HABITAT CONSERVATION PLAN

for the

NORTHERN SPOTTED OWL

on the

CALIFORNIA TIMBERLANDS OF SIMPSON TIMBER COMPANY

September 17, 1992

Simpson

Simpson Timber Company
Redwood Division P.O. BOX 1169
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October 12, 1992

This habitat conservation plan (HCP) was developed based on three years of field work and ongoing discussions with the U.S. Fish and Wildlife Service (Service). It was formally submitted to the Service for final review and approval in April 1992, after which the Service prepared an environmental assessment (EA) for the issuance of an incidental take permit to Simpson's California Subsidiaries. The permit was issued on September 17, 1992.

As part of the Service's review of the documents and in response to public comments solicited by the Service, specific clarifications and refinements of portions of the HCP were made prior to the issuance of the permit. These changes are described in the "Supplement" which can be found at the end of the HCP, following Appendix E.

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Very truly yours,

SIMPSON TIMBER COMPANY

David W. Kaney
Vice President & General Manager

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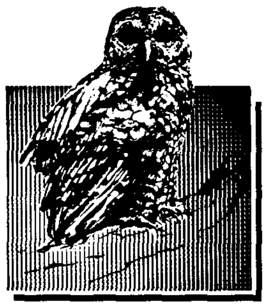

Summary

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

A. The Planning Context and Plan Area

The northern spotted owl was listed as threatened by USFWS on July 23, 1990, which brought the species under the protection of Section 9 of the ESA. This section prohibits "taking" of the species, which is defined in the ESA as meaning "to harass, harm, pursue, shoot, wound, kill, trap, capture, or attempt to engage in any such conduct." However, the ESA also includes provisions for the issuance of special permits for the trapping and handling of a listed species and for take that is incidental to, but not the purpose of, otherwise lawful activities. The former is authorized under Section 10(a)(1)(A) of the ESA; the latter is covered by Section 10(a)(1)(B) and is commonly known as a Section 10(a) or incidental take permit. An HCP is a mandatory component of a Section 10(a) permit application and must specify, among other things, the level of take that will occur and steps that will be taken to minimize and mitigate the impacts of that take to the maximum extent practicable. Authorization for incidental take also can occur under Section 7 of the ESA (which requires all federal agencies to consult with USFWS on actions affecting listed species) but does not entail preparation of an HCP or issuance of a 10(a) permit.

In California, the northern spotted owl is considered a species of special concern by the California Department of Fish and Game and one of several birds explicitly protected by California Forest Practice Rules. The rules are administered by the California Department of Forestry and Fire Protection (CDF) and, in general, require preparation and approval of three-year plans for each area proposed for timber harvest. CDF's current spotted owl rules further require that plans for areas within the species' range either (1) demonstrate that the species is not present or that no take will occur or (2) be accompanied by a federal incidental take permit or documentation of authorization to proceed following a federal Section 7 consultation.

Simpson's California timberlands include about 383,100 acres that are entirely within the California range of the northern spotted owl. The properties are owned by two of Simpson's subsidiaries (Arcata Redwood Company and Simpson Redwood Company) and are located primarily in Del Norte and Humboldt counties, with relatively minor acreage in Mendocino and Trinity counties. The bulk of the ownership is within 20 miles of the coast, with the easternmost tract located 55 miles inland. The holdings range in size from blocks of over 50,000 acres to isolated parcels of about 40 acres. Most of the acreage has been owned and managed by Simpson for at least 20 years and in some cases for more than 40.

About 86 percent of the 383,100 acres are conifer forest, consisting almost entirely of second-growth coastal redwood and Douglas-fir. All but 2 percent of the conifer stands have been harvested at least once since 1890. Hardwoods comprise about 8 percent of the ownership and include red alder, tanoak, Pacific madrone, Oregon white oak, and California black oak. Non-forest areas comprise about 6 percent of the area and include grasslands, wetlands, rock outcrops, and river bars.

