SCIENTIFIC EVALUATION OF THE STATUS OF THE NORTHERN SPOTTED OWL

CHAPTER SIX

Habitat Trends

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SUMMARY

We evaluated current estimates of Northern Spotted Owl habitat trends on Federal lands. We evaluated two sources of suitable habitat (nesting, roosting, and foraging) loss; loss due to timber harvest and loss due to natural disturbance. We also commented on the validity of the conclusions that could be drawn from the available information, and then made an assessment of these habitat changes as potential threats to Northern Spotted Owl conservation. We included an evaluation of the current methods used to determine habitat trends with the intention of fostering improvement of future analysis of habitat changes. We were unable to evaluate habitat trends for non-Federal lands because of the lack of data or access to the data and the ability to verify and conduct quality control on the data.

THREAT ASSESSMENT

The threat of Northern Spotted Owl habitat loss from timber harvest on Federally-managed public lands (hereafter "Federal lands") has clearly been substantially reduced since 1990. Logging of Northern Spotted Owl habitat on Federal lands has been lower than originally anticipated by the Fish and Wildlife Service (USFWS) in 1990, at the time of listing of the owl, and by the Northwest Forest Plan in 1994. While there are risks that some existing suitable habitat could be lost or degraded by natural disturbance anywhere within the range of the Northern Spotted Owl, these risks appear consistent with historical patterns. However, threats from catastrophic habitat loss have increased on the east side of the Cascade Range and some locations within the Klamath region. The trend of forest development in these areas will continue to increase the risk of habitat loss. Because more years of fire suppression have occurred during the time the owl has been listed there has been a concomitant increase in the accumulation of fuels in these forests, which makes these forests more susceptible to stand replacement fires, pests and pathogens. This significant threat will remain for some time. In some areas, managing the threat of habitat loss by wildfire should be a habitat management priority. In addition, it has been hypothesized that succession toward shade-tolerant understory trees on the east slope of the Cascade Range may reduce owl occupancy (presumably because of reduced prey abundance and/or access *(Irwin and Thomas 2002).* If true, this would represent another growing threat resulting from lack of tree density control, which is a consequence of fire suppression.

On non-Federal lands there is evidence that some degree of habitat loss exists, however, it is incompletely documented and will remain a source of conjecture without more complete information. Lack of coordinated conservation measures to assure the continued existence of habitat on non-Federal lands was cited as a risk at the time of listing, and this risk continues. However, the emergence or existence of State Forest Practice Rules and Habitat Conservation Plans have reduced this risk because management of State and private lands are better coordinated with Federal habitat management than at the time of listing.

HABITAT TRENDS ESTIMATES

FEDERAL LANDS

The Northern Spotted Owl habitat trend analysis conducted by the USFWS (USDI 2004) indicated an overall decline of approximately 2.11% in the amount of suitable habitat due to range-wide management activities from 1994 to 2003. The majority of management-related habitat loss was in Oregon. Habitat loss due to natural events totaled 224,041 acres, which equated to a 3.03% decline in available habitat range-wide over this period. Overall, habitat loss range-wide due to all factors has resulted in a total decline of 5.14% between 1994 and 2003 (0.57% per year). Annual rates of habitat loss due to management activities were less than 25% of rates projected at the time of listing. Between 1994 and 2004, it was estimated that there would be an 8% increase in available habitat range-wide, resulting from succession of younger forests into suitable habitat.

NON-FEDERAL LANDS

As noted above, data are insufficient to determine the rate of change on non-Federal lands since 1990. However, there have been two major changes on non-Federal lands concerning suitable habitat protection since the owl was listed; increased state regulation and the emergence of Habitat Conservation Plans (HCPs). In general, HCPs represent a significant positive development in terms of reduced habitat risk over State Forest Practices Rules alone. In concert with the Northwest Forest Plan (NWFP), HCPs offer the opportunity to develop landscape scale approaches to Northern Spotted Owl habitat conservation rather than focusing on individual owl sites. However, poor documentation of initial baselines for most HCPs precludes estimates of habitat trends. We believe the development of HCPs is a positive step in owl conservation because they offer opportunities to increase cooperation between private landowners and government agencies and to seek creative ways to manage habitat in working forests.

EVALUATION OF DATA ON HABITAT TRENDS

It is our conclusion that the habitat losses calculated by the USFWS (USDI 2004) are conservative but reasonable approximations of habitat change. Unfortunately, limited data is available to assess habitat loss on a range-wide basis for Northern Spotted Owls. We recognize that the data and approach used by the USFWS is the best available. However we provide the following evaluation to encourage improvement in future habitat assessment efforts.

In general, the methodologies used by the USFWS to assess trends in suitable habitat are limited by data quality. The reliability of the data from a specific source is difficult to interpret because statistical bias is poorly controlled (i.e. dependence on data from external sources with the ability to conduct quality control, duplicated accounting for the same affect, and subjective corrections to data), and, to a lesser extent, the inclusion of debatable assumptions (such as the inclusion of exchange lands and recently developed habitat). Despite these shortcomings, there are currently no other viable alternatives to estimate habitat change on Federal lands. Given the sources of bias, we believe these data overestimate habitat losses, but we cannot determine the magnitude of

the bias. The risk associated with these estimates being wrong is low, given all indications that the habitat loss has been low.

Habitat removal due to management activities is probably estimated with the greatest accuracy because individual projects that affect Northern Spotted Owl habitat are subject to intensive habitat surveys. Estimates of habitat changes ensuing from natural disturbance events are probably less accurate, due to reduced intensity of surveys and analytical review.

We remain poorly informed concerning habitat trends on non-Federal lands. The USFWS examined information submitted by private entities as well as information contained in Habitat Conservation Plans and associated reports to determine if the information was not sufficient to calculate a rate of change on non-Federal lands. The USFWS determined there was insufficient documentation of the habitat baseline and lack of information about habitat change to allow the estimation of habitat trends on non-Federal lands. The panel recognizes that this information is usually maintained by private landowners and may be proprietary. Future habitat trends analysis of all forested lands within the range of Northern Spotted Owl using remote sensing could provide valuable insight to the continued role of non-Federal lands in supporting conservation of owl habitat.

SOURCES OF UNCERTAINTY FOR HABITAT TRENDS

HABITAT BASELINE ON FEDERAL LANDS

Any assessment of habitat change requires a reference condition for the habitat of interest to provide a basis for comparison at various intervals over time. A regional compilation of baseline habitat to measure change was not available until 1994, with the completion of the Northwest Forest Plan. We recognize that the decade-old Forest Plan habitat assessment, as an accurate portrayal of Northern Spotted Owl habitat, has many shortcomings. The strength of the Forest Plan suitable habitat baseline lies in its consistency across the entire range of the Northern Spotted Owl. The Forest Plan baseline was considered suitable for broad-scale analyses such as comparison of management alternatives. The USFWS was placed in a situation where it had to choose between using an outdated baseline with known weakness or waiting for a new baseline to be completed. We agree with the USFWS's decision that the Forest Plan baseline provides the best available common denominator for calculations of range-wide rates of habitat change.

LAND ACQUISITIONS ON FEDERAL LANDS

Lands containing suitable habitat were acquired by Federal agencies but not counted in the habitat trends data. The lack of inclusion of acquired land by the existing habitat trends estimates has resulted in an overestimation of habitat loss on lands managed under the Northwest Forest Plan for owl conservation, but correctly depicts a non-net change on a landscape basis. About 19,500 acres of habitat were acquired by Federal agencies from 1994 through 2003 through land acquisitions. These lands were not added to the habitat baseline or suitable habitat estimates conducted by the USFWS (USDI 2004). The development of habitat baselines that track changes regardless of ownership to account for this source of variation when estimating

amount of suitable habitat will be very important for the determination of habitat trends in the future.

COLLECTION OF AND ADJUSTMENTS TO CONSULTATION DATA

In general, the basic data derived from the Federal consultation process (Biological Assessments, Section 7 Consultations etc.) generally overestimated impacts to Northern Spotted Owl habitat. Individual consulting agencies used and managed consultation data differently, with different application of terms, different scales at which data were collected, and different data management practices. There was possibly a double counting of effects within a data set.

Recognizing these confounding effects in the data, adjustments to these data made by the USFWS from the consultation process were made to help control known sources of bias in the primary data that were used to determine habitat impacts. The USFWS, who conducted the trends analysis, believes the actual effects described in the consultations are usually less than those originally estimated, because harvest area size is usually reduced from that initially proposed for consultation, and there are delays in project implementation. These effect add another source of potential unknown bias to the estimates of management-based losses. We were unable to fully quantify the extent of overestimated effects.

Interpretations from the available habitat trends data base are also limited because the information is not spatially referenced. Calculations of habitat fragmentation were not possible from the available habitat trends data. Implications of habitat loss of individual Northern Spotted Owl demographic areas can not be determined with these data.

NATURAL HABITAT DISTURBANCE

The 1990 listing document anticipated habitat trends by management only, thus anticipated habitat losses due to natural disturbance events were not calculated. Because there was no baseline or basis for comparison of losses from natural disturbance, we were unable to make comparisons. Estimates of natural disturbance effects on suitable habitat are difficult to assess accurately. The difficulty of tracking widely dispersed natural disturbance effects and interpreting the impact will likely remain the primary source of this uncertainty. Interpretations of natural disturbance effects are likely to differ between agencies and staff in different provinces. It would seem reasonable and prudent for agencies to develop a single consistent, robust procedure for evaluating or characterizing natural disturbance events.

There appear to be considerable inaccuracies in estimates of habitat impact by fire. Assessments made soon after a fire may misrepresent the eventual habitat effects. It is often difficult to determine how much habitat was removed by fire, particularly regarding whether habitat affected by moderate intensity fire was sufficiently altered to be unusable by Spotted Owls. An area that has been burned does not always equate to habitat loss (Bond et al. 2002). Wildfires accounted for 75 percent of the natural disturbance loss of habitat estimated for the period between 1994 and 2003. Fifty percent of the loss from natural disturbances reported can be attributed to the Biscuit fire.

On the east side of the Cascade Range and Klamath region, past forest management practices, including fire suppression, selective logging, and unmanaged overstocked plantations, have resulted in changes in tree species composition that make areas more susceptible to large-scale insect outbreaks. Wildfire risk and management will be a continuing source of threat to existing Late Successional Reserves. Sudden Oak Death is a relatively new and unknown threat to habitat in the southern part of the Northern Spotted Owl range.

