers occur in upland areas within the forest matrix. Additional mitigations in this upland matrix include identifying locations (talus areas inhabit by the species) by using a standardized survey protocol, then designating a buffer of at least the height of one overstory site-potential tree or 100 feet horizontal distance, whichever is greater, surrounding the site. Within the buffer, maintain 40 percent canopy closure and avoid any activities that would 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.

Birds:

White-headed Woodpecker, Black-backed Woodpecker, and Pygmy Nuthatch - All three of these species will not be sufficiently aided by application of mitigation measures for watershed protection or for marbled murrelets. They all occur on the periphery of the range of the northern spotted owl on the east slope of the Cascades Mountains in Washington or Oregon. Their viability within the range of the northern spotted owl was rated as a viability concern on National Forests, although they much more widely distributed elsewhere.

For all three species, mitigation measures to ensure that their distribution and numbers do not severely decline on National Forests within the range of the northern spotted owl generally include maintaining adequate numbers of large snags and green tree replacements for future snags within their range in

appropriate forest types. Specifically, we recommend that the immediate action be to mark no snags over 20 inches dbh for cutting (we recognize, however, that safety considerations may prevent always retaining all snags; use of standardized definitions of hazard trees is required) and, for the longer term, provide for sufficient numbers of green trees to provide for the full (100 percent) population potential of each species. These guidelines would apply in the forest matrix outside designated habitat for the northern spotted owl, but within the ranges of the northern spotted owl, each woodpecker species, and Pygmy Nuthatch.

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 Cascades 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 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.

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 the 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.

Great Gray Owl - This species occurs in lodgepole pine forests adjacent to meadows. In some locations, such as on 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 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. Develop and implement a standardized protocol for surveys and survey for nest locations using the protocol. Protect all future discovered nest sites as previously described. Prior to tree removal within 300 feet of meadows or natural openings within the species'

range (inside the range of the northern spotted owl), surveys must be conducted to protocol standard.

Mammals:

Marten and Fisher - The level of habitat conservation provided by the combination of Alternative B, watershed protection, and Marbled Murrelet mitigation guidelines is sufficient not to require additional standards and guidelines within land management plans to prevent the extirpation of Marten and Fisher within the range of the northern spotted owl. However, we do recommend two additional actions.

First, the National Forests in California must finalize and implement their draft habitat capability model for fisher and marten. Implementation of this model would further reduce risks to viability in those forests. Forests in Oregon and Washington must retain existing management requirement areas for 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 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 National Forests to kill-trapping of 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.

Species Requiring Further Information

We identified 52 species or ranges of nonvascular plants, vascular plants, and terrestrial vertebrates, for which we could not evaluate viability effects. These are species for which (1) the viability panelists identified as lacking scientific studies and (2) viability could not be ranked according to general life history attributes and distribution, because such basic information is lacking. All 52 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. Scientific data were lacking for all 149 species so that individual viability assessments under each of the 5 FEIS alternatives was not possible. All 149 species -- and likely other invertebrate species groups not included in the contract evaluations -- would require further study for more specific analysis of potential viability effects.

Thus, in this report, we identified a total of 201 species (52 fungi, plants, and terrestrial vertebrates, and 149 invertebrates) as needing further field study for analysis of potential viability effects. Only 12 species of this total are vertebrates, all of which are mammals; and all but one of these are species of bats.

The provision of old-growth forests and components under the seven mitigation steps listed above might provide some of these 201 species with some degree of protection, that is, some overlap between each of their distributional ranges with those of the old-growth areas identified in each mitigation step. However, the likelihood and degree of such protection for each species is unknown.

We identified the 52 species of fungi, plants, and terrestrial vertebrates through the following ad hoc assessment (the 149 species of invertebrates were identified in the contract reports evaluations). We first listed all species of nonvascular plants, vascular plants, and terrestrial vertebrates for which at least 3 viability panelists identified as lacking adequate scientific information by which to qualitatively rank viability effects. This resulted in an initial list of 135 species (60 nonvascular plants, 52 vascular plants, numerous invertebrates, 5 amphibians, 7 birds, and 11 mammals).

Next, to further narrow the set of 135 species, we then identified a set of 7 ecological conditions which reflected general distribution or life history patterns suggesting some (unknown) degree of protection from the seven mitigation steps. The 7 ecological 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 that occur on the fringe of the range of the northern spotted owl.

We assumed that habitat conditions for species identified in categories 1 through 5 might be protected by the combination of the seven mitigation steps. 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.

Results of this evaluation were that 83 of the 135 species met at least one of the 7 ecological conditions, leaving 52 species for which effects were truly unknown. The 52 species included 22 nonvascular plants, 18 vascular plants, and 12 mammals (mostly bat species).

Whereas we assert that the mitigations are necessary to help prevent further viability risk, we also recognize that additional information on the ecology of all 135 species or ranges -- especially the 52 highly unknown species or ranges -- is needed to help refine such mitigations over time. In addition, the 149 species of invertebrates all need further study. Such study will profitably identify the important role of each in old-growth ecosystem processes, and would help which set of species could serve as indicators of various aspects of the health of old-growth forests.

There may be species that we did not identify in our evaluation or that show a low risk, that, as more data accumulate, would show close association with late successional and old-growth forests and that might incur 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 potential viability concerns might turn out to be at less risk than initially suggested. At this time, it is impossible without such further study to determine which, if any, species would fall into any of these categories. Surveys, research studies, monitoring, and an adaptive management approach to adoption of mitigation guidelines would all be necessary to gather and account for such new information over time.