Timber operations on the properties are subject to CDF rules and, because of the presence of spotted owls, to the federal ESA. There is no federal action that would trigger a Section 7 consultation, so Simpson is seeking a 10(a) permit for incidental take resulting from ongoing timber harvest operations. Moreover, given the number of spotted owl nest sites and activity centers on and adjacent to its property (146 as of June 30, 1991), Simpson considers implementation of an HCP in connection with a 10(a) permit to be the only effective way to reconcile both its immediate and long-term forest management plans with the laws that protect spotted owls.

B. Simpson's Spotted Owl Surveys and Research

Prior to the listing of the species, little was known about the status of spotted owls on Simpson's property or other commercial timberlands in northern California. Few historical locations were known, and most lands had not been surveyed. Moreover, most of the lands had been logged and were occupied by habitat considerably younger than the old growth (200+ years) then commonly associated with spotted owls. Since 1989, however, both what and how much is known about the presence of spotted owls in second-growth forests have changed.

Simpson's spotted owl research program began in 1989 and includes a combination of surveys, studies, and computer modelling. Over 200,000 acres of Simpson's property have now been surveyed for spotted owls; and as of June 30, 1991, 261 adult and subadult spotted owls have been identified on or within less than one mile of Simpson's property. In addition to documenting the distribution of owls, Simpson also has studied the vegetative characteristics of nest sites, nest stands, and habitat mosaics around nest sites and has examined spotted owl food habits in the plan area based on an analysis of prey species found in regurgitated owl pellets. These efforts have yielded data that provide a clearer picture of what constitutes owl habitat in the plan area and how local conditions compare with those documented in other parts of the owl's range.

Key results of Simpson's surveys and studies to date are as follows:

- The 261 adult and subadult spotted owls identified as of June 30, 1991, include 50 nesting pairs, 44 non-nesting pairs, 21 pairs of unknown status, and 27 males and 4 females of unknown status. Of the 146 sites identified with these owls, 112 (75 percent) were known to be on Simpson's property in 1991.

- Of the 112 owl sites known to be on Simpson's property in 1991, 72 were confirmed nesting or primary activity sites (Figure A) and 40 were locations where owls were recorded but follow-up visits were pending to confirm the status of the site. Most (36 of 40) of the unconfirmed sites are in the northern one-half of Simpson's property, where over 80 percent of the timber is currently 45 years old or younger and over 60 percent is 30 years old or younger.

- As of October 24, 1991, 358 spotted owls have been banded on or adjacent to Simpson's property: 204 adults, 52 subadults, and 102 juveniles. Of the 256 adult and subadult birds banded, 204 (80 percent) were adults and 52 (20 percent) were subadults.

- Twenty-three owlets were observed in 1989, and 102 owlets were banded in 1990 and 1991, indicating that owls successfully reproduced in and around the permit area. Valid estimates of fledging success were obtained for 1990 (0.72 fledged per pair) and 1991 (0.63 fledged per pair) and are consistent with success rates reported by others for spotted owls in northern California.

- A 1991 point estimate of juvenile survival (30 percent) was calculated from one year of data and a small sample size but indicated that juvenile spotted owls successfully dispersed and subsequently survived in second-growth habitats.

- Based on a landscape analysis of thoroughly surveyed areas in the plan area, owl densities were estimated at 1.2 owls/mi^2 in the southern portion of the ownership and 0.32 owl/mi^2 in the northern portion of the ownership. Overall owl density was estimated at 0.65 owl/mi^2. The density observed in the southern property (1.2 owls/mi^2) exceeds the highest density (0.84 owl/mi^2) previously reported for spotted owls in California and is approximately 20 times greater than the 1.7 pairs/township (36 mi^2) recommended for private lands in northern California in the Interagency Scientific Committee's conservation strategy for spotted owls. Overall owl density (0.65 owl/mi^2) is comparable to the 0.61 owl/mi^2 reported in northern California.