HABITAT DEVELOPMENT

The development of suitable Northern Spotted Owl habitat is a vital part of the long-term habitat management approach of the Northwest Forest Plan. Losses of habitat typically occur in a tangible time frame, such as with harvesting or catastrophic fire, while habitat development does not. Management activities designed to accelerate development of new habitat are becoming an important part of forest management. Retention of legacy (snags and course woody debris) in current areas of timber harvest will shorten the time necessary for those areas to achieve the habitat complexity deemed to be suitable Northern Spotted Owl habitat. There is a need for land managers to develop the ability to track development of habitat and validation of that habitat for its suitability to owls. Estimates of habitat development should be included in future habitat trend analyses.

FUTURE INFORMATION NEEDS

A Range-wide, spatially explicit database would make it possible to effectively track changes in forest condition from individual management activities and natural disturbance.

More information is needed on changes on non-Federal land to provide a more complete picture of habitat change within the range of the Northern Spotted Owl.

An improved ability to differentiate types of disturbance would be valuable. Assessments of fire and insect damage are particularly problematic in terms of defining the effect on owl habitat. There appear to be considerable inaccuracies in estimates of habitat impact by fire. Improved confidence in remote sensing methodologies to describe habitat condition would be very valuable, such as Light Detection and Ranging (LIDAR). Increased emphasis on non-clearcut harvest methods may limit traditional remote sensing disturbance detection.

An improved confidence in our ability to track and validate the suitability of newly developed habitat would be very valuable.

More information on the actual impacts of Sudden Oak Death on Northern Spotted Owl habitat would be valuable.

1 INTRODUCTION

When the Northern Spotted Owl was listed as a threatened species throughout its range in 1990 (*USDI 1990*), one primary concern was the widespread loss of habitat. Estimates of loss of old-growth forests since the late 1800s throughout the Pacific Northwest indicated the majority of old-growth forests had been removed. At the same time, predicted rates of habitat removal on Federal lands in 1990 suggested that insufficient suitable habitat would persist outside of existing reserved areas to support a viable population of Northern Spotted Owls. Based upon these factors, the U. S. Fish and Wildlife Service (USFWS) determined that the Northern Spotted Owl was likely to become endangered within the foreseeable future throughout all or a significant portion of its range, which contributed to its listing as a threatened species.

The amount of existing Spotted Owl habitat and its distribution have often been at the center of the Northern Spotted Owl conservation debate. Our objective in this section is to evaluate the estimates of changes in Northern Spotted Owl habitat that have occurred since the owl's listing, and to assess any changes in risk to Northern Spotted Owl habitat.

This chapter provides an evaluation of the relevant information on the distribution and trends in Northern Spotted Owl habitat, the validity of the conclusions drawn from such information, and other information relative to assessment of the habitat changes as a potential threat to Northern Spotted Owl populations. Our assessment was accomplished by examining the literature with a focus on current estimates of the amount of range-wide suitable habitat. The most comprehensive examination of habitat trends was provided by the USFWS for use in this review. The USFWS accepted responsibility for collating and summarizing the information provided in response to public comment and maintained in its databases for the use by SEI. The report (*USDI 2004*) is an update of the first comprehensive attempt by the USFWS to examine changes in habitat (*USDI 2001*) of Northern Spotted Owls since listing in 1990. Throughout this report, we refer to the USFWS reports to provide a description of methods data on habitat trends and a context for interpreting and evaluating the habitat trends results and ultimately, together with other relevant literature, to support our conclusions about changes in threat to the Northern Spotted Owl. Although some parts of this report are based on material contained in the USFWS reports, any conclusions are our own.

Our approach was to:

Provide context for evaluating habitat change as it influences Northern Spotted Owl conservation.
Describe current efforts to evaluate Northern Spotted Owl habitat trends and conditions, and to evaluate the accuracy of those estimates.

Provide an evaluation of risk relative to changes in the extent of Northern Spotted Owl habitat, its condition, and its distribution.

2 CONTEXT FOR EVALUATING NORTHERN SPOTTED OWL HABITAT CHANGE SINCE ITS LISTING

2.1 HISTORIC RANGE OF VARIATION IN HABITAT

Regional estimates of historical old forest variability can provide context for current habitat trends estimates. Historical variability in the amount of old forest (referred to by various authors by different names, but all related to structurally complex forests) in the range of the Northern Spotted Owl has been the subject of keen interest. In western Washington and Oregon, historical disturbance regimes were characterized by large, infrequent fires (Henderson et al. 1989, Wimberley et al. 2000). Calculations of pre-logging old growth in western Washington and Oregon are relatively consistent. Franklin and Spies (1991) suggested between 60 and 70 percent of the landscape was old growth. Booth (1991) estimated approximately 62% of western Washington and Oregon were in forests greater than 200 years of age. Ripple et al. (2000) estimated that in the central Oregon coast range 63% of the pre-logging forest landscape was old growth. Rasmussen and Ripple (1998) estimated 72% of the pre-logging landscape in southern Oregon Coast Range was comprised of the large conifer size class. Similarly, *Teensma et al. (1991)* reported that 62% of the forests in the Oregon Coast Range in 1850 was over 100 years old. Harrington (2003) has provided documentation of the early surveys utilized by many of these estimates. Several of these estimates were aided by Forest Resources surveys from the 1930s. *Zybach (1996)* used a wide variety of historical accounts and timber records to conclude that historically (because of the fire frequency), only about forests of the Columbia Gorge 5 to 15% forest in at least 200 years of age. Range-wide estimates of historic conifer forest > 150 years in Table 6.1 were estimated by the Conservation Biology Institute *(James Strittholt, pers. comm.).* The Puget Lowland Forests and Central Pacific Coastal Forests are two areas that have experienced the largest changes in old forest area and presumably suitable owl habitat.

Wimberley et al. (2000) simulated long-term historical variability in the amount of old growth forest and late successional forests in the Oregon Coast Range. Based on an age-class-demographic simulations and assumptions about the fire regime, they estimated that old growth forests covered between 25 and 75% of the province over the 3,000 year simulation. At the scale of late successional reserves (40,000 ha) old growth percentages varied from 0 to 100%. Contemporary estimates of current old-growth (5%) and late successional forest (11%) in the Oregon Coast Range were lower than expected under the simulated historical fire regimes; however, the authors noted that considerable uncertainty surrounds their estimates.

In the past, estimates of remaining old growth on specific landscapes have been widely divergent (i.e. Haynes 1986 and Morrison 1988). In describing the sometimes widely divergent results from early remote sensing studies, Jiang et al. (2004: 321) stated:

> "differences in the underlying data sources (dates of acquisition, resolution, and ancillary data support) represent other sources of divergence among the studies. Consequently, despite the wealth of data available, a reasonably accurate and timely spatial database for late seral conifer forests for the entire PNW region for conservation planning purposes was not available."

Current estimates of the amount and spatial distribution of contemporary old growth forests benefit from modern data analysis methods and sophisticated error checking.

Jiang at al. (2004) found approximately 11.6 million ha (~19%) of the PNW was classified as old conifer forest (>150 years). Another 11.8 million ha (~19%) was classified as mature conifer forest (50-150 years). Thus, over 23.4 million ha (~38%) of the PNW was late seral conifer forest (old and mature conifer cover classes). The extent of late seral forests varied greatly between the eight ecoregions. The Central and southern Cascades and Klamath-Siskiyou ecoregions contained the highest amount of late seral forest in the region.

2.2 RATES OF NSO HABITAT CHANGE PRE-1990

Long-term habitat trend information for land managed by the Forest Service presented in the listing document was originally supplied and verified by the Forest Service, Pacific Northwest Region (*USDI 1990, Appendix F*). Changes in amount of Spotted Owl habitat was estimated from estimates of the average annual volume of timber harvested during each decade from the 1950s to the present. Because harvest volume was relatively constant from 1960 through 1990, authors of the 1990 status review assumed that rate of habitat decline was also constant during this period.

Several studies within the range of the Northern Spotted Owl have used remote sensing time series as a tool for examining the dynamics of landscape change. Due to the resolution of remote sensing data, the major focus most studies of this landscape change analysis has been on large forest disturbances, primarily clearcut logging and catastrophic fire. There are several examples illustrating differences in forest cover change rates between public and private lands (Table 6.2). Cohen et al. (2002) published landscape-wide estimates of forestland harvest rates for Western Oregon. Although not specific to suitable habitat, these estimates provide insight into harvesting trends over nearly the last quarter century. Cohen et al. (2002) found that across ownerships the stand replacement disturbance was lowest in the early 1970s (0.5% per year) and that rate increased to over 1.2% per year throughout the mid 1980s. By the first half of the 1990s the rate had declined to 0.7% per year. Harvest rates on public lands (state and Federal) were consistently below this average.

Cohen et al. (2002) also found that the harvest rates on private industrial lands were consistently about twice the average rate of harvest on public land throughout the 23 year sample period. In the late 1980s and early 1990s the harvest rate was estimated at 2.4% per year for private industrial land. An increase in private non-industrial lands owner's harvest rates started in the 1970s when the rate was 0.2% per year and continued to increase to the early 1990s when the rate was similar to that of the private industrial lands. There was a steep decline in harvest rates between the late 1980s and the early 1990s on State and Federal and private industrial forest lands.

Natural disturbance has also been documented using remote sensing time series. Staus et al. (2002) found that between 1972 and 1992 forest disturbance inside existing protected areas in the Klamath-Siskiyou Ecoregion was 0.2% per year.

2.3 CONTEXT FOR ASSESSING CHANGES TO NORTHERN SPOTTED OWL HABITAT

The 1994 biological opinion on the Northwest Forest Plan predicted continued losses of suitable habitat as the result of management. The 2001 habitat trends reports (*USDI 2001*:23) states:

> "Based on the analysis and modeling done in 1994 for the ROD (Record of Decision) (*USDA/USDI 1994a* and *b*), the USFWS's 1994 biological opinion on the Forest Plan concluded that the planned decadal timber harvest rate of owl habitat (about 20,000 acres per year or approximately 2.5 percent of all suitable owl habitat per decade) would be consistent with expectations for the conservation of the owl (*USDA/USDI 1994a*). Although this rate of harvest is not a biological threshold for this species, an assessment of the cumulative total impact from past consultation in relation to this decadal rate provides an opportunity for drawing conclusions about then trends in change to owl habitat in relation to implementation of the Forest Plan."

