

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

CHAPTER ELEVEN

Threats

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TABLE OF CONTENTS

1 INTRODUCTION..... 3
 1.1 THE 1990 FINDING AND LISTING DECISION 3
 1.2 5 YEAR STATUS REVIEW..... 5
2 ARE EXISTING THREATS INCREASING, THE SAME, REDUCED, OR ELIMINATED? 6
 2.1 HABITAT..... 6
 2.2 BARRED OWLS..... 8
 2.3 PREDATION..... 8
 2.4 DISEASE..... 9
 2.5 GENETICS..... 9
 2.6 SMALL AND ISOLATED POPULATIONS 9
3 ARE THERE ARE ANY NEW THREATS? 10
4 DOES NEW SCIENTIFIC INFORMATION OR ANALYSIS CHALLENGE OR INVALIDATE ANY OF THE CONCLUSIONS IN THE ORIGINAL LISTING DETERMINATION? 10
5 DOES NEW SCIENTIFIC INFORMATION SUGGEST THAT THE SPECIES POPULATION IS INCREASING, DECREASING, OR STABLE? 10
6 UNCERTAINTIES 12
7 SUMMARY OF TRENDS AND THREATS, AND OVERALL EVALUATION OF POPULATION STATUS 12
8 TABLE 1: SUMMARY OF MAIN FINDINGS OF THIS REVIEW 15

1 INTRODUCTION

In this chapter we summarize our findings in terms of operational and potential threats to the Northern Spotted Owl. We define an operational threat as one that we perceive is currently negatively influencing the status of the owl, whereas a potential threat is either a factor that could become an operational threat in the near (15-20 years) future or is a factor that may be threatening the owl currently but for which we are uncertain about the extent of the threat. Operational threats can be considered analogous to “imminent threats” in the Endangered Species Act. While the logic underpinning our summary here is shown in detail in previous chapters, we also briefly summarize the reasoning for our conclusions in this section. We also compare the information that was available for our review to that available at the time of the 1990 listing decision. In this context, we frame our discussion relative to abatement or increase in various threats as well as new threats that have emerged since the 1990 listing decision. Finally, we briefly discuss the quality of currently available information, and of the relative certainties and uncertainties of our findings. Collectively, we bring our findings together in our overall summary of population trends and threats. Finally, we emphasize to the reader that we defined the time period of our consideration for the impact of threats based on the approximate longevity for Northern Spotted Owls of 15-20 years, with the understanding that there is a great deal of geographic variation that influences the ecology and status of the owl. We chose a time of reference based on the bird’s biology because evaluation of risks and status of species based on life history parameters is used throughout the world, particularly by the IUCN (IUCN 2001).

1.1 THE 1990 FINDING AND LISTING DECISION

The Northern Spotted Owl was listed as threatened on June 26 1990 (USDI 1990):

“The U.S. Fish and Wildlife Service (Service) determines the northern spotted owl (*Strix occidentalis caurina*) to be a threatened species pursuant to the Endangered Species Act of 1973, as amended (Act). The present range of the subspecies is from southwestern British Columbia through western Washington, western Oregon, and the coast range area of northwestern California south to San Francisco Bay. The northern spotted owl is threatened throughout its range by the loss and adverse modification of suitable habitat as the result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms.”

Federal Register 55: 28114

As noted above, the U.S. Fish and Wildlife Service reviewed much information in making its determination, but emphasized both past and continuing loss of habitat. However, throughout the listing decision, many other factors were discussed. Under the terms of the ESA section 4(a)(1) the USFWS makes decisions on listing status based on a finding whether there is an imminent or probable future risk of extinction due to any one of five factors:

- A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range.

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

- B. Over-utilization for Commercial, Recreational, Scientific, or Educational Purposes.
- C. Disease or Predation
- D. The Inadequacy of Existing Regulatory Mechanisms.
- E. Other Natural or Man-Made Factors Affecting Its Continued Existence

The Service determined on each of these factors as follows:

Factor A: The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range.