DISCUSSION AND CONCLUSIONS

Effectiveness of the Mitigations

We feel that the combination of forest management standards, guidelines, and mitigations for (1) FEIS Alternative B with modifications (see Chapter 4), (2) watershed protection, (3) habitat protection for marbled murrelet, (4) rare and locally endemic species, and (5) other species (in east slope Cascades Mountains), would provide for a high likelihood of continued existence of well-distributed plant and wildlife populations and fish habitat associated with old-growth forest and habitat for the northern spotted owl, on National Forests throughout the range of northern spotted owl in the Pacific Northwest. Although it is not possible to predict effects on most invertebrate species associated with old-growth forests and northern spotted owl habitat, nonetheless future security of this species group is likely also to be greatly enhanced under this scheme.

The guidelines and mitigations presented in this report require further refinement for specific use in National Forest Land Management Plans. This would be needed for specific modification of standards and guidelines in forest plans, and for their practical implementation on the ground.

We also strongly urge the application of regional oversight and guidance to ensure consistent interpretation and application of these guidelines and mitigations across all pertinent National Forests based on our prior experience of implementation of management direction. 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 and instituting appropriate conservation strategies; and gathering new scientific information on species and ecological conditions where such information is lacking and for species that might incur viability risks.

Applying the mitigation measures presented in this report would provide preemptive actions to help prevent currently secure species from becoming viability concerns in the future. The list of secure species are those on the short lists (Appendices 6-B, 6-D) that do not appear as viability concerns (Appendix 6-H). However, better inventories are still needed on vegetation condition that can be used to project the extent, distribution, and trend of habitat for both secure and viability risk species. 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 predict the locations 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.

Uncertainties associated with identifying viability risk species and mitigation options include the degree to which viability risk factors are currently a threat, and the pace at which such threats can be offset by restoring habitat conditions in key locations. For many species such quantitative analyses are

not possible without further knowledge of specific habitat associations, demography of populations, and dynamics of habitat changes, including anthropogenic (human-caused) and ecological (such as succession, fire regimes, etc.). 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 study and inventories, in the name of ecological management and despite potential declines in timber commodity production. Basic life history and ecology studies, and inventories for presence and habitat associations, are needed on a variety of plant, invertebrate, and some vertebrate species.

Toward Ecosystem Management

We emphasize the need to treat our viability evaluations and proposed mitigation options as preliminary management hypotheses. All species that we identified as associated with old growth, and particularly those that we identified as a viability risk, require further basic research, and 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 fuller 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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Appendix 6-A Terrestrial vertebrates associated with late-successional
or old-growth forests within the range of the Northern
Spotted Owl ("long list") (with references)

TERRESTRIAL VERT EBRATES

Associated with late-successional or old-growth forests
within the range of the northern spotted owl

Long List

file TVERTS WQ1

Scientific Analysis Team

Nov. 4 '92

Species	References									
	RP	UF	SVO	LSO	PS	KP	OFW	WO	CWH	

HERPS

<i>Amphibians</i>										
Oregon Slender salamander	x	x	x	x			x	x		
Larch Mt. salamander	x		x		x		x	x		
Siskiyou Mt. salamander	x		x				x	x	x	
Del Norte salamander	x	x	x	x			x	x	x	
Van Dyke's salamander	x				x			x		
Mount Lyell salamander										x
Dunn's salamander	x	x		x	x			x		
Western red-backed salamander	x	x						x		
Black salamander	x	x	x					x	x	
California slender salamander		x	x	x				x		
Clouded salamander	x	x	x	x			x		x	
Arboreal salamander										x
Ensatina	x	x		x				x		
Pacific giant salamander	x	x		x				x	x	
Cope's giant salamander	x	x	x	x			x			
Olympic salamander	x	x	x	x			x	x	x	
Northwestern salamander	x	x		x				x	x	
Shasta salamander	x									x
Red-bellied newt										x
Roughskin newt		x		x				x	x	
Pacific treefrog		x						x	x	
Tailed frog	x	x	x	x			x	x	x	
Cascades frog	x		x					x		
Red-legged frog	x	x	x							
Western spotted frog	x		x		x					
Foothill yellow-legged frog	x	x	x							
Western Toad	x									x
Northern leopard frog										

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc.	
	WA	OR	CA	WA	OR	CA	Loc	Broa	Reference	

		SC			+		X		Ruggiero et al. 1991	
C2	C	SC			*		X		Beatty et al. 1991	
C2		SC	T				X		Beatty et al. 1991	
C2		SC	SC			*	X		Ruggiero et al. 1991	
C3	C			+			X		Beatty 1991 pers. comm.	
	C				+	?	X		Ruggiero et al. 1991	
							X		Ruggiero et al. 1991	
		SC						X	Ruggiero et al. 1991	
		SC			+	+	X		Ruggiero et al. 1991	
						+			Ruggiero et al. 1991	
				+	+	*		X	Raphael 1988	
				+	?		X		Ruggiero et al. 1991	
	SC	SC	SC	+	*	*		X	Ruggiero et al. 1991	
				*	+	?	X		Ruggiero et al. 1991	
C2			T				X		Beatty et al. 1991	
				*					Ruggiero et al. 1991	
	SC	SC	SC	+	+	*		X	Ruggiero et al. 1991	
C2		SC	SC				X		Beatty et al. 1991	
C2		SC	SC			?		X	Ruggiero et al. 1991	
C2	C	SC							Beatty et al. 1991	
C2		SC	SC		?			X	Ruggiero et al. 1991	
									Beatty 1991 pers. comm.	