The assessment of impacts habitat trends over time to Northern Spotted Owl conservation requires a valid comparison with reported effects on owls relative to baseline data. There are two key sources of baseline data that can be used to predict the status of Northern Spotted Owls: 1) demographic analyses and 2) overall change in suitable habitat. The USFWS (and other agencies) rely on these data to evaluate owl status. The status and trend (effectiveness) monitoring plan for the owl integrates results of demographic studies with those from habitat studies to estimate whether owl populations will respond as predicted to given changes in habitat quantity and quality. The USFWS assumed that tracking and evaluating changes to owl habitat provides the basis for assessing the success of conservation efforts in relation to effects on owl populations.

In the 2001 report the USFWS (*USFWS 2001*:*8*) stated that:

> "Previous owl survey efforts don't provide a valid baseline since they do not represent population size nor are effects to specific sites tracked over time. There is insufficient information on owl densities in different habitat types or on different ownerships for determining population size. Numbers of owl individuals or pairs, without link to habitat estimates, don't offer a basis for tracking changes to the owls' status on other than local areas. The demographic study provides range wide estimates of population trends and are critical in assessing the overall conservation effect. Range-wide meta-analyses of demographic data tracks owls across a variety of ownerships and ecological conditions, the results provide trend information that extends beyond just Forest Plan implementation, and incorporates effects of other natural and human-made factors."

When reporting potential impacts to owls from specific projects (Section 7 consultation), agencies have reported numbers of known owl locations (or activity centers) in project areas. Changes in numbers of owls have not played a role in any of the major planning efforts, and most of the data from previous survey reports of owl locations are now outdated and of little use in addressing population questions. However, if the surveys were adequate then they represent a condition at a point in time. If at a later date surveys over the same area showed a decline in owl

territories, it suggests something might have happened, particularly if this were matched to other surveys in an adaptive management (quasi experiment) context. Lint et al. (1999) noted that more useful information about species trends was gained through a demographic and habitat-based monitoring effort than by surveys alone.

2.3.1 ANTICIPATED HABITAT LOSS FROM MANAGEMENT ACTIVITIES

The USFWS (*USDI 2004*) compared the estimated habitat losses to those that were expected in 1990. As stated in *(USDI 2004:16*):

> "The 1990 listing document states the following regarding management-based habitat trends on Federal lands: 'In Oregon and Washington, about 64,000 acres of old-growth and mature forests suitable for Northern Spotted Owls have been logged on the National Forests each year over the past nine years; this represents a decline in non-reserved owl habitat on Forest Service land of about 2.3 percent per year and a reduction of about 1.5 percent per year in the total amount of owl habitat on National Forests in Oregon and Washington (Thomas et al. 1990). The anticipated harvest rates for old-growth and mature forests for the next 10 years are about 39,400 acres/year, or roughly 1.4 percent of the non reserved old-growth and mature forests on Forest Service lands annually in Oregon and Washington. About 1 percent (4,700 acres) of the suitable habitat on Forest Service lands in California will be harvest each year (Thomas et al. 1990).'(*USDI 1990 p.26188*)
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> 'On an annual basis, the Bureau of Land Management awards contracts to harvest 32,940 acres, of which 22,800 acres are clear-cut and 10,140 acres are partially cut. Of the acreage cut, approximately 66 percent of the harvest is in forests over 200 years old (*Nietro, pers. comm.*). On Bureau of Land Management lands in Oregon, an average cutting rate of 23,400 acres/year is expected to continue. This would eliminate all Northern Spotted Owl habitat on non-protected Bureau lands, except for the Medford District, within the next 26 years (*USDI 1990*). At current logging rates all remaining suitable habitat will be eliminated in 12 (Eugene District) to 52 (Medford District) years (*USDI 1990*).' (*USDI 1990* p. 26193)
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> 'This loss of old-growth and mature habitat continues, with projected losses on Federal lands of about 3 percent per year on Bureau of Land Management and 1 percent per year (about 40,000 acres) on Forest Service land (*USDI 1990*).' (*USDI 1990 : 26152, 26160, 26163, 26184*)"

3 ESTIMATES OF SUITABLE HABITAT TRENDS

3.1 CHANGES IN HABITAT AMOUNT ON FEDERAL LANDS

The USFWS (*USDI 2004*) estimated trends in suitable habitat acreage on Federal lands for the nine year period between 1994-2003. The 2004 (*USDI 2004*) assessment incorporated the habitat trends calculated in 2001 (*USDI 2001*). The first comprehensive attempt by the USFWS

to examine changes in critical habitat (*USDI 2001*) and take of Northern Spotted Owls since listing in 1990, the latest report (*USDI 2004*) updated those values. Both reports used the same approach of assessing individual project scale impacts and summarizing results on a province scale. The USFWS was dependent on a partnership with the US Forest Service and the Bureau of Land Management to supply the basic data the USFWS used to create the habitat trends reports. The USFWS did not have the resources to produce an independent estimate of habitat change and remains dependent on a shared responsibility with the management agencies. The 2004 report (*USDI 2004*) superceded the 2001 report (*USDI 2001*). The 2004 report benefited from previous experience in having increased clarity and a keener focus *(Karl Halupka, pers. comm.)*. The USFWS used the same metric (annual rates of habitat change) for habitat change as the 1990-listing document. The panel has no information in which to assess the habitat trends between 1990 and 1994.

3.1.1 OBJECTIVES

As stated in the 2004 report (*USDI 2004: 30*):

> "The objectives of this report were to 1) calculate rates of habitat change on federal lands that have occurred due to management actions, natural events, and habitat development since the Northern Spotted Owl was listed; and 2) compare these rates to rates that occurred before listing and that were anticipated to occur after listing."

3.1.2 METHODS

Both the 2001 and the 2004 assessments used data that were gathered to make assessments of habitat change used Section 7 consultations, Biological Opinions, and Biological Assessments to determine possible impacts to habitat. These estimates were compared to the Forest Plan baseline as well as the changes in habitat there were anticipated at the time of listing. Section 7 consultations between the USFWS and other Federal agencies to assess project impacts are required under the Endangered Species Act. USFWS has focused its analysis of project-related effects on the Northern Spotted Owl to the land use allocations established under the Forest Plan for the purpose of owl conservation.

3.1.3 CONSULTATION DATA BASE

The USFWS maintains the primary data from their own consultation records (management-related loss) needed to evaluate changes to habitat. This database was created for the 2001 estimate of habitat change. Because consultations and other habitat impact assessments were derived from planned activities, assistance from the Forest Service and BLM was required to update their consultation data. The best available information provided by the land management agencies (FS and BLM) was used on the changes that actually occurred following individual project implementation. Updates primarily consisted of adjustments to the consultation database for habitat acres that were not harvested or otherwise removed, although they were originally planned for removal during consultation. Federal land management agencies were asked to provide additional information on activities and natural events of 100 acres or more in size that may have impacted suitable habitat.

3.1.4 RESULTS OF THE USFWS HABITAT CHANGE ASSESSMENT

The USFWS report (*USDI 2004*) presents rates of habitat loss attributed to management activities and natural events (e.g., fire, insects, disease, etc.) on Federal lands across the range of the Northern Spotted Owl and by individual physiographic province. The USFWS (*USDI 2004*) provides rates of habitat loss spatially and by agency as reported in the 1990 listing document for comparison purposes. Differences in how habitat is estimated and defined can confound estimates of actual change to habitat across the landscape. The USFWS focused on calculating rates as the percent change in habitat availability over time to standardize measures of change in spite of differences in starting baselines. Estimates of habitat that has developed through vegetative succession and growth (referred to by some as "ingrowth") were discussed in the report but not included in the synthesis.

The results were summarized as follows from the 2004 report (*USDI 2004:11*), See Appendices for supporting tables from (*USDI 2004:20*).

> "Our results indicated an approximate 2.11 percent decline in the amount of available habitat due to management activities range-wide. The majority of management-related loss was concentrated in Oregon, although the California Cascades province suffered a relatively high rate of loss as well. Habitat loss due to natural events totaled 224,041 acres, equating to a 3.03 percent decline in available habitat range-wide from 1994 to 2002. Between 1994 and 2004, project methods estimated that there would be an 8 percent increase in habitat available rangewide due to ingrowth/successional processes. Overall, habitat loss rangewide due to all factors has resulted in a total decline of 5.14 percent between 1994 and 2003 (0.57 percent per year).
>
> Annual rates of habitat loss due to management activities from 1994 to 2003 are less than 25 percent of rates projected at the time of listing and 15 percent of rates reported up to the time of listing."

3.2 CHANGES IN HABITAT AMOUNT ON NON-FEDERAL LANDS

The USFWS (*USDI 2004*) report does not consider habitat change on non-Federal lands. The USFWS examined information in their files that was submitted by private entities on their Habitat Conservation Plans and associated reports to determine if the information was sufficient to calculate a rate of change on non-Federal lands. They concluded (*USDI 2004*:6) that:

> "Such a calculation requires an estimate of the amount of Northern Spotted Owl habitat at some past time (usually the start of the Habitat Conservation Plan) and either a current habitat estimate or the amount of habitat removed/added since the original habitat estimate. Habitat values must be based on approximately the same definition or description to allow calculation and comparison of rates. Unfortunately, in almost all cases, we lacked some of the necessary information. The information typically lacked a starting estimate of habitat, reported harvest in terms of total forest acres that included

non-habitat, or included significant amounts of habitat acquisition that could not be accounted for in the baseline."