“The dependence of northern spotted owls on older forest, the low probability that significant amounts of suitable habitat will persist outside of preserved areas, and the inability of the protected areas to support a viable population of northern spotted owls, all indicate that the northern spotted owl is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.”

Factor B. Over-utilization for Commercial, Recreational, Scientific, or Educational Purposes.

“Considerable research by Federal, State, and private groups is being conducted on this subspecies. This work is providing valuable information and is not having a negative impact on the subspecies. The spotted owl is not a game bird, nor is there any known commercial or sporting use”

Factor C. Disease or Predation

No clear determination of threat level was made although Great Horned Owl, *Bubo virginianus*, predation as well as the potential impact of parasites were noted.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

“The cumulative impact of timber-cutting practices by land managing agencies increases and exacerbates the fragmentation of existing owl habitat. The proposed spotted owl management plans of the Forest Service and Bureau of Land Management are untested. Recent legal actions aside, there is no indication from the land management agencies that the current rate of change from old growth to young, even-aged forest management will diminish. Further, as agencies concentrate their clear cutting activities outside designated spotted owl habitat management areas, future habitat management options will be lost if currently planned habitat networks prove later to be deficient. Existing regulatory mechanisms are insufficient to protect either the northern spotted owl or its habitat.”

E. Other Natural or Man-Made Factors Affecting Its Continued Existence

No formal determination of threat level was made for this factor, although Barred Owl competition, issues related to genetics (e.g. inbreeding), malicious taking, and extrinsic factors (fire, wind) were mentioned.

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

In summary, the 1990 listing decision found:

“Given the loss of a substantial amount (60 percent) of historical habitat from timber harvesting, and continuing reduction and fragmentation of a large portion of the remaining old-growth and mature habitat, the northern spotted owl population will continue to decline unless steps are taken to offset these losses”

1.2 5 YEAR STATUS REVIEW

Under the terms of the contract with USFWS, SEI committed to evaluate recent information on

1. Habitat Condition and Use
2. Over-utilization for Commercial, Recreational, Scientific, or Educational Purposes
3. Predation and Disease
4. Other Factors
 - Population trend and demographics
 - Barred owl (range expansion)
 - Genetic issues
 - Malicious taking (poaching)

The manner in which we approached this review was to first gather relevant literature written subsequent to the listing decision. This information was identified as peer-reviewed literature and non-peer reviewed (“gray”) literature. We then held public forums to solicit relevant information that had not been published as well as to provide an opportunity to scientists, managers, and others to provide personal and professional insight regarding the status of the Northern Spotted Owl. These processes are discussed in detail elsewhere in this report. However, we note here that we relied primarily on peer-reviewed literature (i.e., we gave most weight in our deliberations to peer-reviewed data). We used “gray” literature and the public forums as mechanisms to derive insight about operational or potential threats to the owl and to direct our attention to areas that concerned parties felt were important issues to consider. Thus, our process was to 1) synthesize new information, 2) solicit insight into the status of the owl, and 3) evaluate past, present, and potential threats in the context of the new information and suggestions provided to us through “gray” literature and public input. Finally, we critically evaluated all issues in the context of availability of data to support or refute the issue.

In our scientific evaluation, we have considered all the major factors known to potentially or actually affect the Northern Spotted Owl. Our chapters do not follow the order set out in the contract, but all major issues are addressed:

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

- Habitat Condition and Use is discussed in chapters on Prey, Habitat Associations, and Habitat Distribution (chapters 4, 5, 6)
- Predation and Disease are discussed in the chapter on Demography (chapter 8)
- Other Factors are discussed in chapters on Genetics, Barred Owls, and Demography (chapters 3, 7, 8).

We did not find any synthesis of new information pertaining to use for commercial, recreational, scientific, and educational purposes, and regard this as a minor issue, which was consistent with the 1990 listing decision. We note that, as per terms of our contract, we did not address one of the factors used by USFWS in listing decisions. Factor D, the adequacy/inadequacy of regulatory mechanisms, is more appropriately assessed by USFWS as the regulatory agency. Nevertheless, our chapter 9 (conservation science) contains information on the degree to which current conservation planning in the U.S. and Canada is based on sound scientific principles.