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp 'Long List'

Enter an 'x' below, ONLY in shaded columns, if a species fits a factor

Species	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	A	B	C	D	E	F	G	H	I

HERPS

Amphibians

Oregon Slender salamander			x	x				x	
Larch Mt. salamander	x					x	R6	x	
Siskiyou Mt. salamander			x	x		x	R6	x	
Del Norte salamander	x		x	x		x	R6	x	
Van Dyke's salamander			x	x		x		x	
Mount Lyell salamander									
Dunn's salamander			x	x				x	
Western red-backed salamander									
Black salamander		x						x	
California slender salamander			x	x					
Clouded salamander			x	x				x	
Arboreal salamander				x					x
Ensatina			x						
Pacific giant salamander	x	x?	x						
Cope's giant salamander		x?	x				R6		x
Olympic salamander	x							x	
Northwestern salamander	x								
Shasta salamander		x?				x		x	x?
Red-bellied newt									
Roughskin newt	x		x						
Pacific treefrog									
Tailed frog	x							x	
Cascades frog						x		x	
Red-legged frog						x	R6	x	
Western spotted frog						x		x	
Foothill yellow-legged frog						x		x	
Western Toad									
Northern leopard frog									

TERRESTRIAL VERT Associated with late-successional or within the range of the northern sp "Long List"	Do NOT enter anything in the blocks below				Conclusion: On old-growth associated list?	Comments
	Criteria for assigning species to old-growth associated list					
Species	1	2	3	4		

HERPS

Amphibians

Oregon Slender salamander		x			YES	uses down logs
Larch Mt. salamander	x		x		YES	also protected in forest plans
Siskiyou Mt. salamander		x			YES	threatened in Calif.
Del Norte salamander	x	x	x		YES	
Van Dyke's salamander		x			YES	uses down logs
Mount Lyell salamander					no	????? out of range of NSO?
Dunn's salamander		x			YES	not known if late seral required
Western red-backed salamander					no	
Black salamander	x				YES	
California slender salamander		x			YES	
Clouded salamander		x			YES	
Arboreal salamander					no	widespread; & wide variety of habitat conditions
Ensatina					no	ubiq.; uses small down wood
Pacific giant salamander	x				YES	Gomez 1992, Raphael 1988
Cope's giant salamander	x				YES	assumes similar ecology as w/ Pac. Giant Sal.
Olympic salamander	x		x		YES	
Northwestern salamander	x				YES	
Shasta salamander	x				YES	??? need more info on OG assoc.
Red-bellied newt					no	
Roughskin newt	x				YES	??? OG associate?
Pacific treefrog					no	
Tailed frog	x		x		YES	
Cascades frog					no	
Red-legged frog					no	
Western spotted frog					no	
Foothill yellow-legged frog					no	
Western Toad					no	
Northern leopard frog					no	

TERRESTRIAL VERT EBRATES

Associated with late-successional or old-growth forests within the range of the northern spotted owl.

Long List

file 'TVERTS.WQ1'

Scientific Analysis Team

Nov. 4 '92

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc.
	WA	OR	CA	WA	OR	CA	Loc	Broa	Reference

Reptiles

Reptiles								
Western pond turtle	x		x	x				
Sharp-tailed snake	x		x					
Rubber boa							x	
Gopher snake								x
Western aquatic garter snake								x
Western terrestrial garter snake								x
Common garter snake								x
Western rattlesnake								x
Northern alligator lizard		x						x
Western fence lizard								x

[illegible]

TERRESTRIAL VERT	Enter an 'x' below, ONLY in shaded columns, if a species fits a factor								
	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq. field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
Species	A	B	C	D	E	F	G	H	I

Reptiles									
Western pond turtle						x	R6	x	
Sharp-tailed snake				x				x	
Rubber boa									
Gopher snake									
Western aquatic garter snake									
Western terrestrial garter snake									
Common garter snake									
Western rattlesnake									
Northern alligator lizard									
Western fence lizard									

TERRESTRIAL VERT		Do NOT enter anything in the blocks below				Conclusion: On old-growth associated list?	Comments
Associated with late-successional or within the range of the northern sp		Criteria for assigning species to old-growth associated list					
Long List		1	2	3	4		
Species							

Reptiles						
Western pond turtle					no	
Sharp-tailed snake					no	
Rubber boa					no	
Gopher snake					no	
Western aquatic garter snake					no	
Western terrestrial garter snake					no	
Common garter snake					no	
Western rattlesnake					no	
Northern alligator lizard					no	
Western fence lizard					no	

TERRESTRIAL VERTEBRATES

Associated with late-successional or old-growth forests
within the range of the northern spotted owl

"Long List"

file 'TVERTS.WQ1'