- Based on an analysis of habitat mosaics within 502-acre circles around 60 nest sites and 60 random sites, several variables were found to be significantly ($P < 0.05$) different between the two sets. On average, the mosaics in the nest circles differed from those in the random-site circles by having less acreage in the 8-30 age-class, more acreage in the 31-45 and 46-60 age-classes, more edge area, greater number of cover types per mosaic, more acreage dominated by hardwoods, greater distance to forest openings, and lower position on slope.

- The landscape analysis of thoroughly surveyed areas also indicates that areas of high owl density on the property have over twice the amount of stands 46 years or older than areas of low density and over six times more than areas not used by owls. (Areas not used by owls were defined in the analysis as blocks [not linear segments] of forested areas greater than 2,000 acres and not intersecting an owl site.) In areas not used by owls, 70 percent of the stands were 8-30 years old, and only 7.4 percent were 46 years or older.

- Data collected in the 1989-1990 food habit study suggest that the abundance of spotted owls in the plan area may be related to the presence of woodrats, which some studies have found to be positively associated with brushy regrowth areas. Woodrats comprised the largest share of the prey species identified in the pellets collected in the plan area, both in terms of frequency (46.5 percent) and biomass (69.8 percent). Woodrats and brush rabbits combined comprised 80 percent of the owl diet biomass.

C. Supplemental Planning and Analysis

The information resulting from Simpson's 1989-1991 spotted owl surveys and studies provides the basis for planning a conservation strategy that would meet

Figure A

oversize

(2 count as pages)

the requirements of both federal and state laws protecting the species. However, documentation of current conditions is only one part of the planning process. Simpson's goal is to reconcile long-term and large-scale timber management with the protection of spotted owls, and meeting that goal requires a long-term and large-scale conservation strategy. To this end, Simpson has taken four additional steps in preparing this plan. These steps are:

- Preparation of a 30-year forecast to help determine how much habitat would be available for spotted owls on the property over time;

- Development of a computer model by which potential habitat for spotted owls could be identified throughout the property;

- Identification of other species of concern in the plan area and a preliminary analysis of their habitat needs and sensitivity to impacts; and

- Consideration of alternative approaches and conservation strategies.

The 30-year forecast covers January 1, 1991 through January 1, 2021, and groups the results into the following age-classes: 0-7 years (no direct value to owls); 8-30 years (potential foraging and prey reservoir habitat); 31-45 years (foraging, roosting, and occasional nesting habitat); and 46+ years (prime nesting and roosting habitat and also foraging habitat). The groupings were based on data from the 1989-1991 studies which indicate that woodrats were consistently present only in stands over 7 years old, that some existing roost and nest sites were located in stands 31-45 years old, and that almost all stands 46 years or older were used by spotted owls. The forecast assumed that timber harvesting would occur at an annual rate of 3,000 to 6,000 acres over the period. Totals for each of the age-classes were tabulated and mapped for the base year (1991) and three points in the forecast period: 1996, 2011, and 2021.

Results of the forecast indicate that second-growth stands in the 46+ age-class will more than double over the 30-year period, increasing from 67,214 acres in 1991 to 140,907 acres in 2021 (Table A and Figure B). The 31-45 age-class increases by nearly 50,000 acres in the first 10 years and then returns to 1991 levels (about 77,000 acres) by 2021. The 8-30 age-class decreases over the period but remains above 115,000 acres through 2001. Combined, age-classes 31-45 and 46+ show a net increase of about 55,000 acres between 1991 and 2021. The proportion of Simpson's ownership represented by these two age-classes also increases over the period and remains above 50 percent from 1996 through 2021. Currently, the two include nearly 145,000 acres, or about 38 percent of the ownership, with most (76 percent) of the 46+ age-class concentrated in the southern one-half of the property.