The Panel found no additional sources of information to make any meaningful statements about habitat trends on non-Federal lands. The same methodological and access problems that limited the USFWS in their 2004 estimates (*USDI 2004*), also limited the panel. Most timber harvest records are in terms of volume and are of little value in interpreting habitat removal (for example *American Resource Council, 2004*). Remote sensing studies are generally out of date ending in the early 1990s (see Table 6.2). Cohen et al (2002) reported harvest rate by ownership group for five periods between 1972 and 1995 and by three Oregon coast range provinces. Inference as to change in suitable habitat would require significant assumptions concerning the percent of habitat that made up the harvests, and the amount of natural disturbance. Estimates of habitat change from HCPs often are either simulated (i.e. *Farber 2003*) and may lack verification or lack a reliable baseline for comparison and have known shortcomings in estimation of habitat change despite, in the case of the Washington State Department of Natural Resources, high quality stand inventories (*WA DNR 2004a*). In a recent workshop in British Columbia, no information was presented on habitat trends (*Zimmerman et al. 2004*). Efforts are currently ongoing to attempt to estimate habitat change on non-Federal lands in Washington State (*Joe Buchanan, pers. comm.*) The panel recognizes that this information on potential harvest of habitat is usually maintained by private land owners and is proprietary and that would have little access to the information for conducting this habitat trend analysis.

4 EVALUATION OF SUITABLE HABITAT TRENDS AND THE RISKS TO OWL HABITAT

Limited empirical data is available to assess habitat loss on a range-wide basis for Northern Spotted owls. *Thomas et al.* (*1990*) compiled estimates of the amount of spotted owl habitat on most public lands, but were unable to estimate amount of habitat on private lands and from several state and tribal landscapes. Since then, several estimates of current suitable habitat and projected rates of change have become available only for Federally managed lands. Those habitat trends estimates that are available were prepared by the Services (*USDI 2004*).

The following section discusses the accuracy of habitat assessments, the sources of bias, and the assumptions made in the USFWS's analysis of suitable habitat trends (*USDI 2004*). Our interpretations are made with respect to the strengths and limitations of the existing level of resolution of habitat change. We also assess our confidence in these estimates.

4.1 EVALUATION OF METHODOLOGIES USED TO DETECT CHANGE

We conclude that the habitat losses presented in (*USDI 2004*) are conservative, but are reasonable approximations of habitat change. In general, the methodologies used by the USFWS to assess trends in suitable habitat are limited by data quality, and the reliability of specific applications is difficult to interpret because there was a poorly controlled bias inherent in the methodology and data acquisition process that was available. Despite these shortcomings there

are no other viable alternatives to estimate habitat change on Federal lands. Given the sources of bias, we believe these estimates of habitat loss overestimate losses, although the magnitude of the inaccuracy cannot be determined. However, the risk associated with these estimates being wrong is low, given that all information indicates that habitat loss has been low.

The following section discusses sources of uncertainty concerning methodologies, data, assumptions, and their implications for estimating habitat trends. This section is organized by topic: data from consultations and their adjustments and natural events, the baseline from which change was estimated, the calculation method, assumption about land transfers, and habitat development.

4.2 BASELINE HABITAT FROM WHICH HABITAT CHANGE IS ESTIMATED

4.2.1 CREATION OF THE NORTHWEST FOREST PLAN BASELINE.

When the Northern Spotted Owl was listed in 1990, a regional compilation of habitat was not available. This habitat compilation was not completed until 1994, with the completion of the NWFP. In order to develop a regional map of existing Northern Spotted Owl habitat, two types of information were needed: (1) the distribution of vegetative cover types, and (2) identification of the cover types that provide habitat for Northern Spotted Owls.

At the time FEMAT was convened, there was no single source of vegetation information across the range of the Northern Spotted Owl. A new vegetation map showing seral classes was created by FEMAT reclassifying and merging information from different federal ownerships (*FEMAT 1993*, Appendix VIII A). Satellite imagery was used to define general stand conditions while suitable habitat definitions provided by local biologists were used to develop a classification believed to represent nesting, roosting, and foraging habitat (suitable habitat). The methods for compiling and checking the FEMAT baseline using geographic information system technology was a substantive advance over the manual methods used in previous regional assessments, such as the Interagency Scientific Committee report (*Thomas et al. 1990*).

4.2.2 USE OF THE FOREST PLAN BASELINE

In both assessments used to estimate Northern Spotted Owl habitat trends, the *USFWS (USDI 2001, 2004*) used the Forest Plan baseline. They required a reference condition for habitat, against which to evaluate changes in suitable habitat acreage over time. They ideally sought a habitat baseline with particular characteristics. The USFWS stated (*USDI 2004*:2) that:

> "We sought a habitat baseline with particular characteristics. The habitat baseline needed to be: range-wide in scale; developed with a consistent methodology across that range; consistently applied over a number of years to allow for change over time to be evaluated; and recognized and accepted as a reasonable approach to this complex problem by the agencies responsible for managing Federal lands."

The USFWS's 2001 (*USDI 2004:3*) rational for selection of the Forest Plan baseline is summarized as follows: They stated:

> "The habitat baseline developed for the Northwest Forest Plan (Forest Plan) was used as a reference condition because it has all of these characteristics. It is a spatially unified database that covers 57 million acres of the Spotted owl's range in the Pacific Northwest. Temporally the Forest Plan baseline (1994), spans a time period close to a decade, thus allowing for a reasonable calculation of a rate of change over time and is comparable in length to that evaluated in 1990 at the time the Spotted owl was listed.
>
> The Forest Plan habitat baseline was formally adopted by the land management agencies in 1994 with the signing of the Record of Decision for Amendment to Forest Service and BLM Planning Documents within the Range of the Northern Spotted Owl. This database includes Spotted owl baseline habitat values for all administrative units within the Forest Plan boundaries and serves as the habitat baseline for this report."

4.2.3 ALTERNATIVE BASELINES CONSIDERED

In 2004 the USFWS revisited the use of the Forest Land Baseline. It was generally recognized that the decade old habitat assessment may have many shortcomings in terms of an accurate portrayal of habitat used by Northern Spotted Owls. Since the 1994 Forest Plan baseline was developed, there have been several efforts to create alternate, more accurate, descriptions of baseline conditions. The USFWS (*USDI 2004*) explored a number of other habitat baselines that were products of these efforts to evaluate whether they might better to calculate current rates of habitat change across the range of the Northern Spotted Owl. These baselines included various local habitat baselines, the California Baseline, and the Interagency Vegetation Mapping Project. The Interagency Vegetation Mapping Project represents the new generation of habitat assessment, but was not ready for use by the USFWS and us. It was the determination of the USFWS that local habitat baselines generally did not meet the above-mentioned criteria. The USFWS (*USDI 2004*) examined other habitat baselines as a reference for conditions against which to evaluate changes in habitat over time across the range of the Northern Spotted Owl (see Appendices for a summary and evaluation of these other baselines.)

4.3 EVALUATION OF BASELINE INFORMATION

The strength of the Forest Plan suitable habitat baseline lies in its consistency across the entire range of the Northern Spotted Owl. It was developed with the best methods available at the time and attempts to portray habitat believed, by local biologists, to be used by owls. The Forest Plan baseline was considered suitable for broad-scale analyses such as comparison of management alternatives in FEIS (*USDI 1993, 2004*). *Mickey (2004)* has criticized the claims that the Northwest Forest Plan baseline is based on too general a data set to accurately represent habitat used by spotted owls, and that the consistency of the methodologies are difficult to determine.

Due to variation in GIS and maintenance of baseline data at multiple scales, estimates of suitable owl habitat have varied among administrative units since 1994. Since only nine years have passed since implementation of the Record of Decision, the USFWS used estimates from the

FSEIS (*USDA/USDI 1994a* and *b*) as the basis for estimating change over time. The point accuracy of the Forest Plan Baseline was not intended to be sufficient for project-scale assessments. In a recent analysis comparing Northern Spotted Owl location data with the Northwest forest plan baseline (*USDI 2004*, see Appendices), the data suggests that the vast majority of owl sites were within or near designated suitable habitat. However, there was fairly low confidence among owl biologists that the Forest Plan Baseline accurately describes suitable owl habitat *(Martin Raphael, pers. comm.)*.

Since establishment of this baseline in 1994, most changes to the Forest Plan baseline have been measured at the project scale using habitat information available only to the local administrative units conducting the assessments. These administrative units maintain a local baseline of habitat customized to their local situation and information. These local habitat baselines have not been consolidated at the regional or range-wide level and do not have consistent approaches or definitions. Solis (1995) noted in reference to the Northwest Forest Plan that detailed descriptions of suitable habitat were lacking and inventories to accurately describe the quantity, quality and distribution of habitat were also missing.

Our interpretation is that local habitat baselines do not allow effects of habitat to be aggregated across the range of the Northern Spotted Owl. At the scale of individual projects, agencies (BLM, USFS, USFWS) assess effects to habitat using the best available information (the local baselines). We now know that these local baselines can differ substantially from the Forest Plan baseline.

The extent of possible overlap between the local baselines and the Forest Plan Baseline is not clear. Although the accuracy can not be totally reconciled, *USDI 2004* (Appendix 4 and 10) reports considerable overlap when comparing Northern Spotted Owl location data with suitable habitat maps for Washington, Oregon, and California. This is important evidence that, although the accuracy of the Northwest Forest Plan baseline may not be validated, the risk in using the baseline for range-wide estimates is reasonable. It is possible that the local and Forest Plan baselines account for different acreages; if true, this represents a source of uncontrolled bias. If this local habitat baseline includes, under its definition of habitat, areas or conditions not considered habitat in the Forest Plan baseline, the reported acres of habitat removed may overestimate the effects of the project relative to the Forest Plan baseline. Conversely, if the local habitat baseline does not include all areas defined as habitat in the Forest Plan baseline, effects are underestimated relative to the Forest Plan baseline. The USFWS has stated the project effects that compiled overestimate effects relative to the Forest Plan baseline *(USDI 2004:16*). The level and direction of differences between local baselines by the Forest Plan baseline varies widely by area.

Our assessment is that there are flaws in the Forest Plan baseline, but there is no viable alternative. It would be very difficult to aggregate local baselines, which are believed to better reflect the key components of suitable habitat, into a new baseline. The Interagency Vegetation Mapping Project has the potential to update the vegetation classification range-wide and be validated with local definitions that have been field verified.

The USFWS had to choose between using an outdated baseline with known weakness or waiting for a new baseline to be completed. Using local habitat definitions from a region-wide assessment was not practical. The argument for using the Forest Plan baseline was reasonable given the range-wide scale required. Determining the inaccuracies inherent in using an alternative baseline to the Forest Plan baseline were beyond our capabilities to evaluate. We did not know if bias in the Forest Plan baseline had consistent consequences range-wide. However, given the small changes in suitable habitat observed between 1994 and 2002, the relative risk of using available habitat trend assessment information for Federal lands was low.