Scientific Analysis Team

Nov. 4 '92

Species	References									
	RP	UF	SVO	LSO	PS	KP	OFW	WO	CWH	

BIRDS

Marbled murrelet	x	x	x	x	x	x	x		x	
Great blue heron								x	x	
Barrow's goldeneye			x		x		x	x		
Bufflehead			x		x		x	x		
Wood duck					x			x		
Hooded merganser					x			x		
Common merganser								x		
Harlequin duck	x		x		x					
Blue grouse			x	x	x			x	x	
Spruce grouse								x		
Ruffed grouse		x		x				x	x	
Mountain quail		x							x	
California quail									x	
Merriam's turkey					x					
Wild turkey								x	x	
Mourning dove								x	x	
Band-tailed pigeon		x						x	x	
Northern goshawk	x		x	x	x	x	x	x	x	
Sharp-shinned hawk								x	x	
Cooper's hawk								x	x	
Red-tailed hawk								x	x	
Golden eagle								x	x	
American kestrel									x	
Mertlin										
Peregrine falcon									x	
Prairie falcon									x	
Bald eagle	x			x	x	x		x	x	
Osprey					x				x	
Turkey vulture								x	x	
Barred owl		x						x		
Northern pygmy-owl	x	x	x				x	x	x	

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc.	
	WA	OR	CA	WA	OR	CA	Loc	Broa	Reference	

T	C	S(C)	E		*	*			Ruggiero et al. 1991
C2					+	+	?		Ruggiero et al. 1991
					+	P	?		Ruggiero et al. 1991
C2					?	P	P		Ruggiero et al. 1991
					P	P	?		Ruggiero et al. 1991
C2	C	S(C)	SC		+	+	+		Hayward et al. 1990
E	E	E	?						
T	T	T	E		*	*	*		Anthony et al. 1982
					P	?	?		Ruggiero et al. 1991
					P	+	?		Ruggiero et al. 1991

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp "Long List"

Enter an 'x' below, ONLY in shaded columns, if a species fits a factor

Species	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq. field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	A	B	C	D	E	F	G	H	I

BIRDS

Marbled murrelet	x		x	x	x		R6	x	x
Great blue heron									
Barrow's goldeneye			x	x					
Bufflehead			x	x					
Wood duck			x	x					
Hooded merganser			x	x					
Common merganser			x	x					
Harlequin duck			x	x		x	R6		
Blue grouse								x	
Spruce grouse								x	
Ruffed grouse						x			
Mountain quail									
California quail									
Merriam's turkey									
Wild turkey									
Mourning dove									
Band-tailed pigeon									
Northern goshawk		x				x		x	
Sharp-shinned hawk									
Cooper's hawk									
Red-tailed hawk									
Golden eagle									
American kestrel									
Merlin									
Peregrine falcon					x		R6	x	
Prairie falcon									
Bald eagle	x	x			x		R6	x	x
Osprey				x					
Turkey vulture									
Barred owl			x	x					
Northern pygmy-owl			x	x?					

TERRESTRIAL VERT Associated with late-successional or within the range of the northern sp "Long List"	Do NOT enter anything in the blocks below				Conclusion: On old-growth associated list?	Comments
	Criteria for assigning species to old-growth associated list					
Species	1	2	3	4		

BIRDS

Marbled murrelet	x	x	x	x	YES	recently listed as Threatened
Great blue heron					no	
Barrow's goldeneye		x			YES	riparian management for snags
Bufflehead		x			YES	riparian management for snags
Wood duck		x			YES	riparian management for snags
Hooded merganser		x			YES	riparian management for snags
Common merganser		x			YES	riparian management for snags
Harlequin duck		x			YES	riparian management for snags
Blue grouse					no	
Spruce grouse					no	
Ruffed grouse					no	
Mountain quail					no	
California quail					no	
Merriam's turkey					no	
Wild turkey					no	
Mourning dove					no	
Band-tailed pigeon					no	
Northern goshawk	x				YES	Reynolds references; OG associated on Olymp. Pen.
Sharp-shinned hawk					no	
Cooper's hawk					no	
Red-tailed hawk					no	
Golden eagle					no	
American kestrel					no	
Merlin					no	??? discuss w/ SAT
Peregrine falcon					no	
Prairie falcon					no	
Bald eagle	x		x	x	YES	
Osprey					no	snags, esp. along lakes, rivers
Turkey vulture					no	
Barred owl		x			YES	Brown lists elements incl. snags
Northern pygmy-owl		x			YES	check factor D?; Brown lists snags

'Long List'

Nov. 4 '92

251[illegible]

TERRESTRIAL VERT

Associated with late-successional or
within the range of the northern sp
"Long List"

Enter an 'X' below, ONLY in shaded columns, if a species fits a factor

Associated with late-successional or within the range of the northern sp "Long List"	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq. field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	A	B	C	D	E	F	G	H	I
Species									
Northern spotted owl	x				x		R6	x	
Flammulated owl			x	x					
Great gray owl			x	x					
Western screech owl									
Great horned owl									
Long-eared owl									
Northern saw-whet owl									
Common nighthawk									
Whip-poor-will									
Allen's hummingbird									
Calliope hummingbird									
Rufous hummingbird								x	
White-throated swift									
Vaux's swift	x			x				x	
Black swift									
Tree swallow				x					
Violet-green swallow									
Belted kingfisher								x	
Pileated woodpecker			x	x					
Downy woodpecker				x					
Hairy woodpecker	x			x				x	
White-headed woodpecker			x	x				x	
Black-backed woodpecker			x	x					
Acorn woodpecker				x					
Lewis woodpecker				x					
Three-toed woodpecker			x	x					
Nuttall's woodpecker				x					
Common raven									
Gray jay									
Steller's jay									
Clark's nutcracker (1)									
Red-breasted sapsucker		x		x					
Williamson's sapsucker			x	x					

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp

"Long List"

Do NOT enter anything in the blocks below

Criteria for assigning species to old-growth associated list

Conclusion:
On old-growth associated list?