In the sections that follow, we will use the information developed in the preceding chapters and following the logical procedure outlined above to address the issues identified in the ESA as required for 5-year Status Reviews. Under the terms of our contract with USFWS we were to address:

- Whether existing (operational) threats are increasing, the same, reduced, or eliminated
- Whether there are any new (potential) threats
- Whether new information or analysis challenges or invalidates any of the conclusions in the original listing determination
- Whether new information suggests that populations are increasing, decreasing, or stable

2 ARE EXISTING THREATS INCREASING, THE SAME, REDUCED, OR ELIMINATED?

2.1 HABITAT

Operational Threats

Clearly, one of the primary threats indicated in the listing decision and in the 1990 status review was loss of habitat due to timber harvest. [We note for completeness that “adequacy of regulatory mechanisms” was the other primary threat discussed in the 1990 listing decision, but as stated above we will not discuss this issue further.] As shown in chapters 5 and 6, the listing of the Northern Spotted Owl and the subsequent conservation measures enacted to protect the owl has resulted in greatly reduced rates of habitat loss from timber harvest on federal lands. Thus, the threat posed by current and ongoing timber harvest on these lands has been greatly reduced since 1990 primarily because of the Pacific Northwest Forest Plan. In addition, protection measures invoked under the ESA have reduced harvest of habitat or mitigated the

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

impact of timber harvest on some non-federal lands, although timber harvest on these lands continues.

Although the 1990 listing document did not parse the effects (in terms of predicted future effects on Northern Spotted Owl population trends) of past, current, and future timber harvest, we feel that it would be useful for scientists to attempt such an endeavor. Such an endeavor has not been attempted by scientists studying owls primarily because there is not a consistent or accurate habitat map across all physiographic provinces inhabited by the owl. Although timber harvest has been greatly reduced on federal lands, the effects of past harvest on Northern Spotted Owls may still persist because of time-lag effects (i.e., owls are long-lived and individuals may persist in disturbed habitats even if that habitat is unsuitable for future colonization by other Spotted Owls; or habitat could have been reduced in quality and may only marginally support owls). Although we are certain that current harvest effects are reduced, and that past harvest is also probably having a reduced effect now as compared to 1990, we are still unable to fully evaluate the current levels of threat posed by harvest because of the potential for lag effects, especially if they interact with other factors (e.g., if past harvest has reduced habitat quality it may lose its ability to buffer the owls against poor climatic conditions *sensu* Franklin et al. 2000). In their questionnaire responses (see chapter 10), 6 of 8 panel members identified past habitat loss due to timber harvest as a current threat, but only 4 viewed current harvest as a present threat.

Fragmentation of habitat was identified as a major issue in the 1990 listing decision. While there can be little doubt that in some parts of the range (particularly the north), fragmentation was and likely remains a cause of poor demographic performance, recent research has also shown that habitat heterogeneity in some parts of the southern range appears to have net positive effects. We note here the distinction between habitat fragmentation and habitat heterogeneity, where the former is loss of habitat and the latter is habitat diversity (Franklin et al. 2002). That is, the recent work by Franklin et al. (2000) shows positive effects of habitat heterogeneity on reproduction. This work could be misinterpreted to suggest that logging is positive for owls. Such interpretation is not correct; we simply know that the diversity of habitats within an owl's territory may be beneficial, some of which may or may not result from logging. Further, the results of this study are applicable only to the geographic province where the study occurred (i.e., these results may not be applicable to areas in the central or northern part of the Northern Spotted Owl's range). Thus, we conclude that the threat posed by fragmentation was not (and is not now) fully understood at the time of listing. However, we believe the concern about habitat fragmentation's effect on Northern Spotted Owls was reasonable given our knowledge in 1990 about spotted owl habitat relationships. Thus, the new research discussed above suggests that habitat diversity may be important to owls in some parts of their range (particularly the southern part of its range), but it is unknown what is the best mechanism to promote that diversity or whether such diversity would be uniformly beneficial in all parts of the Northern Spotted Owl's range. Regardless, timber harvest rates have decreased and this has been associated with a likely concomitant decline in fragmentation since 1990. Two panelists viewed habitat fragmentation as a current threat.