The Interagency Vegetation Mapping Project, once complete and validated, will provide a new reference condition, and thus may be useful for evaluating trends in habitat change in the future. It will contain the local accuracy constraints as does the current Forest Plan baseline. However, there must be both methodological and validation consistency in order to achieve a consistent baseline. The Interagency Vegetation Mapping Project will also provide a baseline for all habitats within the range of the Northern Spotted Owl. We believe that the appropriate scale to interpret habitat change should remain at the province.

4.4 ASSUMPTIONS CONCERNING CHANGES IN FEDERAL LAND OWNERSHIP

Another source that contributes to the overestimation of habitat loss was the treatment of land exchanges. About 19,500 acres of habitat were acquired by Federal agencies from 1994 to 2003 through land transfers and exchanges (*USDI 2004* Appendix 5). The USFWS did not consider habitat additions to the Federal land base as a change in habitat condition. These additions were not included in the Forest Plan baseline or in calculations of habitat trends. We believe it was reasonable for the USFWS to maintain a common baseline for this assessment because often the land use allocation was not known and details of habitat status were from mixed sources and not verifiable (*Karl Halupka, pers. comm.*). Changing the baseline through time influences the relative contribution of specific habitat losses or gains through time.

In the long term, failure to include land transfers will result in underestimation of habitat managed under the Forest Plan. In the East Cascades province the habitat acquisitions were about 80% of the acreage that was lost (8,613 acquired, 10,788 lost). In the West Cascades province land that was acquired replaced about 35% of the acreage lost (4,025 acquired, 11,389 assumed lost).

The lack of inclusion of these lands represents an important footnote in the interpretation of these habitat change rates. Future analysis based on the Interagency Vegetation Mapping Project will cross ownerships and provide a better bases to address changes in ownership in the context of distribution of habitat.

4.5 CONSULTATIONS USED IN HABITAT CHANGE CALCULATIONS

As previously stated, the most recent analysis of habitat trends by the USFWS (*USDI 2004*) is an update of the 2001 report (*USDI 2001*). The 2004 report incorporated all the refinements of the

information from the 2002 report as well as updated information. In assembling data for the 2001 habitat assessment (*USDI 2001:6*), the authors of the assessment noted that it was apparent to the USFWS that individual consulting agencies used and managed consultation data differently. These differences included the use of terms and/or definitions of terms, the interpretation of impacts to owls, the different scales at which data are collected, how data are managed, and double counting of effects data.

In both 2001 and 2004 (*USDI 2001, 2004*), the majority of data available for habitat assessments were associated with implementation of the Forest Plan as individual projects or plans on local scales. Because of inherent GIS errors associated with digitizing, use of different mapping sources, use of different terms, and use of different organizational levels, the USFWS recognized that the consultation data base did not lend itself to sophisticated statistical analysis.

Instead, the USFWS viewed these data as useful to evaluate general tendencies or trends and identify issues warranting further consideration (*USDI 2004:16*). We agree with this view; as such, all acreage change figures are rounded to the nearest one thousand, and should be viewed as approximations only. Although the USFWS estimates are approximations, our conclusion is that these trend assessments provide reasonable estimations about the general status of Northern Spotted Owl habitat on Federal lands.

4.5.1 ADJUSTMENTS TO IMPACTS IN PRIMARY DATA

A simple cumulative total of consultation acres cannot be directly compared to the total estimate of owl habitat over the Forest Plan area to accurately calculate actual impacts to owls. Adjustments were made to help control known sources of bias in the primary consultation data that were used to determine habitat impacts. To support the evaluation, the USFWS (*USDI 2001*), along with the Forest Service and BLM, investigated the accuracy of 35 biological opinions to identify whether the figures reported in the opinions accurately represented potential effects to owls. Of the 298 consultations examined for the assessment, 35 opinions represented the majority (about 70%) of the acres under the purview of the Forest Plan. The results of this examination were used to remove sources of double counting, reconcile terms, and adjust the cumulative database and total effects downward approximately 40% to represent a more realistic estimate of expected impacts to owls (*USDI 2001* Table 6.4-1). However, since adjustment data were used only from opinions where there were acre differences greater than 1,000 acres (8 of 35 opinions reviewed out of 298 Forest Plan opinions in total), these revised effect estimates still slightly over-represent potential effects to owl habitat (*USDI 2001*).

The sources of data (project level consultations) for habitat change were believed to have consistently overestimated actual habitat loss (*Danielle Chi, pers. comm.*). It was assumed that counting of unimplemented projects over-represented the actual anticipated effects to Northern Spotted Owl habitat. Improved tracking of projects was in place for the 2004 estimates to help reduce much of the source of error from unimplemented projects.

Consultations (Section 7) assess the potential effects of the worst case alternative, but often other alternatives are selected *(Karl Halupka, pers. comm.).* The USFWS believes the actual effects are usually less than those originally predicted, adding another source of potential unknown bias

(very likely overestimate of actual habitat acres harvested) to the estimates of management-based losses *(Karl Halupka and Danielle Chi, pers. comm.).* The 2004 (*USDI 2004*) assessment is an improvement in that it focused on suitable habitat only, while avoiding quantification of harassment. In 2001 (*USDI 2001*), double counting of effects to the same acres and activity centers may be the largest source of overestimation. Therefore , the USFWS is unable to fully quantify the extent of overestimated effects.

4.5.2 EVALUATION OF CALCULATIONS OF HABITAT CHANGE FOR FEDERAL LANDS

We agree with the USFWS's decision that the Forest Plan baseline provides the best available common denominator for calculations of range-wide rates of habitat change. Calculating rates of habitat removal from the Forest Plan baseline was intended to provide an index of habitat removal that should be generally applicable under other broad habitat definitions and their associated baseline levels. The 1990 listing document presented information about habitat trends separated by management agency and state. Anticipated habitat loss due to natural disturbance events was not calculated in 1990. Having no baseline or basis for comparison eliminated the possibility for making this comparison.

Calculating average rates across years smoothes the effects of adjustments to project scope provided by the land management agencies. The USFWS's methods for tracking effects would inflate inter-annual variation. Averaging reduces this potential bias, because treatment effects from a project or natural disturbance are assigned to a single year, though in reality they likely occur over a longer period.

The USFWS calculated separate rates of change for habitat removal (resulting from management activities and different types of natural disturbance) and for habitat development. We agree with the USFWS that estimates of habitat removal due to management activities is probably estimated with the greatest accuracy because individual projects that affect Northern Spotted Owl habitat are subject to intensive habitat surveys. Estimates of habitat changes ensuing from natural disturbance events are probably less accurate due to reduced intensity of surveys and analytical review. Timber harvests included all forestry activities in the USFWS's consultation database, so these calculations probably will slightly overestimate timber harvest impacts.

4.6 HABITAT CHANGE AS A RESULT OF MANAGEMENT

The rate of habitat loss on all federal lands managed for the Northern Spotted Owl has been less than anticipated at the time of listing and under the NWFP. Riparian areas and other designations have resulted in about 15% more land being managed for late-successional forest objectives (*USDI 2004*).

We concluded the reasons for the lower loss of habitat on Federal lands include the following:

The anticipated harvest levels on Federal lands has been lower than anticipated.

The changing approach to harvesting has left more structural legacy (residual trees and coarse woody debris), which fosters the development of habitat complexity.

The harvest of old growth forests has been lower than anticipated.

Lower levels and less intense harvest has resulted in less loss of existing late-successional forest.

The area in riparian management zones was significantly underestimated in original FEMAT assessments.

4.7 NATURAL STAND DISTURBANCE EVENTS

Estimates of natural disturbance effects (fire, insect damage etc.) on suitable habitat are difficult to assess accurately. The difficulty in tracking these widely dispersed effects and interpreting the impacts will likely remain the primarily source of uncertainty in impact assessment. The acreages of habitat appear to be large (*USDI 2004* Table 6.3 and 6.5, Appendices), but are consistent with historical variation.

4.7.1 INCONSISTENT INTERPRETATION OF IMPACT INFORMATION

The majority of changes to suitable Northern Spotted Owl habitat probably are captured in the USFWS's 2004 (*USDI 2004*) assessment despite likely inconsistencies in agency interpretation. Apparently, the USFWS was still developing a tracking strategy for natural disturbances at the time the assessment was written. Data used for the habitat trend assessment was generated in response to requests to Federal land management agencies (Forest Service, BLM, and National Park Service) to provide estimates of habitat lost from all natural events affecting over 100 acres of habitat.

Interpretations of natural disturbance effects are likely to differ between agencies and staff from different provinces. Confounding estimates of habitat removal by fire and assessments made soon after the event may misrepresent the total habitat effects. In particular, the impact of moderate intensity fire on habitat suitability is difficult to assess. *Bond (2003)* assessed the habitat condition after the Star fire in the Sierra Nevada and found a considerable discrepancy between the condition and suitability assumed by the Forest Service and what was verified in the field. Many of the areas that were assumed not to be suitable because of fire damage still met the specification that were known to support California Spotted Owls in the area. *Bevis et al.* (*1997*) also reported continued owl use of lightly burned sites in the eastern Cascades, however, overall owl use shifted away from more heavily burned areas. High intensity fires resulted in a loss of habitat suitability. *Anthony et al*. (*2002*) found continued occupancy of forests impacted by the Quartz Creek fire on the Rogue River National Forest in Oregon. Bond et al. (2002) observed Spotted Owls for fires in California, Arizona and New Mexico and found that moderate and light severity wildfires in those areas had short-term impact on owl survival, site fidelity, and reproductive success. Estimating the influence of fire on habitat has the danger of either overestimating or underestimating the eventual (i.e., long-term) effect. Delayed tree mortality, especially after moderate intensity wildfire or by secondary insect activity in injured trees, could expand post-fire mortality (Gaines et al. 1997).

In conducting their habitat trend analysis, the USFWS did not specify how to characterize disturbance effects on habitat to natural disturbance, and noted evidence of inconsistency of treatment in their request for information about natural disturbance. The report (*USDI 2004:8*) states "Consequently, different administrative units may have used different criteria for determining how much habitat was removed by an event, particularly regarding whether habitat affected by moderate intensity fire was sufficiently damaged to be unusable by Spotted owls."