Species

1

2

3

4

list?

Comments

Northern spotted owl	x		x		YES	
Flammulated owl		x			YES	occurs in NSO range only in nw CA? Goggans 1986
Great gray owl		x			YES	E. Bull references
Western screech owl					no	
Great horned owl					no	
Long-eared owl					no	
Northern saw-whet owl					no	
Common nighthawk					no	
Whip-poor-will					no	
Allen's hummingbird					no	
Calliope hummingbird					no	
Rufous hummingbird					no	
White-throated swift					no	
Vaux's swift	x		x		YES	closely assoc. w/ OG; WA candidate
Black swift					no	
Tree swallow					no	
Violet-green swallow					no	
Belted kingfisher					no	
Pileated woodpecker		x			YES	
Downy woodpecker					no	uses small snags
Hairy woodpecker	x		x		YES	closely assoc. w/ OG in no. CA (Raphael 1988)
White-headed woodpecker		x			YES	uses large snags; Bull reference
Black-backed woodpecker		x			YES	uses large snags; Goggans et al. 1987
Acorn woodpecker					no	assoc. w/ oak woodlands, hardwood components
Lewis woodpecker					no	
Three-toed woodpecker		x			YES	Brown lists as using snags; Goggans et al. 1987
Nuttall's woodpecker					no	
Common raven					no	
Gray jay					no	
Steller's jay					no	
Clark's nutcracker (1)					no	
Red-breasted sapsucker	x				YES	
Williamson's sapsucker		x			YES	

TERRESTRIAL VERT EBRATES

Associated with late-successional or old-growth forests within the range of the northern spotted owl

'Long List'

file 'TVERTS.WQ1'

Scientific Analysis Team

Nov 4 '92

Species	References									
	RP	UF	SVO	LSO	PS	KP	QFW	WO	CWH	
Northern flicker		x		x				x	x	
Dusky/Hammond's flycatcher		x		x					x	
Western flycatcher	x	x		x				x	x	
Olive-sided flycatcher		x		x				x	x	
Hammond's flycatcher	x	x						x	x	
Willow flycatcher	x			x		x				
Western wood-peewee		x						x	x	
Black-capped chickadee		x						x		
Chestnut-backed chickadee	x	x		x				x	x	
Mountain chickadee								x	x	
Brown creeper	x	x		x				x	x	
Red-breasted nuthatch	x	x		x				x	x	
White breasted nuthatch		x						x	x	
Pygmy nuthatch			x				x	x	x	
Winter wren	x	x		x				x	x	
House wren		x								
Western bluebird									x	
Mountain bluebird										
Golden-crowned kinglet		x						x	x	
Ruby-crowned kinglet		x						x	x	
American robin		x		x					x	
Hermit thrush	x	x		x				x	x	
Swainson's thrush		x		x				x	x	
Townsend's solitaire		x						x	x	
Varied thrush		x		x				x	x	
Wrentit		x		x						
Cedar waxwing									x	
Brewer's blackbird									x	
Hermit/Townsend's warbler		x						x		
MacGillivray's warbler		x								
Black-throated gray warbler		x						x	x	
Nashville warbler		x							x	
Hermit warbler		(x)						(x)	x	

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc.	
	WA	OR	CA	WA	OR	CA	Loc	Broa	Reference	
				P	+	P			Ruggiero et al. 1991	
					+				Ruggiero et al. 1991	
				P	*	*			Ruggiero et al. 1991	
								X	(see comments)	
				P	P	*				
				P	P	P			Ruggiero et al. 1991	
				?	P			X	Ruggiero et al. 1991	
				+	+	+			Ruggiero et al. 1991	
				+	*	*			Ruggiero et al. 1991	
				+	?	?			Ruggiero et al. 1991	
				?	P	?			Ruggiero et al. 1991	
				+	+	+			Ruggiero et al. 1991	
				+	+	+			Ruggiero et al. 1991	
				?	P	?			Ruggiero et al. 1991	
				P	P	P			Ruggiero et al. 1991	
				?	P	?			Ruggiero et al. 1991	
				P	+	+			Ruggiero et al. 1991	
				P	P	+			Rugg. et al. 91, Raphael 1985	
				+	P	?			Rugg. et al. 91	
	C	S(C)		+	+	+			Goggans 1986	
			E	+	+	P			Ruggiero et al. 1991	
				P	P	+			Ruggiero et al. 1991	
				P	P				Ruggiero et al. 1991	
				P	P	?			Ruggiero et al. 1991	
				P	P	P			Ruggiero et al. 1991	
				?	P	P			Ruggiero et al. 1991	
				?	P	+			Ruggiero et al. 1991	

[illegible]

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp "Long List"

Do NOT enter anything in the blocks below

Criteria for assigning species to old-growth associated list

Conclusion:
On old-growth associated list?