Losses of habitat to other factors have continued unabated. We note in chapters 6 and 9 that currently the primary source of habitat loss is catastrophic wildfire, although the total amount of habitat affected by wildfires has been small (a total of 2.3% of the range-wide habitat base over a

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

10-year period). It is logical to conclude that this will continue to be the case, particularly if the fuels reductions provisions of the NWFP continue to be under-applied. Five panelists regarded fire as a major source of habitat loss in the eastern Cascades and Klamath regions, and on federal lands (as opposed to 2, 1, and 1 panelists, respectively, who thought that timber harvest was a major source of loss for each these areas).

Potential Threats

Some biologists and managers have suggested that ingrowth due to vegetation succession (i.e. the regeneration of young trees under the established canopy of older trees, particularly of different species) may make suitable foraging areas unavailable to Spotted Owls, because of vegetation density. We acknowledge this possibility exists but found no data by which we could evaluate this process as a threat. In addition, other areas of potential concern voiced during our public forums and in other discussions with concerned individuals were loss of trees to insect damage and windthrow. However, based on the available information, only 2 panelists viewed insect damage as a current threat, while none viewed windthrow as a significant factor.

In the future, there exists a potential for habitat loss due to Sudden Oak Death. This is neither a present nor an immediate threat, but it poses a threat of uncertain proportions because of its potential impact on forest tree dynamics and alteration of key habitat components (e.g., hardwood trees) in the southern portion of the range. Six of 8 panel members saw Sudden Oak Death as a future threat, while 1 panelist viewed it as a current threat.

2.2 BARRED OWLS

The listing document and the 1990 status review provided limited assessment of Barred Owls and their potential impacts on Spotted Owls. As shown in chapter 7, Barred Owls have been invading the range of the Northern Spotted Owl since at least the 1960s. Although the panel had strong differences of opinion on the conclusiveness of some of the evidence suggesting Barred Owl displacement of Northern Spotted Owls, and the mechanisms by which this might be occurring, there was no disagreement that Barred Owls represented an operational threat. In the questionnaire, all 8 panel members identified Barred Owls as a current threat, and also expressed concern about future trends in Barred Owl populations.

We note that hybridization between Barred and Northern Spotted Owls was one of the concerns expressed in the listing decision. Hybridization has not materialized as a significant problem, and was not regarded by any panelist as a current major threat. We recognize that hybridization could exacerbate a decline if a population of Spotted Owls is extremely low. However, if this situation occurs it is likely that demographic processes will exert a greater influence on the persistence of such a population than will hybridization.

2.3 PREDATION

There is very little available evidence that predation on Spotted Owls is having an effect on its population dynamics (chapter 8). While predation on Northern Spotted Owls occurs (and may be numerically important as a cause of death), no panel member identified this as a significant

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

operational or potential threat (0 of 8 respondents to the questionnaire). Hence, the concern expressed in the 1990 listing document may have been an over-estimate of the threat posed by predation (even though no clear determination of threat level was made). We base this conclusion on several lines of reasoning. First, there have been many radio telemetry studies of Spotted Owls, but no published study has identified predation as a primary source of mortality. Second, survival rates of Spotted Owls are high in the presence of Great Horned Owls (a known predator of Spotted Owls). Third, the abundance of Great Horned Owls and Spotted Owls may be more related to the presence of suitable habitat for each species rather than to each other. Thus, there does not appear to be compelling evidence that predation by Great Horned Owls is a risk to Northern Spotted Owl viability.

2.4 DISEASE

The panel did not identify disease as a current major operational threat. However, there was considerable concern among the panel members about the imminent arrival of West Nile Virus. While there is no way to predict the impact of West Nile Virus, the panel was unanimous in regarding this as a potential threat in the future. We base this conclusion on the following line of reasoning: the virus has spread rapidly across the United States, and is now within the range of the Northern Spotted Owl in northwestern California and Washington (*Alan Franklin, John Marzluff, pers. comm.*). It is known to be fatal to many species of birds including Spotted Owls. However, we do not know how this virus will ultimately affect populations.