TABLE A
DISTRIBUTION IN ACRES OF SIMPSON TIMBERLAND STANDS IN OWL HABITAT AGE-CLASSES FROM 1991-2021

Grouping	1991	1996	2001	2011	2021
0-7	40,750	34,860	35,179	33,506	42,772
8-30	157,559	140,780	116,485	85,112	89,932
31-45	77,451	103,952	126,714	112,957	79,146
46+	67,214	68,096	73,066	120,517	140,907
ROG/MIX	17,768	13,054	9,298	8,650	7,985
NF	22,364	22,364	22,364	22,364	22,364
TOTAL	383,106	383,106	383,106	383,106	383,106

0-7 = recently regenerated stands that have no direct value for owls

8-30 = potential foraging and "prey reservoir" habitat

31-45 = foraging, roosting, and occasional nesting habitat

46+ = prime nesting and roosting habitat and also foraging habitat

ROG/MIX = hardwood and brush cover types with a minor old growth residual component and remnant old growth cover types

NF = non-forested land, no direct value to owls

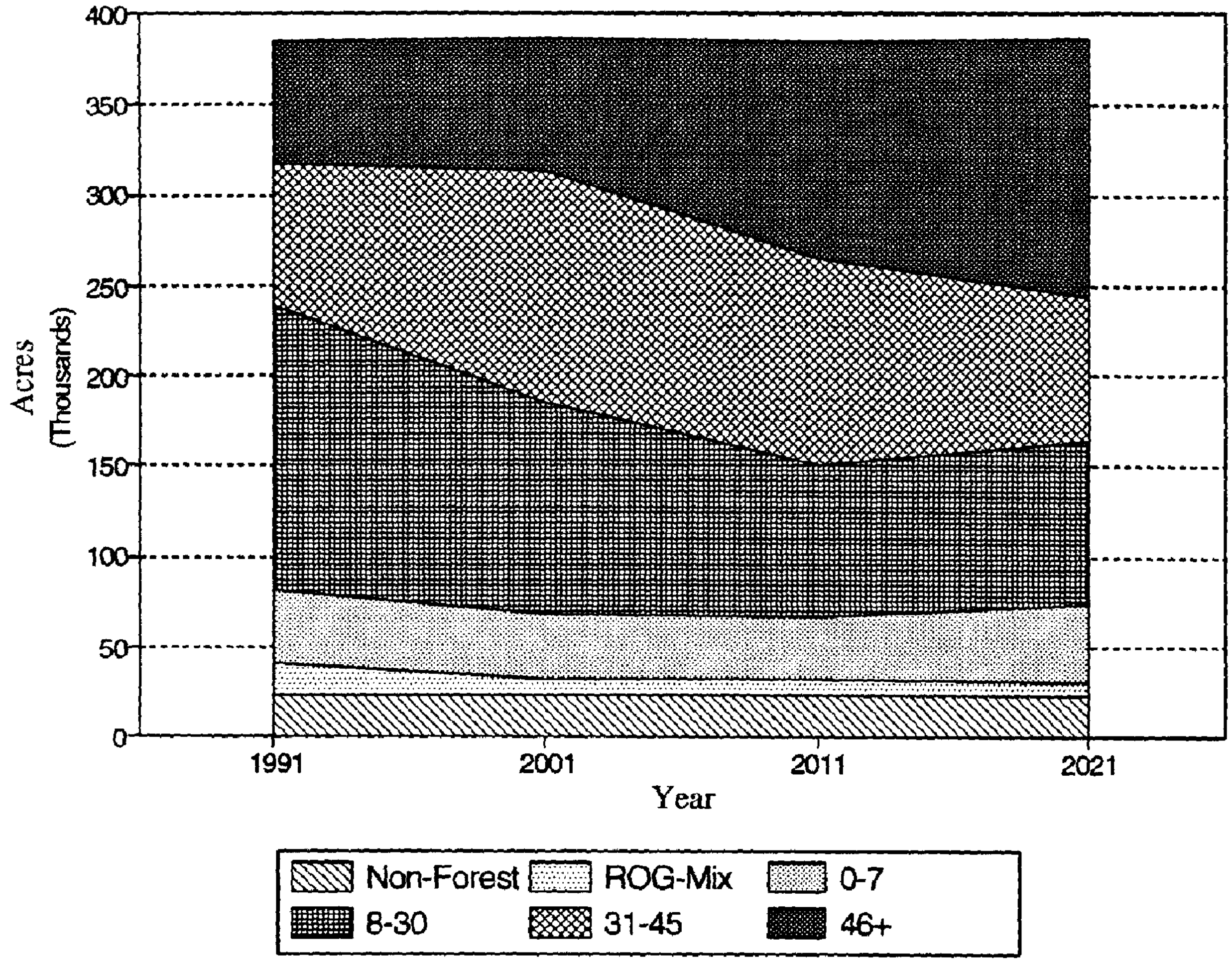

Figure B. Distribution of Simpson Timberland Stands in Owl Habitat Age-Classes from 1991-2021