Species	1	2	3	4	list?	Comments
Northern flicker		x			YES	assoc w/ open forests, but uses lg snags
Dusky/Hammond's flycatcher					no	
Western flycatcher	x				YES	assoc. w/ OG in no. Cal. (Raphael 1988)
Olive-sided flycatcher					no	
Hammond's flycatcher	x				YES	Ruggiero et al. 1991; Sakai & Noon 1991 (CA)
Willow flycatcher					no	
Western wood-peewee					no	
Black-capped chickadee					no	
Chestnut-backed chickadee	x				YES	assoc. w/ OG in no. Cal. (Raphael 1988)
Mountain chickadee					no	
Brown creeper	x				YES	assoc. w/ OG in no. Cal. (Ruggiero et al. 1991)
Red-breasted nuthatch		x			YES	uses smaller snags; Brown lists in mature & OG
White breasted nuthatch		x			YES	uses smaller snags; Brown lists in mature & OG
Pygmy nuthatch		x			YES	uses smaller snags; Brown lists in mature & OG
Winter wren	x				YES	assoc. w/ OG in no. Cal. (Raphael 1988)
House wren					no	
Western bluebird					no	
Mountain bluebird					no	
Golden-crowned kinglet	x				YES	assoc. w/ OG in no. Cal. (Raphael 1988)
Ruby-crowned kinglet					no	
American robin					no	
Hermit thrush	x				YES	assoc w/ OG in no. Cal. (Raphael 1988)
Swainson's thrush					no	
Townsend's solitaire					no	
Varied thrush	x				YES	assoc. w/ OG in no. Cal. in winter
Wren tit					no	
Cedar waxwing					no	
Brewer's blackbird					no	
Hermit/Townsend's warbler	x				YES	see individual species ratings
MacGillivray's warbler					no	
Black-throated gray warbler					no	
Nashville warbler					no	
Hermit warbler					no	

TERRESTRIAL VERTEBRATES

Associated with late-successional or old-growth forests
within the range of the northern spotted owl

"Long List"

file 'TVERTS WQ1'

Scientific Analysis Team

Nov. 4 '92

Species	References									
	RP	UF	SVO	LSO	PS	KP	OFW	WO	CWH	
Orange-crowned warbler		x						x	x	
Townsend's warbler		x						(x)	x	
Yellow warbler									x	
Wilson's warbler	x	x		x				x		
Yellow-rumped warbler		x						x	x	
Hutton's vireo		x							x	
Solitary vireo		x		x				x	x	
Warbling vireo	x	x						x	x	
Western tanager		x		x				x	x	
Chipping sparrow		x								
Dark-eyed junco		x						x		
Rufous-sided towhee		x								
Song sparrow		x								
Black-headed grosbeak		x		x					x	
Evening grosbeak		x						x	x	
Pine grosbeak								x		
Pine siskin		x		x				x	x	
Purple finch		x						x	x	
Cassin's finch									x	
Red crossbill		x		x				x	x	
White-winged crossbill							x			
Common redpoll							x			

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc. Reference
	WA	OR	CA	WA	OR	CA	Loc	Broa	
				?	P	P			Ruggiero et al. 1991
				?	P	?			Ruggiero et al. 1991
				+	P	*			Ruggiero et al. 1991, Raphael 1985 (CA)
				P	P	P			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				P	+	+			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				P	P	+			Ruggiero et al. 1991
				?	P	?			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				?	P	P			Ruggiero et al. 1991
				P	P	?			Ruggiero et al. 1991
				P	+	+			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				P	P	P			Ruggiero et al. 1991
				+	+	P			Ruggiero et al. 1991

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp "Long List"

Enter an 'x' below, ONLY in shaded columns, if a species fits a factor

Species	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	A	B	C	D	E	F	G	H	I
Orange-crowned warbler									
Townsend's warbler		x	x						
Yellow warbler									
Wilson's warbler	x								
Yellow-rumped warbler									
Hutton's vireo									
Solitary vireo									
Warbling vireo		x							
Western tanager									
Chipping sparrow									
Dark-eyed junco									
Rufous-sided towhee									
Song sparrow									
Black-headed grosbeak									
Evening grosbeak									
Pine grosbeak									
Pine siskin									
Purple finch									
Cassin's finch									
Red crossbill			x	x					
White-winged crossbill									
Common redpoll									

TERRESTRIAL VERT Associated with late-successional or within the range of the northern sp 'Long List'		Do NOT enter anything in the blocks below				Conclusion: On old-growth associated	Comments
Species		1	2	3	4	list?	
Orange-crowned warbler						no	
Townsend's warbler		x				YES	mature (Brown '85, Marcot '85), OG (Brown '85)
Yellow warbler						no	
Wilson's warbler		x				YES	in OG in no. Cal. (Raphael 1985), but also in yng grth
Yellow-rumped warbler						no	
Hutton's vireo						no	
Solitary vireo						no	
Warbling vireo		x				YES	assoc. w/ OG in no. Cal. (Raphael 1988)
Western tanager						no	
Chipping sparrow						no	
Dark-eyed junco						no	
Rufous-sided towhee						no	
Song sparrow						no	
Black-headed grosbeak						no	
Evening grosbeak						no	
Pine grosbeak						no	
Pine siskin						no	
Purple finch						no	
Cassin's finch						no	
Red crossbill			x			YES	large canopy, no fragmentation; species complex
White-winged crossbill						no	
Common redpoll						no	

Associated with late-successional or old-growth forests within the range of the northern spotted owl

Lang List

file 'TVERTS.WQ1'

Scientific Analysis Team

Nov. 4 '92

[illegible]

Marten	x		x	x	x	x	x	x	x
Ermine		x						x	x
Long-tailed weasel								x	x
Fisher	x	x	x	x	x	x	x	x	x
Wolverine	x			x			x	x	
Gray wolf	x			x					
Black bear								x	x
Grizzly bear	x			x				x	
Porcupine								x	x
Mountain beaver									x
Brush rabbit								x	
Raccoon								x	x
Ringtail							x		
Opposum								x	
Dusky-footed woodrat	x							x	x
Bushy-tailed woodrat	x			x				x	x
Northern flying squirrel	x	x		x				x	x
Western gray squirrel					x			x	x
Golden mantled ground squirrel								x	x
Cascade mantled ground squirrel								x	
Siskiyou chipmunk								x	x
Yellow pine chipmunk (1)									x
Yellow-cheeked chipmunk									x
Allen's chipmunk									x
California chipmunk									x
Douglas squirrel		x		x				x	x
Townsend's chipmunk		x						x	
Red tree vole (P.longicaudus)	x	x		x				x	x
Red tree vole (P.pomo)	x	x		x				x	x
White-footed vole	x		x	x				x	
Western red-backed vole	x	x		x				x	x

Information from USFWS Draft Recovery Plan (Anthony et al.)