4.7.2 FIRE EFFECTS

Wildfires accounted for 75 percent of the natural disturbance loss of habitat in the nine years between 1994 and 2003. New approaches to wildfire detection, prevention, and suppression were successful in reducing the extent of wildfires until the 1960s. During that period fire frequencies declined and fuel loadings increased (Agee 1994). Area burned by wildfires in the Interior Columbia Basin has steadily increased from the 1970s to the present. Currently the extent of wildfires in the Interior Columbia Basin is approaching the historical levels of the early 1900s (*USDA / USDI 2000*).

Hessburg et al. (1994) described the historical and current roles of insects and pathogens in eastern Oregon and Washington. They concluded that a century of fire protection has promoted a steady shift away from open ponderosa pine and western larch forests toward denser late-seral fir forests. The harvesting of high valued seral overstory trees accelerated conversion to insect and pathogen susceptible late successional forests. Douglas fir and grand fir are highly susceptible to root pathogens, bark beetles, defoliators, and dwarf mistletoe. Excluding fire from the grand fir and Douglas fir forests has been the single greatest detriment to diversity of eastside forests, and the primary factor in current susceptibility to major pathogens and insects.

Management can promote forest structures that are consistent with those that would have resulted from the historical fire regimes. Agee and Edmonds (*USDI 1992,* Appendix F:419) recommend active management that affords longer term protection of habitat. MacCracken et al. (1996) describe the forest health/spotted owl dilemma in the eastern Cascades as either 1) basically do nothing and hope for the best or 2) restore some semblance of historical range of variability in disturbance. There are often considerable administrative and economic barriers to forest restoration. The Washington State Department of Natural Resources *(WA DNR 2004b)* recently amended their HCP to promote Northern Spotted Owl habitat restoration in eastern Cascades. On the Yakima Indian reservation, King et al. (1997) describes how recent management trends can be reversed by shifting forests from late seral, fire tolerant, pathogen and insect susceptible forests by developing a seral dominated forest matrix. There are similar threats to the long-term maintenance of Northern Spotted Owls habitat exist on the Okanogan and Wenatchee National Forests in Washington state (*Paul Flanagan, pers. comm.*)

The Gotchen Late-successional Reserve in the eastern cascades of Washington provides an interesting case study for LSR susceptibility. Mendez-Treneman (2002) describes a LSR on the trajectory of substantial continued tree mortality, increased fuel loading and increased risk of stand replacement fire. Spruce budworm has been defoliating portions of the LSR since 1994 (*Willhite 1999*). After several years of defoliation by spruce budworms, grand fir mortality increased with mortality varying from individual pockets of 6-12 trees to the majority of the

stand (Mendez-Treneman 2002). *Willhite (1999)* detailed the extent of defoliation and examined the possible suppression of the Spruce budworm populations on the Gotchen with a biological insecticide (*Bacillus thuringiensis* (*Bt*)). Mendez-Treneman (2002) examines the possibility of active management to maintain owl habitat and reduce risks associated with crown fire and mortality from the spruce budworm. No loss of habitat as a result of insect or pest activity was reported for this province in the 2004 USFWS report on habitat (*USDI 2004 Table 6.3*).

The changes in the mixed conifer community that have resulted in habitat conducive to the Northern Spotted Owl, have also resulted in a shift toward greater instability (Maffei and Tandy 2002). Much of the newly developed Spotted Owl habitat may be relatively short-lived as habitat because replacement Douglas-fir and ponderosa pine nest trees are unlikely to develop given the successional pathway (Lehmkuhl et al. 1994). Maffei and Tandy (2002) estimate that 70 percent of the Spotted Owl suitable habitat has been lost as a result of combined effects of western spruce budworm, root disease, bark beetles in the McCache LSR in the eastern Oregon Cascades.

The Forest Plan acknowledges the potential for the loss of owls and habitat from catastrophic events such as wildfire, particularly in East Cascades Provinces and the Klamath Province. Fires can have significant impacts on owl habitat and forest health in general and are of particular concern when they affect large portions of LSRs or multiple LSRs. Fifty percent of the habitat loss from natural disturbances reported in by the USFWS (*USDI 2004:Table 6.3 and Appendix 9)*, can be attributed to the Biscuit fire. Treatments to reduce risk in and around LSRs are typically designed to protect owl habitat over the long term by reducing the likelihood of catastrophic effects; in the short term however, prescribed fire could adversely affect nesting owls directly or indirectly by affecting their prey (Carey et al. 1992, Zabel et al. 1995, North et al. 1999, *Wirtz et. al. 1988*). Bond (2002), however found no such short-term affect on owls.

The extent and intensity of natural disturbance events is highly variable (Wimberley et al. 2000). The nine years of record (*USDI 2004*) in the available assessment is simply a snapshot in time allowing no conclusion about natural disturbance trends. Long term changes in fire regime have been studied. Taylor and Skinner (2002) found in the Klamath Mountains that the fire return intervals at the watershed level are currently less frequent than they were historically. Their hypothesis is that fire suppression has altered the historic fire regime of 20 years to the current estimate of 238 years. Wildfire risk and management will be a continuing source of threat to existing LSRs.

4.7.3 PESTS AND DISEASE

Forest management practices including fire suppression, selective logging, and unmanaged overstocked plantations have resulted in changes in tree species composition that make areas more susceptible to large-scale insect outbreaks (Agee and Edmonds *USDI 1992*, Hessburg et al. 1994, Lehmkuhl et al. 1994). A spruce budworm outbreak in the eastern Washington Cascades started in 1998 and has caused widespread tree defoliation. There is evidence of competitive stress on large old ponderosa pine and Douglas-fir trees in eastside forests making these trees susceptible to fir-engraver beetles and western pine beetles (*Paul Flanagan, pers. comm.*). It was surprising that no habitat loss was documented in the 2004 (*USDI 2004*) assessment of

changes in suitable habitat in eastern Washington. These types of impacts were anticipated and considered in the development of the Forest Plan (*USDA/USDI 1994a and b*).

Lehmkuhl et al. (1994) documented changes in vegetation cover, landscape attributes and the range of historical variability in eastern Oregon and Washington. They documented that forests became more dense in vertical and horizontal canopy structure as understory cover increased with regeneration of mostly shade-tolerant species. The distribution of forest age class and structure changed with smaller area in early seral and old forest stages and greater area in multiple canopy young and mature stands. The percentage of visible dead trees increased.

4.7.4 POTENTIAL IMPACTS OF SUDDEN OAK DEATH

Sudden Oak Death (SOD) has the potential to be locally important in some parts for the range of the Northern Spotted Owl. SOD infects many important tree species within the range of the NSO including Douglas-fir, coast redwood, tanoak, Pacific madrone, Canyon live oak, and California black oak. Tanoak, Pacific madrone, and Canyon live oak are important hardwood components in the mixed-evergreen forests characteristic of the Klamath-Siskiyou region of southwestern Oregon and northwestern California. The virulence of the disease in tanoak and Canyon live oak has already been noted. Although the literature does not yet cite golden chinkapin (*Castanopsis chrysophylla*) as a host for SOD, it may be susceptible because it is closely related to oaks. Douglas-fir is unquestionably the most important conifer within the range of the NSO; the eventual effect of SOD on Douglas-fir and coast redwood are currently unknown although branch mortality has been noted on both species as well as mortality on redwood sprouts. Significant mortality of any of these species would certainly modify existing NSO habitat, and could cause local extinction of some species such as tanoak, the species that appears most vulnerable to SOD (See Appendices for an overview of the disease).

The current effect of SOD and its possible duration are unknown. Modifications to Northern Spotted Owl habitat from SOD would be in the form of: (1) altered forest structure and composition, with potential impacts on thermal cover and vertical structure, hunting perches, and ground cover density; (2) elimination of potential nest trees; and (3) changes in prey base because of loss of food and cover for prey.

Altered forest structure due to SOD is most probable in the case of the mixed-evergreen forests that are characteristic of much of the Northern Spotted Owl habitat in the Klamath-Siskiyou region. These forests are characterized by a mixed forest of evergreen conifers (Douglas-fir, western hemlock, sugar pine, incense-cedar, and Port-Orford-cedar) and evergreen hardwoods (tanoak, Pacific madrone, golden chinkapin) (Franklin and Dyrness 1973). Douglas-fir and tanoak are the most common constituent species with Douglas-fir emerging above a lower canopy of tanoak and other evergreen hardwoods. Evergreen shrubs, such as Pacific rhododendron and salal along with hardwood saplings characterize the understory.

The evergreen hardwood trees and shrubs, which are the group currently projected to be most impacted by SOD, are important in supporting the prey base for NSO. For example, tanoak, Canyon live oak, and golden chinkapin periodically produce large crops of acorns (mast) and Pacific madrone produces large crops of fruit that are important food resources for small

mammals. They also provide nest sites for arboreal species, such as the Northern Flying Squirrel, as well as for any other species that utilize tree cavities.

Elimination of the evergreen hardwood tree over- and mid-story would also result in significant modification of the microclimate within the stands, which could last for a significant period. This level of mortality has been observed in some heavily infected stands in which tanoak was dominant or co-dominant. Replacement of the lost evergreen hardwood component by conifers, such as Douglas-fir, could take decades or even centuries on some of these sites. Depending upon the relative proportion of evergreen hardwoods and conifers, increases in radiation and temperature and reductions in relative humidity could range from slight to very significant, including effective elimination of forest influence on the site.

Loss of the evergreen hardwood dominant and co-dominant trees would directly affect Northern Spotted Owls by eliminating potential nest trees and thermal cover. Evergreen hardwoods are currently used as nest trees. For example, in the California Coast Range 8% of the nest trees were tanoak and 1% were golden chinkapin (Pious 1994). In the redwood region, 11% of the nest trees were hardwoods, primarily California bay laurel and tanoak (*Chow 2001*). In a study of the Klamath region and California Coast Range, Northern Spotted Owl nest trees included small numbers of tanoak, California live oak, California black oak, and golden chinkapin (LaHaye and Gutiérrez 1999). Effects on thermal cover would depend on the percentage of the stand overstory that was composed of susceptible hardwood species, as noted in the previous paragraph.