Since age-class alone does not determine suitable owl habitat, Simpson also is developing a forecasting model that takes into account the habitat mosaics associated with spotted owls in the plan area. The model is still in a developmental phase and will be refined over time as part of the implementation of the HCP. It currently is based on Simpson's 1990 study of the habitat around spotted owl nest sites and is designed to identify areas that have the mix of age-classes and cover types (the nesting mosaic) of the studied sites.

When applied to 1991 cover types and age-classes, the model indicates that 158,477 acres of the ownership currently fit the nesting mosaic profile (Table B). While subject to further refinement, this estimate is consistent with the number of owl sites on the property. When applied to the results of the 30-year age-class forecast, the model indicates that the number of acres with the nesting mosaic will be roughly the same in 2021 as in 1991 (about 160,000 acres), with a 16 percent decrease between 2001 and 2011. While subject to further refinement, these projections are consistent with the age-class forecast.

Both the age-class and nesting mosaic forecasts indicate that stands with the characteristics of existing owl habitat on the property will be present at existing or increased levels for the next 30 years. More specifically, the age-class forecast indicates that prime nesting and roosting habitat (46+ age-class) will double over the period, and younger stands used by owls for foraging, roosting, and occasional nesting habitat (31-45 age-class) will be at or above existing levels.

To ensure that conservation measures for spotted owls would not be in conflict with the needs of other listed species and to identify opportunities to benefit multiple species, Simpson also compiled data on 39 other species associated with the habitat in the plan area, excluding insects. These species include 9 plants, 5 fish, 6 amphibians and reptiles, 15 birds, and 4 mammals. The data compiled include information on the range, habitat requirements, status, sensitivity to timber harvests, occurrence in the plan area, and potential effects of the HCP on these other species of concern (see appendixes). Of the 39 species, 7 are federally or state listed as threatened or endangered, 1 is proposed for federal listing, 9 are candidates for federal listing, 7 are designated as sensitive bird species by the California Board of Forestry, and 23 are species of special concern in California. Nineteen of the 39 species have been observed on Simpson's property, and 4 fish of special concern are assumed to occur in streams on Simpson's ownership based on observations of adult and juvenile salmonids.

While conducting this supplemental planning and analysis, Simpson also considered alternative ways to meet the requirements of the ESA, including avoidance of take. In general, three different approaches to conservation were evaluated: one based on maximum protection of existing spotted owl sites, one based on

TABLE B
ACREAGE OF SIMPSON TIMBERLANDS IDENTIFIED BY COMPUTER HARVEST SIMULATION MODEL AS POTENTIAL SPOTTED OWL NESTING MOSAIC FROM 1991-2021

Year	Acres
1991	158,477
1996	163,297
2001	164,452
2011	138,348
2021	159,417

recommendations by the Interagency Scientific Committee, and one based on timber resource management. After weighing these approaches, Simpson concluded that the best way to meet its goals would be to combine aspects of all three. Specifically, the strategy proposed in this HCP emphasizes habitat management in concert with nest site protection and designation of areas where no timber harvesting will be allowed. Ongoing research also is proposed, both for its use in planning habitat management over time and for its value in planning the recovery of the species.