2.5 GENETICS

The listing decision also mentions genetic concerns, although the 1990 Status Review regards these as minor. In general, we concur that the genetic effects often associated with small population size, for example, are unlikely to be as important as the effects attributable to purely demographic factors. While genetics issues are not an operational threat, some (4 of 8) panelists considered genetic problems as a potential threat in the future. We base this conclusion on the following line of reasoning: there is no empirical evidence that Spotted Owls are currently suffering from the effects, for example, of inbreeding depression which might manifest itself in declining reproductive rates. Based on the abundant information on reproductive output of Spotted Owls, no such negative genetic trends in reproductive output are apparent. We also note that in the very small Canadian population, genetic effects could be occurring, but we have no empirical evidence to support this possibility.

2.6 SMALL AND ISOLATED POPULATIONS

The listing decision makes reference to the problems faced by small and isolated populations. While we have no firm evidence of such effects, or of their relative importance, we note that the reduced populations in the northern part of the range must be at increased risk for demographic stochasticity, etc., simply because they are becoming smaller. We base this conclusion on the results of the 2004 meta-analysis which shows that some populations have shown high rates of decline over the past decade or more. Moreover, populations in some provinces (e.g., Western Washington Lowlands) that were exceedingly low at the time of listing continue to remain low.

3 ARE THERE ARE ANY NEW THREATS?

As noted above, emergent biological invasions (Barred Owls, West Nile Virus, Sudden Oak Death) are operational, imminent, or possible future threats.

Recent research suggests that a significant factor in demographic performance may be interaction among factors (chapter 8). While individual factors (such as habitat loss or fragmentation) were previously identified as threats, their relative importance and effect may depend on the interactions (synergisms) between and among factors. Five of 8 panel members regarded the results of such interaction as a significant current threat. Unfortunately, at this time, there is little information available to examine such interactions; this would require far more detailed and statistically robust data on the causes of population trends than are currently available. However, limited analysis of such interactions suggests that good quality habitat may buffer the owls against the negative effects of bad weather (Franklin et al. 2000). If interactions such as this one occur at different scales and with different factors, synergistic effects could be very important.

4 DOES NEW SCIENTIFIC INFORMATION OR ANALYSIS CHALLENGE OR INVALIDATE ANY OF THE CONCLUSIONS IN THE ORIGINAL LISTING DETERMINATION?

Our review provides a comparison of our current knowledge with that existing at the time of listing. To a large extent, many of the broad conclusions made in 1990 are supported or confirmed, for habitat associations, habitat trends, disease, genetics, etc. Some small differences in scientific opinion have emerged; for instance, the effects of fragmentation, which are incompletely understood and may vary geographically in their effect, which led us to a conclusion that this issue may not be as great as originally perceived or that the threat has been reduced as a consequence of lower logging rates. Predation also appears to have been over-emphasized, but this appears by our reading of the listing decision to have been a minor part of the listing rationale.

Perhaps the most difficult task for the panel was to evaluate the relative importance of the three identified major operational threats: timber harvest, catastrophic wildfire, and Barred Owls. We regard all as currently important. In 1990, timber harvest was regarded as one of the two primary threats. The 1990 listing decision may have under-estimated the importance of potential threats other than harvest, but the evidence at that time (e.g. for Barred Owl effects) was weak or absent. This was certainly true when compared to the extensive knowledge and history of habitat loss across the range of the Northern Spotted Owl.

5 DOES NEW SCIENTIFIC INFORMATION SUGGEST THAT THE SPECIES POPULATION IS INCREASING, DECREASING, OR STABLE?

Chapter 8 reports on the most recent information on population status and trends throughout the range of the Northern Spotted Owl. Although we have summarized all available information for a

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

number of factors, and on population trends, the panel feels strongly that the most appropriate summary of population trends of the Northern Spotted Owl *per se* is the meta-analysis prepared by Anthony et al. (2004). The panel defers to that group in terms of findings on population trends because we feel that this is a state-of-the-art analysis based on one of the most rigorously gathered and largest data sets on a species population status in the world.