4.7.5 PROSPECTS AND UNCERTAINTIES SURROUNDING SOD

SOD is of such recent origin that it is difficult to predict the impacts that it will have on Northern Spotted Owls, even in the near future. Based on initial observations of vulnerable species it appears very likely that there will be a significant impact on Northern Spotted Owl habitat on sites occupied by stands with a significant component of tanoak, especially when associated with susceptible tree species that are major sources of inocula, such as California bay laurel. This will include negative impacts, at least initially, on prey species, thermal cover, and nest sites.

Stands with a major susceptible evergreen hardwood component are probably the most common type of Northern Spotted Owl habitat with the Klamath-Siskiyou region. Consequently, if other evergreen hardwood species, such as Pacific madrone, Canyon live oak, and golden chinkapin, ultimately suffer significant mortality from SOD, the potential impacts of SOD could be large in terms of the acreage of Northern Spotted Owl habitat affected.

In the (hopefully) unlikely event that major coniferous species, such as Douglas-fir and coast redwood, prove to be seriously affected by SOD, than impacts to Northern Spotted Owl habitat could be even more dramatic and potentially extend beyond the mixed-evergreen forests of southwestern Oregon and northwestern California.

Fuel loadings and architecture associated with high levels of mortality in the hardwood component of mixed-evergreen forest stands will also increase the risk of intense wildfire if SOD causes widespread mortality of trees and shrubs.

To conclude, there currently are many uncertainties regarding the eventual impact of SOD on Northern Spotted Owl habitat. It is very likely that, at least, SOD will have significant local impacts on Northern Spotted Owl habitat with a major component of tanoak, given this species' evident vulnerability. Possible, but less likely, would be impacts on all stands with major components of madrone, chinkapin, and Canyon live oak. The worst case will be if native conifers suffer significant growth reductions or mortality from SOD.

4.7.6 ASSESSMENT OF RISK FROM NATURAL DISTURBANCE

At the time of listing a significant risk to habitat was recognized from the vulnerability some habitat had to catastrophic wildfire (*USDI 1992*; 41 and Appendix F). Especially vulnerable are the provinces in eastern Oregon and eastern Washington and some areas of the Klamath province. Several elements of the Forest Plan were designed to provide adequate resiliency to prevent isolation due to catastrophic events. Action has not been taken to significantly reduce the uncharacteristic accumulations of fuels and thus the threat of catastrophic fire. The risk to habitat has continued to increase. Management requires the must balancing of the short-term impacts of risk reduction management on the Northern Spotted Owl versus long-term risks of catastrophic losses of habitat.

Judicious thinning and partial harvest is believed to reduce the risk of habitat loss for Spotted Owls from catastrophic wildfires *(Irwin 2003). Irwin and Thomas (2002)* explore the policy conflicts of managing for long-term habitat in fire-adapted forests. They emphasize that Federal land managers must be willing to tolerate important short-term risk in restoring landscapes with altered fire (and insect and pathogen) disturbance regimes. King et al. (1997) promote the use of a mixed landscape and site-based protections to high-quality fairly continuous dispersal habitat and well-distributed nesting, roosting, and foraging habitat on a fire prone east Cascade landscape.

4.8 HABITAT DEVELOPMENT

The development of suitable Northern Spotted Owl habitat is a vital part of the long term habitat management approach of the Forest Plan. Losses of habitat typically occur in a tangible time frame, such as with harvesting or catastrophic fire; rates of habitat development on the other hand, are influenced by many variables (such as site type and disturbance history) as to make the accuracy of predictions limited.

Habitat development is an important aspect of habitat change. Management activities designed to accelerate development of new habitat are becoming an important part of forest management. Carey (2003) and Franklin et al. (2002) provide background for management and the processes that can accelerate the development of habitat. It is assumed that retention of legacy components in current areas of timber harvest will shorten the time needed for them to achieve the habitat complexity to be suitable as Northern Spotted Owl habitat.

4.8.1 EXISTING ESTIMATES OF HABITAT DEVELOPMENT

In contrast to the habitat effects due to management and natural disturbances, available existing estimates of habitat development were calculated at the regional scale rather than at the project scale. Regional estimates of habitat development were derived as a modeled projection (*USDI 1993, 2004*). Habitat removal estimates are an aggregation of smaller scale estimates from local surveys and have not been validated with field information. The USFWS (*USDI 2004:13*) contends that "given the differences in the approach, describing a net rate of habitat change would be misleading when compared with project level habitat loss estimate." We do not concur. The intention of the analysis is to scale the effects to the province scale; habitat losses are already being portrayed at that scale. These are averages to be applied over vast acreages and are consistent with the goals of the assessment.

Ideally, field-measurement or inventories should be used to track changes in suitable habitat development. Unfortunately, this lack field work has resulted in the Federal agencies using modeled age-based projection approach based on general forest inventories. Projected forest development across the range of the Northern Spotted Owl (*USDA/ USDI 1993, 2004*) are used to help evaluate the consequences of different conservation or management alternatives.

4.8.2 PREVIOUS USE OF HABITAT DEVELOPMENT ESTIMATES TO ASSES IMPACTS

Net increases in late-successional forest of 600,000 acres per decade have been included in range-wide projections of Spotted Owl habitat development (*USDI 2004*) to evaluate management alternatives. This rate represents about an 8% decadal increase in forest over 80 years of age on federal lands relative to the Forest Plan baseline. Raphael et al. (1992) used a similar rate in 1992 to model the influence of habitat changes on possible survivorship.

Existing calculations are based on forward projection (*USDI 1993, 2004*) starting with data used in development of the Forest Plan in 1994 *(Martin Raphael and Chris Cadwell, pers. comm.).* As the Forest Plan baseline assumes that mature forest conditions have the function of suitable habitat, so do estimates of habitat development. In reality, projecting the transition of a forests age and size classes to different levels of habitat function requires extensive field verification. We recognize that the accuracy of both estimates is unknown without field validation.

Validation of potential habitat development is a difficult task. In part, validation of stand development will be part of the new suitable habitat baselines developed from the Interagency Vegetation Mapping Project. Remote sensing approaches have already demonstrated value in tracking both negative and positive changes in forest cover. For example, in an analysis of forest disturbance in the Klamath-Siskiyou ecoregion, Staus et al. (2001) found that forest disturbance was somewhat offset by approximately 220,096 ha (2%) of regrowth in areas that were non-forested in 1972 but forested in 1992.

We agree that the USFWS can appropriately utilize habitat development averages. Habitat development certainly is not a mechanistic process and there is considerable variability with predictions of habitat development. The habitat complexity that most definitions project as suitable habitat develops over multiple decades and is not a threshold that is achieved with an average size class. Stand age or size does not account for the history, growing conditions,

species composition, and other factors that determine the rate of habitat development. There is considerable uncertainty in the transition between mid-seral stage stands and suitable habitat. These uncertainties still exist with remote sensing information or inventory methods that are not specifically designed to sample the key components of suitable habitat. Utilizing new remote sensing approaches that better portray the 3-dimensional structure of the stand, such as LIDAR, might allow quantification of Northern Spotted Owl habitat.

Estimates of habitat development were calculated by a modeled projection of stands at the regional scale. Stands that reach the age of 80 years are assumed to become habitat. Net increases in late-successional forest (80 years or greater) were estimated by decade. The lack of more detailed stand condition information precluded alternative methods of habitat development assessment. In reality, projecting the transition of a forests age and size classes to different levels of habitat function requires extensive field verification. We recognize that the accuracy of both estimates are approximations to be used on range-wide scales.

Given the uncertainty about the rate of complex forest structure development in the 80+ year-old stands, habitat development was likely overestimated. We cannot determine the extent of overestimation. However, since many of the stands that are projected to become habitat originated after natural disturbances, it is highly plausible that the majority of the projected new habitat would function as suitable habitat when predicted, and the remainder would follow within additional projection periods.

4.9 CHANGES ON NON-FEDERAL LANDS

There have been two major changes on non-Federal lands concerning suitable habitat protection since 1990: increased state regulation and the emergence of Habitat Conservation Plans (HCPs). The USFWS proposed a special rule under section 4(d) (*USDI 1995*) for non-Federal lands. It was never finalized, and the prohibition on take remains as it was when the species was listed.

State regulations have changed considerably since 1990. In 1993, the State Forest Practices Board in Washington adopted rules that would "contribute to conserving the Northern Spotted Owl and its habitat on non-Federal lands," (*WA Forest Practices Board 1996*) and recommended roles for those lands in owl conservation (*Hanson et al. 1993, Buchanan et al. 1994*). Seven HCPs with owl protection provisions covering 1,952,730 acres have been approved in Washington. These plans are designed to provide the demographic support and connectivity support that are recommended in draft recovery plan (*USDI 1992b*), and provide support to the Northwest Forest Plan. *Buchanan and Swedeen (2004)* examined the current known distribution of territorial Spotted Owl centers in relation to management designation. Of the approximately 1027 owl centers known in Washington, 86% were on primarily Federal lands, about half of the owl centers on non-Federal lands are on ownerships managed under an HCP.

In 2000, the Oregon Forest Practices Act provided for protection of 70-acre owl core areas around known nest sites on State and private lands, but did not provide for protection of owl habitat beyond these areas (*ODF 2000*). In general, there has been no large-scale Northern Spotted Owl habitat protection strategy or mechanism on non-Federal lands in Oregon. The four

owl-related HCPs currently in effect included 303,541 acres of land and will provide some nesting habitat and connectivity over the next few decades.

Detrich et al. (1993) documented the evolution of management planning efforts in California. In 1990, the California State Forest Practice Rules were amended to require surveys for Northern Spotted Owls in suitable habitat and to provide protection around activity centers (O*DF 2001*). Under the these rules, no timber harvesting plan can be approved if it is likely to result in incidental take of Federally-listed species, unless authorized by a Federal HCP. The California Department of Fish and Game reviewed all timber harvest plans to ensure that take was not likely to occur, and the USFWS took over that review function in 2000. Several large industrial owners operate under Northern Spotted Owl Management Plans, with concurrence by the USFWS, in which they've specified the basic measures they will undertake for owl protection. Three HCPs authorizing take of Northern Spotted Owls in California have been approved on lands covering 594,580 acres.

Since 1990, 13 Habitat Conservation Plans have been issued that address the Northern Spotted Owl and provide habitat functions across the landscape. Since implementation of the Forest Plan in 1994, the USFWS's expectations for non-Federal lands are for contributions to demographic support or to provide connectivity with Forest Plan lands by providing dispersal habitat.