[illegible][illegible]

TERRESTRIAL VERT

Associated with late-successional or within the range of the northern sp

Long List

Species

Enter an 'x' below, ONLY in shaded columns, if a species fits a factor

More abundant
in LS forest

field SAT
data judgment

Assoc w/
LS forest

Requires
LS
elements

Federal
USFWS
T&E

Federal
USFWS
Candidat

USFS
sensitive
species

State
list

Inadeq.
field
data

A

B

C

D

E

F

G

H

I

MAMMALS

Marten			x	x				x	
Ermine									
Long-tailed weasel									
Fisher			x	x		x		x	
Wolverine						x	R6	x	x
Gray wolf					x		R6	x	
Black bear									
Grizzly bear					x		R6	x	
Porcupine									
Mountain beaver									
Brush rabbit									
Raccoon									
Ringtail									
Opposum									
Dusky-footed woodrat	x		x					x	
Bushy-tailed woodrat									
Northern flying squirrel	x		x	x				x	
Western gray squirrel									
Golden mantled ground squirrel									
Cascade mantled ground squirrel									
Siskiyou chipmunk									
Yellow pine chipmunk (1)									
Yellow-cheeked chipmunk									
Allen's chipmunk									
California chipmunk									
Douglas squirrel	x		x	x					
Townsend's chipmunk	x								
Red tree vole (P.longicaudus)	x		x						
Red tree vole (P.pomo)		x	x					x	
White-footed vole						x	R6	x	x
Western red-backed vole	x			x					

TERRESTRIAL VERT

Associated with late-successional or
within the range of the northern sp
"Long List"

Do NOT enter anything
in the blocks below

Criteria for assigning species
to old-growth associated list

Conclusion:

On old-growth
associated
list?

Species

1

2

3

4

Comments

MAMMALS

Marten		x			YES	uses snags & down logs for den sites
Ermine					no	assoc. w/ early succ. stages too
Long-tailed weasel					no	assoc. w/ early succ. stages too
Fisher		x			YES	uses snags & down logs for den sites
Wolverine					no	high elev./subalpine associate
Gray wolf					no	
Black bear					no	
Grizzly bear					no	
Porcupine					no	
Mountain beaver					no	most abund. in early growth stages
Brush rabbit					no	
Raccoon					no	
Ringtail					no	
Opposum					no	
Dusky-footed woodrat	x		x		YES	also in early shrub stages; but OG use > mid-succ.
Bushy-tailed woodrat					no	
Northern flying squirrel	x	x	x		YES	
Western gray squirrel					no	
Golden mantled ground squirrel					no	
Cascade mantled ground squirrel					no	
Siskiyou chipmunk					no	
Yellow pine chipmunk (1)					no	
Yellow-cheeked chipmunk					no	?? Need info from CWHR; habitat assoc.?
Allen's chipmunk					no	
California chipmunk					no	?? Need info from CWHR; habitat assoc.?
Douglas squirrel	x	x			YES	requires lg conifers w/ seed production
Townsend's chipmunk	x				YES	but also is abundant in early stages
Red tree vole (P. longicaudus)	x				YES	recov plan shows OR only
Red tree vole (P. pomo)	x				YES	recov plan shows CA only
White-footed vole					no	riparian assoc.; not sig. across seral stages (Gomez)
Western red-backed vole	x				YES	

Long List

Nov. 4 '92

[illegible]

Information from USFWS Draft Recovery Plan (Anthony et al.)										
USFWS		State listing			OG assoc.			Endemic		OG assoc.
listing	status	WA	OR	CA	WA	OR	CA	Loc	Broa	Reference
					P					Ruggiero et al. 1991
					+			X		Ruggiero et al. 1991
					+	+	*			Rug. 91 (WA,OR); Raph 88 (CA)
							P			Ruggiero et al. 1991
						+				Ruggiero et al. 1991
					P	P	P			Ruggiero et al. 1991
					P	P	P			Ruggiero et al. 1991
						+	*			Rugg 91 (OR), Raph 88 (CA)
					P	P	?			Ruggiero et al. 1991
					P	P	?			Ruggiero et al. 1991
					P	+	?			Ruggiero et al. 1991
						*				Ruggiero et al. 1991
					+	*	?			Ruggiero et al. 1991
C2	C	S(C	SC							
	M				*	*	?			Ruggiero et al. 1991
					*	*	?			Ruggiero et al. 1991 (Myotis A complex)
					*	*	?			Ruggiero et al. 1991 (Myotis B complex)
					*	*	?			Ruggiero et al. 1991 (Myotis B complex)
					*	*	?			Ruggiero et al. 1991 (Myotis B complex)
					*	*	?			Ruggiero et al. 1991 (Myotis B complex)
					?	*	?			Ruggiero et al. 1991
					*	*	?			Ruggiero et al. 1991 (Myotis A complex)