The best available information indicates that some population of the Northern Spotted Owl are declining with different trends in demographic performance among the different provinces (Anthony et al. 2004). Anthony et al. (2004) demonstrated variation in demographic performance at both local and regional scales and across different ownerships. Of the 13 demographic study areas for which rates of population change (λ) were estimated by Anthony et al. (2004), 12 had point estimates of $\lambda < 1$ over the study period (approximately 1985 – 2003) (i.e., $\lambda = 1$ indicates a stable population, $\lambda < 1$ indicates a declining population, $\lambda > 1$ indicates an increase population, but see below). However, only 4 of these 13 sites had a rate of decline where the evidence for a decline was especially strong (see Figure 9 of Anthony et al 2004), which suggested that demographic performance was variable across the range. The rate of decline averaged across all 13 study areas was about 4.1% per year.

Hence, the best available evidence suggests a decline in Northern Spotted Owl populations in portions of their range from 1985 through 2003. However, it is not easy, for a variety of reasons, to partition data pre- and post-listing, or pre- and post-adoption of the NWFP, and then to compare demographic performance under each of these circumstances. Thus, we cannot determine, absent extensive further analysis, whether overall negative population trends are currently changing relative to previous negative trends. *A priori*, the predicted effects of adoption of the NWFP should have been to reduce population decline. However, no analyses have formally compared data pre-and post adoption of this plan, so we cannot determine whether population trends are getting worse or better. Earlier concerns about strongly decreasing populations and decreasing reproductive and survival rates appear to have abated (except perhaps in Washington state), perhaps suggesting that some improvement has taken place in parts of the Northern Spotted Owl range. We do note that the meta-analysis shows no trends (increasing or decreasing) in reproductive success, but that there were negative time trends in survival in 4 populations (including 3 of the 4 study populations in Washington).

We note that the NWFP predicted a continuing decline of Northern Spotted Owls until such time as new habitat developed (over a course of decades) (Appendix J of FSEIS). Hence, declining populations are not necessarily alarming, and could be following the trend predicted in the NWFP. However, the NWFP did not provide specific (quantitative) predictions for population trends. Thus, we cannot determine whether the observed rates of decline are greater or less than those predicted under the NWFP. In addition, regional differences (significantly greater rates of decline in Washington), and declining survival rates (once again in Washington), were not explicitly predicted by the NWFP.

Although there were no Canadian populations represented in the meta-analysis, Canadian populations are listed under the United States ESA and more importantly under Canada's Species at Risk Act. These populations appear to be in serious decline and could face imminent extinction. We note that Factor A in the listing decision criteria includes "*Curtailed of Its*

Habitat or Range.” Thus, we conclude that the Northern Spotted Owl’s range will be curtailed if the Canadian population becomes extinct; whether this will be followed by loss of some parts of the Washington range is currently unknown.

6 UNCERTAINTIES

In the individual chapters (2 to 9) we discussed the information available on the biology of the Northern Spotted Owl relative to key issues and threats. We have presented this information critically, with careful examination of the evidence, and discussion of alternative hypotheses and data adequacy. In chapter 10 we have elaborated in more detail on this issue, using individual panelists’ opinions as a subjective measure of the relative strength of extant data and information, and of the uncertainties associated with our findings. While we found that there were many excellent sources of information on Northern Spotted Owls, and that a great deal of information has been collected since 1990, there were still key uncertainties that prevented an unambiguous evaluation of the trends and threats affecting Northern Spotted Owls. Moreover, this uncertainty is increased because of the geographic variability of owl habitat, environmental, conditions, and responses. Panel responses to questions 48 - 51 in particular illustrated many of the difficulties faced by the panel in evaluating the threats posed to the subspecies. Nevertheless, there were some clear patterns of panel responses. Three major current threats to Northern Spotted Owls, as identified by all the panelists in their responses to questions 48 and 49, were habitat loss due to timber harvest, habitat loss due to wildfire, and Barred Owls.