Poor documentation of initial baselines for most HCPs precludes estimates of habitat modification. In addition, the implementation schedule and rate of habitat removal and development would require frequent updates. As with Federal lands, there is a time scale difference between HCPs and actions consulted on for the Forest Plan and other agencies; the term of most large-scale HCPs covers periods of 20 to 100 years (and more), whereas the term of actions on Northwest Forest Plan lands is from one to five years. For this reason, comparisons are difficult.

4.10 NON-FEDERAL LANDS CHANGE EVALUATION

Significant changes in conservation have taken place on non-Federal lands since the listing of the owl. Federal conservation efforts recognized that contributions from non-Federal lands (State, Tribal, and private) were important to the goal of achieving the owl's conservation and recovery (Thomas et al. 1990 and 1993, *USDI 1992a* and *b*). The need for non-Federal contributions in areas of special concern was reiterated in the FEMAT Report (*USDA 1993*). The specific importance of the role of non-Federal lands will vary by individual physiographic province and conditions within each province. Holthausen et al. (1995), Raphael et al. (1995), *Michaels (1996)* and Hof and Raphael (1997) discuss possible contribution of non-Federal lands to Federal Northern Spotted Owl conservation efforts. They concluded that the retention of non-Federal habitat would make a biologically significant contribution to the maintenance of the Northern Spotted Owl population on the western Olympic Peninsula in Washington State.

State Forest Practice Rules offer some level of suitable habitat protection in each state. However, timber harvest on non-Federal lands still has the potential to displace owls and affect suitable habitat. Harvest of suitable habitat has been documented in Washington State *(Buchanan, pers. comm.)*, and elsewhere in unknown amounts on non-Federal lands. In general,

states do not require comprehensive monitoring of Northern Spotted Owl habitat loss. Efforts are currently ongoing to attempt to estimate habitat change on non-Federal lands in Washington State.

We remain poorly informed concerning habitat trends on non-Federal lands. A recent report (*American Resource Council, 2004*) illustrates the difficulty in obtaining data that could relate to habitat change on private lands. Each state has their own accounting systems and the data once obtained require considerable interpretation in terms of the impact of treatments and the time frame in which the treatments were conducted. The USFWS examined information submitted by private entities as well as information contained in Habitat Conservation Plans and associated reports to determine if the information was sufficient to calculate a rate of change on non-Federal lands. The USFWS determined there was insufficient documentation of the habitat baseline and lack of information about habitat change to allow the estimation of habitat trends on non-Federal lands. The panel recognizes that this information is usually maintained by private landowners and may be proprietary. Future habitat trends analysis of all forested lands within the range of Northern Spotted Owl using remote sensing could provide valuable insight to the continued role of non-Federal lands in supporting conservation of owl habitat.

Habitat Conservation plans will provide a more consistent role for owl conservation on non-Federal lands and should increase confidence that continued and often increasing habitat will be a management goal on some non-Federal lands. Implementation of these HCPs will provide for owl demographic and connectivity support to lands managed under the Forest Plan. Most physiographic provinces are influenced by one of the 13 HCPs for the Northern Spotted Owl that have been issued to date, covering periods from one to 100 years. Habitat conservation plans represent a significant positive development over State Forest Practices Rules alone in terms of reduced habitat risk. In concert with the Forest Plan, HCPs offer the opportunity to develop landscape scale approaches to habitat conservation and development, rather than focusing on individual owl sites. Increased assurances of habitat maintenance and development on non-Federal lands should promote the planning and analysis of management alternative for habitat on a landscape scale as illustrated by McComb et al. (2002). We believe that HCPs should be encouraged, and the continued cooperation between the USFWS and private land owners to seek creative ways to manage habitat in working forests is a positive development since listing.

5 ASSESSMENT OF RISK

5.1 FEDERAL LANDS

Our evaluation is that the reductions of Northern Spotted Owl habitat on Federal lands since 1994 are lower than those originally anticipated by the USFWS and the Forest Plan. The Northwest Forest Plan has maintained large blocks of suitable owl habitat on federal landscapes. While some of the suitable habitat is at risk of loss or degradation from pests and fire, these risks appear consistent with historical norms. Fire risk and the forest health situations on the east side of the Cascade Range and within Klamath provinces may be exceptions.

We have considerable uncertainty about how to estimate future habitat development, but development of mature forests will undoubtedly continue to add suitable Northern Spotted Owl habitat. Conclusions about the changes in the distribution of suitable habitat are restricted to the provincial level. However, given the low rate of suitable habitat change, these province-wide estimates are adequate to assess habitat risk range-wide.

It is clear that the threat from habitat loss on Federal Lands has been reduced from the time the owl was listed. Since the adoption of the Forest Plan, habitat loss has been lower than anticipated. Our best qualitative assessment is that losses (*USDI 2004*) have been overestimated. The current methods used to assess habitat trends on federal lands have significant sources of uncontrolled and difficult-to-document bias, such as what the baseline represents in terms of functional owl habitat and the imprecise approximations of trend assessments. However, the estimated rates of suitable habitat change on federal lands are small. A precise assessment of impact to owl habitat is not possible because of uncertainty in the baseline and the quality of data available; however, the risk of reaching the wrong conclusion in terms of the scale of habitat loss is low.

The annual estimated rate of habitat development is about 8% and is perhaps another overestimate because it is difficult to predict the establishment of the key components of habitat that are believed to render it functional. For the sake of argument, if half of the estimated long term habitat development was accepted, the net change in suitable habitat range-wide would probably balance approximated losses. Inclusion of estimates of habitat development would have helped the USFWS provide perspective on their estimated suitable habitat trends. However, current estimated rates of habitat development need to be considered cautiously because the growth models used to develop those estimates have not been adequately evaluated in the field.

Given the low estimates of suitable habitat loss, the consequences of error are low. We believe that it is an acceptable risk to wait for new monitoring approaches such as the Interagency Vegetation Mapping Project to be developed.

The trends discussed in the USFWS's habitat analysis are more important than precise acreage values. The trends are consistent with range-wide expectations about effects of Forest Plan implementation. The focus in habitat assessment should turn to other emerging threats to habitat utilization (e.g. Barred Owls) and managing threats to the current reserve system (e.g. fire). Because the habitat trends databases are not spatially specific, further interpretations of the implications of habitat trends are limited. A synthesis of habitat trends in relation to spotted owl population change is not possible with the information made available to us. We are unable to make any conclusions concerning the implications of the distribution of habitat loss. However, readers should be warned that habitat losses are not evenly distributed and that range-wide averages can be deceptive. For example, range-wide trends are low, but the majority of habitat losses has occurred in a portion of the range where Northern Spotted Owls are most densely populated in the Klamath region. The interpretation of the habitat loss is complex and beyond the scope of this review, but Bond et al. (2003) suggest that at least short-term fire effects are often overestimated. See the Demography section of this report for a discussion of the possible impacts of habitat loss.

5.2 NON FEDERAL LANDS

Data are insufficient to determine the rate of change on all non-Federal lands in the last 13 years. However, two conclusions are inescapable. First, the regulatory environment has significantly changed forest management on non-Federal lands. The management of significant acreages are now under Habitat Conservation Plans and State regulations that provide for significant contribution to Northern Spotted Owl habitat.

Second, the type of harvest on non-Federal lands has resulted in a different type of habitat configuration that is often highly fragmented and generally of younger age (Richards et al. 2002, Staus et al. 2002). The influence of this landscape for the long-term conservation of the Northern Spotted Owl will be highly variable by ownership.

Monitoring habitat changes on non-Federal land does not appear to be sufficient to determine trends. This may be particularly important in Oregon where state regulations provide minimal protection of suitable habitat. The impact of habitat change on non-Federal lands needs to be interpreted in terms of efforts on Federal lands to recovery of the Northern Spotted Owl.

5.3 INFORMATION NEEDED RELATIVE TO RISK ASSESSMENT

Our current understanding of Northern Spotted Owl habitat amount and distribution is limited by data quality that will remain as long as the assessments are done on a project by project basis. We encourage developing a coordinated effort to validate all aspects of habitat trends across the range of the Northern Spotted Owl, to help validate options to encourage the coexistence of forest management and Northern Spotted owl.

We believe the persistence of the NWFP reserve system will be critical to maintaining owls and other old forest associated species. We also believe that there needs to be a concerted effort to implement strategies to reduce risk of catastrophic habitat loss, particularly n the East Cascades Province and the Klamath Province. Moreover, there is a need to understand the relationship between these risk reduction endeavors and the persistence of owls and the viability of LSRs.

Creative solutions have been perused in the efforts to reduce the risk of catastrophic loss. Historical landscape patterns and disturbance regimes can be used as a guide for landscape management. Cissel et al (1999) illustrated the use of historical fire regimes in the landscape planning on the Blue River in Oregon. Their plan compared the future forest development on an extensive reserve system and standard matrix prescriptions in the Northwest Forest Plan. Their hypothesis was that the use of historical information to guide management recognizes the dynamic and variable character of the landscape and may offer an improved ability to meet ecosystem management objectives. We would promote adaptive management where forest management programs are designed to yield learning opportunities. The design of active adaptive management should include replication in space and time, implementation of different treatment alternatives and the maintenance of untreated controls. These are all part of operational activities that will help validate options to encourage the coexistence of forest management and Northern Spotted owl habitat.

The following points are expanded on in the information needs section:

A Range-wide, spatially explicit database would make it possible to effectively track changes in forest condition from individual management activities and natural disturbance.

More information is needed on changes on non-Federal land to provide a more complete picture of habitat change within the range of the Northern Spotted Owl.

An improved ability to differentiate different types of disturbance would be valuable. Assessments of fire and insect damage are particularly problematic in terms of defining the effect on owl habitat. There appear to be considerable inaccuracies in estimates of habitat impact by fire. Improved confidence in remote sensing methodologies to describe habitat condition would be very valuable, such as Light Detection and Ranging (LIDAR). Increased emphasis on non-clearcut harvest methods may limit traditional remote sensing disturbance detection.

An improved confidence in our ability to track and validate the suitability of newly developed habitat would be very valuable.

More information on the actual impacts of Sudden Oak Death on Northern Spotted Owl habitat would be valuable.