Four alternatives to the preparation of this HCP also were considered but rejected as being economically infeasible for Simpson or having less beneficial effect on spotted owls. The four alternatives considered are as follows:

- **No Project.** Under the no project alternative, spotted owls on Simpson's property would be protected by Section 9 of the federal ESA. Timber harvesting technically could still occur under this scenario, provided no owls were killed, injured, or affected in a way that would constitute harm or harassment under the ESA. However, given the current distribution of spotted owls on the property, it is not likely that Simpson could continue commercial timber harvest operations on its properties under this alternative. Moreover, the no project alternative would not promote the regeneration of owl habitat, establish set-asides where no harvesting would occur, or provide additional owl research that would benefit the species.

- **Compliance with Existing CDF Rules.** Under this alternative, Simpson would plan harvests in one or more areas to prevent harm or harassment of spotted owls as specifically defined in CDF's spotted owl rules and as required under federal ESA. No incidental take would occur, and no permit would be necessary. As with the no project alternative, this approach avoids take but does not otherwise directly benefit the owl population on Simpson's property. While the alternative provides a way to demonstrate compliance with prohibitions on take, it does not reconcile long-term and large-scale timber management with the conservation of a federally listed species. Moreover, the pattern of timber removal and regrowth under a no take scenario could have detrimental effects on spotted owls over time. It is the consensus of the scientific committee for the California HCP that the no take rules will lead to fragmentation and degradation of habitation over time and do not represent a long-term viable alternative for the northern spotted owl. The committee ranked six alternatives for the coastal mesic and mixed evergreen subregions. In both subregions, the current no take rules were ranked next to last in terms of maintaining long-term viability for spotted owls (CDF 1991).

- **Completion of the California HCP.** Under this alternative, Simpson would wait until the statewide spotted owl HCP initiated by CDF is completed and a regional incidental take permit has been approved. Incidental take on Simpson's property would then be authorized through the permit secured and administered by CDF. This option would postpone incidental take on Simpson's land until CDF's plan is approved but also would delay implementation of the conservation measures that Simpson has proposed. This delay would not benefit the existing owl population on or adjacent to Simpson's property.

- **Preparation of a Multiple Species Plan.** Under this alternative, Simpson would prepare an HCP for all threatened, endangered, and candidate species on its California properties. Since some of the species are state as well as federally listed, such a plan could involve processing of a state Section 2081 permit/agreement. While this approach would cover a broader range of species than Simpson's spotted owl HCP, the multiple species HCP would require data on each of the other species equivalent to the level collected on the owl. Collection of the additional data and processing of the state and federal permits would postpone implementation of the conservation measures proposed for the owl for several years and thereby also delay the anticipated benefits of those measures to owls in and adjacent to the permit area. This alternative was rejected because although other species of concern occur on Simpson's property, Simpson does not propose to take any such species and is not seeking a permit for such take. Moreover, Simpson's spotted owl HCP is designed to avoid activities which are inconsistent with conservation efforts for other species.

D. Simpson's Spotted Owl Conservation Plan

As previously noted, the conservation strategy adopted by Simpson is designed to meet two goals: compliance with the ESA and continuation of timber harvest operations on Simpson's property. Moreover, the underlying philosophy of the HCP that Simpson has prepared is that these two goals are not mutually exclusive and that, in fact, silviculture can and will be used to sustain spotted owl habitat on Simpson's property.

Simpson's spotted owl conservation plan has three major components, each of which reflect the fact that the plan is part of an application for an incidental take permit. The three components are:

- Scope of the 10(a) permit, which identifies the permit area, permit period, and estimated level of take;
- Mitigation measures, which identifies the steps that Simpson will take to minimize and mitigate to the maximum extent practicable the impacts of the take; and

- Plan implementation, which identifies how the measures will be implemented, monitored, and funded.

Simpson believes that the proposed conservation plan will fully mitigate any adverse impacts from the incidental take that is likely to occur. No significant adverse impacts to the local, regional, or rangewide population of spotted owls would result, and the beneficial effects of the proposed conservation program would contribute to the survival and recovery of the species.