7 SUMMARY OF TRENDS AND THREATS, AND OVERALL EVALUATION OF POPULATION STATUS

We find that there are significant threats to the Northern Spotted Owl at this time. Table 1 shows a summary of our main findings. Overall the population of this subspecies appears to be declining, but this varies by physiographic province.

As discussed in chapter 8 (demography), one approach to evaluating threats is to make explicit estimates of risks using modeling approaches. PVAs and other sorts of models may have value both in assessing overall extinction probabilities, and in evaluating the relative importance of different threats. No such model is available for Northern Spotted Owls. In Chapter 8 we discuss the relative strengths and weaknesses of such an approach, and (following the discussion in the Appendix by B.Noon) the value that may or may not be derived from developing such a model (as an aid to synthesis and planning). However, for our present purposes, there is no currently accepted overall framework for quantifying extinction risks for Northern Spotted Owls, or the relative importance of different threats. Hence we have focused instead on the more tractable issue of how perceived threats have changed from 1990 to the present.

Loss of habitat due to timber harvest appears to have been generally reduced, and current timber harvest is now primarily occurring on non-federal lands. We base this conclusion on the protection of millions of acres of suitable habitat by the NWFP following the 1990 listing decision. In addition, rates of logging allowed under the NWFP have not been realized, which has further reduced the loss of habitat due to logging. As timber harvest rates decline, other potential threats are becoming relatively more important (e.g., loss of habitat to catastrophic

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

wildfire). We base this conclusion not only on the known areas lost to catastrophic wildfire, but the continued accumulation of surface fuels and ladder fuels. In addition, very little management has been conducted to reduce risk of wildfire by removing these surface and ladder fuels forests. However, we also are concerned that widespread thinning to reduce the risk of catastrophic wildfire without understanding its effects on Northern Spotted Owl habitat may itself pose a threat. We concur with the 1990 listing decision that some factors (genetics, disease, scientific disturbance) are probably unimportant at this time. Our concurrence is based on the lack of information that would support such conclusions. Further, the relatively high rates of survival, relatively few owl mortalities resulting from handling by scientists and no declining rates in reproductive output (which might be a manifestation of disturbance because much work occurs during the nesting cycle) suggest that scientific disturbance has not been a factor in the owl's decline (although there have been no explicit studies of this issue). We believe that predation and fragmentation effects were not understood well enough to draw firm conclusions on their importance in 1990. However, we note that the 1990 listing decision did not place much emphasis on these factors. Barred Owl expansion was beginning to occur prior to the listing decision, but while recognized in the decision as a potential factor, the implications or extent of the Barred Owl invasion was not well known relative to today (although Barred Owl effects on Spotted Owls are still being debated). Some factors (demographic and genetic consequences of small population size) may become more important in those parts of the range where populations become small and do not receive immigrants. This last conclusion is based on theoretical and empirical observations of small populations.

Given that some populations of Northern Spotted Owls are relatively numerous, and that some populations cannot be shown to be declining, there appears to be little risk of extinction in the short-term (15-20 years; the approximate longevity of a Northern Spotted Owl) of the entire Northern Spotted Owl subspecies. Conversely, some regions or populations are precarious (e.g., Canada and perhaps Washington state), and the trends in a number of the populations for the subspecies appear negative. We believe that one of the primary reasons (habitat loss due to logging) for listing has been significantly reduced, which has enhanced the prospect of persistence of the owl in the short-term. Certainly, had the NWFP not been formulated to conserve the owl and its habitat, the species' situation would be much more serious than it is today despite our continued concern for the status of Northern Spotted Owl populations. Nevertheless, it is unknown if there are lag effects or synergistic relationships related to past habitat loss that may still be affecting the owl's demographic performance since listing.

In addition, new operational or potential threats have arisen since the 1990 listing decision, which promote a high level of concern over their effect on the owl. Most notably among these is the impact of Barred Owls and the potential threats of West Nile virus and Sudden Oak Death. At least at this time, the effect of Barred Owls appears to vary geographically, with greater potential effects in the northern part of the owl's range. Close monitoring and research of this situation will be needed to elucidate these effects as well as to formulate a response if necessary. Hence, while we believe there is no reason to conclude that the Northern Spotted Owl is at high risk of extinction in the short term, it is equally clear that, with several increasing threats, there is a distinct possibility that the species may become at high risk of extirpation (particularly in northern parts of its range).