TERRESTRIAL VERT

Associated with late-successional or
within the range of the northern sp

"Long List"

Enter an 'x' below, ONLY in shaded columns, if a species fits a factor

Species	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq. field data
	field data	SAT judgment			Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	A	B	C	D	E	F	G	H	I
Heather vole (1)									
Southern red-backed vole		x		x					x
Forest deer mouse		x?	x						
Deer mouse	x		x						
Western jumping mouse									
Pacific jumping mouse									
Pinyon mouse									
Marsh shrew									
Montane shrew									
Masked shrew			x						
Dusky shrew			x						x
Trowbridge's shrew			x						
Pacific shrew	x		x						
Vagrant shrew									
Coast mole			x						
Shrew-mole		x?	x						x
Big brown bat	x			x					
Silver-haired bat	x			x					
Western (Townsend's) big-eared bat						x	R6	x	
Pallid bat			x						
Hoary bat			x	x					
Brazilian free-tailed bat									
Red bat									
Long-legged myotis	x		x	x				x	
Yuma myotis	x		x	x					
California myotis	x		x	x					
Keen's myotis	x		x	x					
Long-eared myotis	x		x	x					
Western small-footed myotis	x		x	x					
Fringed myotis	x								
Little brown myotis	x		x	x					
Black-tailed deer									
Mule deer									

TERRESTRIAL VERT		Do NOT enter anything in the blocks below				Conclusion:	
Associated with late-successional or within the range of the northern sp		Criteria for assigning species to old-growth associated list				On old-growth associated	
Long List						list?	Comments
Species		1	2	3	4		
Heather vole (1)						no	
Southern red-backed vole	x					YES	little data available
Forest deer mouse	x					YES	
Deer mouse	x					YES	data show OG, but also very abund. in early seral veg
Western jumping mouse						no	
Pacific jumping mouse						no	
Pinyon mouse						no	assoc. w/ early seral stages
Marsh shrew						no	strong riparian assoc. (Gomez 92)
Montane shrew						no	
Masked shrew						no	boreal, widespread species
Dusky shrew						no	
Trowbridge's shrew						no	broad assoc. w/ all forest stages
Pacific shrew	x					YES	abund in young forest (Gomez 92) but taxonomy uncertain
Vagrant shrew						no	low elev, early stage assoc. (Gomez 92) but tax. uncertain
Coast mole						no	fossorial, tied to soil structure
Shrew-mole	x					YES	regional OG analysis shows *** (Aubry)
Big brown bat	x					YES	Christy & West in press; comb. w/ fringed in Rugg. et al. '91
Silver-haired bat	x					YES	Christy & West in press
Western (Townsend's) big-eared bat						no	Christy & West in press
Pallid bat						no	cliffs and caves (Ingles 1967)
Hoary bat			x			YES	Christy & West in press
Brazilian free-tailed bat						no	assoc. w/ caves (Brown 1985)
Red bat						no	
Long-legged myotis	x	x	x			YES	Christy & West in press
Yuma myotis	x	x				YES	part of 'Myotis A' group in Ruggiero et al. 1991
California myotis	x	x				YES	part of 'Myotis B' group in Ruggiero et al. 1991
Kean's myotis	x	x				YES	part of 'Myotis B' group in Ruggiero et al. 1991
Long-eared myotis	x	x				YES	part of 'Myotis B' group in Ruggiero et al. 1991
Western small-footed myotis	x	x				YES	part of 'Myotis B' but NOT OG associated
Fringed myotis	x					YES	? combined w/ big brown bat in Ruggiero et al. 1991
Little brown myotis	x	x				YES	part of 'Myotis A' group in Ruggiero et al. 1991
Black-tailed deer						no	
Mule deer						no	

TERRESTRIAL VERT EBRATES

Associated with late-successional or old-growth forests
within the range of the northern spotted owl

file TVERTS.WQ1

Scientific Analysis Team

Nov. 4 '92

"Long List"

Species	References									
	RP	UF	SVO	LSO	PS	KP	OFW	WO	CWH	

Elk					x			x	x	
Mountain lion								x	x	
Lynx					x					

Information from USFWS Draft Recovery Plan (Anthony et al.)

USFWS listing status	State listing			OG assoc.			Endemic		OG assoc.	
	WA	OR	CA	WA	OR	CA	Loc	Broad	Reference	

C2										

TERRESTRIAL VERT	Enter an 'x' below, ONLY in shaded columns, if a species fits a factor								
	More abundant in LS forest		Assoc w/ LS forest	Requires LS elements	Species lists				Inadeq. field data
					Federal USFWS T&E	Federal USFWS Candidat	USFS sensitive species	State list	
	field data	SAT judgment			E	F	G	H	
	Species	A	B	C	D	E	F	G	H
Elk			x	x					
Mountain lion									
Lynx			x	x		x	R6		

TERRESTRIAL VERT		Do NOT enter anything in the blocks below				Conclusion: On old-growth associated list?	Comments
Associated with late-successional or within the range of the northern sp		Criteria for assigning species to old-growth associated list					
Long List		1	2	3	4		
Species							
Elk			x			YES	OG assoc. on Olympic Peninsula
Mountain lion						no	
Lynx			x			YES	req. old for. cov & early seral for feeding; Koehler 199?