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

In 1990, the USFWS determined that the risks and threats faced by the Northern Spotted Owl warranted threatened status under ESA. It is not our role either to re-evaluate that decision, or to make recommendations on future status or regulatory decisions. We have instead focused on determining whether the effects of different threats have increased or decreased since 1990. As shown, some threats have decreased and others have increased or are new. It is not possible (for reasons discussed above) to provide quantitative estimates of the overall risk faced by Northern Spotted Owl, or to provide exact estimates showing whether this overall risk is numerically greater or lesser than at the time of listing. Nevertheless it is our firm and unanimous conclusion that the risks currently faced by Northern Spotted Owls are significant; our qualitative evaluation is that these risks are comparable in magnitude to those faced by the species in 1990. Based on the best scientific information, as shown throughout this report, we believe that there are significant threats to the species at this time, and that these threats have the potential to increase.

8 TABLE 1: SUMMARY OF MAIN FINDINGS OF THIS REVIEW

| <u>Issue / Threat</u> | <u>Chapter</u> | <u>Information quality</u> | <u>Findings</u> |
|-----------------------|----------------|----------------------------|--|
| Genetics | 3 | Well understood | <p>Northern subspecies confirmed as distinct</p> <p>Reduced genetic diversity not a current threat</p> <p>Hybridization and introgression occurs but at low levels</p> |
| Prey | 4 | Poorly understood | <p>Undoubtedly drives some aspects of NSO biology (e.g., habitat associations, population dynamics)</p> |
| Habitat Associations | 5 | Well understood | <p>Association with forest structure broadly confirmed</p> <p>Other forest components locally important</p> <p>Heterogeneity in some areas favors demographic performance</p> |
| Habitat Trends | 6 | Data of mixed quality | <p>Major cause of listing in 1990</p> <p>Major achievement by 2004 was reduction of habitat loss to harvest (federal lands)</p> <p>Past habitat loss could still be having effect</p> <p>Current habitat loss to harvest mostly on non-federal lands, but harvest subject to review and consultation</p> <p>Habitat Conservation Plans are important and valuable factors in owl</p> |

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

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| | | | <p>conservation</p> <p>Continuing/ Increasing threat from catastrophic wildfires</p> <p>Monitoring data relatively weak</p> <p>Modeling projections uncertain</p> |
| Barred Owls | 7 | Poorly understood | <p>Identified as issue in listing document</p> <p>Major threat in 2004</p> <p>Diversity of panel opinion related to strength of causal link</p> <p>No evidence that fragmentation increases probability of invasion</p> <p>Some evidence for displacement of Spotted Owls</p> <p>Some evidence that Barred Owls use older forests and LSRs as well as young forest</p> |
| Demography | 8 | Well understood with data gaps | <p>14 demographic studies are a major achievement in wildlife/conservation biology</p> <p>Predation (fragmentation effects) probably unimportant (change from 1990)</p> <p>West Nile Virus imminent arrival, but risk unknown</p> <p>Trends are down, but it is unclear how these relate to NWFP projections</p> <p>Decline in Washington state of high concern</p> <p>Causes of trends poorly understood</p> |

SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

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| | | | Lack of causation in meta-analysis. We know trends but not mechanisms causing those trends. |
| Conservation Science | 9 | | <p>Core concepts of NWFP unchallenged</p> <p>Harvest levels under NWFP less than predicted, therefore, hard to determine future impact of NWFP on NSO persistence</p> <p>Fuels treatments not applied as predicted</p> |
| Threats | 11 | | <p>1990: Habitat loss to timber harvest pre-eminent threat</p> <p>2004: Threats have changed both quantitatively and qualitatively</p> <p>Rate of harvest (federal lands) greatly reduced</p> <p>Risk of catastrophic wildfire continuing or increasing</p> <p>Barred Owl increasing</p> <p>Disease risks imminent</p> |