1) Scope of the 10(a) Permit

The permit would allow incidental take on the Simpson's California properties for a 30-year period, with a comprehensive review of permit conditions at the end of 10 years. This 10-year review will be in addition to annual reporting requirements.

a) Type of Take

The permit will cover incidental take of spotted owls in connection with otherwise lawful timber harvest operations on Simpson's properties, including habitat modification that could constitute harm or harassment under the ESA. As defined in federal regulations, "harm" means an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). "Harass" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

The primary form of incidental take for which Simpson seeks this permit is displacement of owls due to modification of owl habitat, particularly areas with nest sites and primary activity centers (owl sites). No direct killing or injuring of spotted owls is anticipated, and Simpson will take all reasonable precautions to avoid such impacts; instances of unintentional or inadvertent harm, however, would be covered by the permit. Some foraging, roosting, and nesting habitat would be removed annually, but no net loss of habitat in the age-classes and with the characteristics of areas currently used by owls is expected because harvested habitat would be replaced through maturing of younger timber stands.

The following is an estimate of the level of take which will result from habitat modification and owl displacement. Whether such activities will actually impair essential behavioral patterns and result in death or injury, constituting "harm," will depend on the circumstances involved in each case. In addition, the conservation measures identified in the HCP (e.g., protection of nest sites during the nesting and fledging season) are designed to avoid the likelihood of injury to owls which would constitute harassment. Nevertheless, Simpson seeks a permit covering any activity which could result in a take and has, therefore, made very conservative assumptions in its analysis, both as to the type and level of take. In effect, this analysis reflects a "worst case" scenario.

Accordingly, for purposes of the incidental take permit and this HCP, it is assumed that a take will occur when owl sites are harvested, displacing owls that occupied those sites during the nesting and fledging season (direct displacement). Simpson has also assumed that displacement, and therefore take, will occur where owl sites themselves are not harvested but harvesting within stands near those sites reduces habitat to threshold levels discussed below (indirect displacement). Simpson believes that the actual take caused by its operations will be much lower than the estimates that follow.

b) Estimated Level of Take

The calculations of take from direct and indirect displacement are expressed as annual rates and are based on the number of owl sites potentially affected by Simpson's timber harvest operations over the next 10 years. Both calculations assume steps to avoid and minimize the impacts of take, including the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed. Simpson also has assessed the possibility that additional owls in currently unknown locations might be displaced.

- **Direct Displacement.** Simpson estimates that approximately 3 owl pairs per year would be displaced by the harvest of stands with known owl sites. This estimate is based on the number of owl sites in areas planned for harvest over the next 10 years and was calculated as follows.

  First, the locations of the 72 confirmed owl sites on Simpson property (see Figure A) were plotted on sourcing maps used to plan timber harvests. This mapping indicated that 19 (26.4 percent) of the 72 sites were in stands that would be entered for harvest by 2001. Owls in the 19 sites were assumed to be taken as soon as the stand was entered for harvest. Then, to ensure that displacement was not underestimated, it was assumed that 40 unconfirmed sites would be affected by timber harvesting in the same proportion (26.4 percent) as the confirmed sites. By this calculation, owls in an additional 10.6 sites would be displaced. The two estimates were combined, yielding a total of 29.6 sites over the 10-year period or approximately 3 displaced pairs per year.

This estimate of owl displacement (3 pairs per year) is considered high because of the following assumptions that were built into the calculation: (1) owls were considered taken as soon as the stand was entered for harvest even though some owls would likely move to an adjacent stand with minimal disruption of their behavior (also see Section 4.C); (2) unconfirmed sites were included in the calculation even though most of the sites are in the areas not scheduled for harvest in the next 10 years; and (3) each site was assumed to be occupied by a pair even if currently occupied by only one owl.

As noted above, steps will be taken to avoid direct displacement and to minimize and mitigate its impacts when it occurs. These steps include the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed (see "Mitigation Measures" below).

- **Indirect Displacement.** Regarding potential displacement of owls due to habitat removal in adjacent stands, Simpson estimates that approximately 2 owl pairs per year might be affected by such activities. This estimate is an extension of the detailed 1990-91 study of habitat variables within 502-acre circles around 60 nest sites. A summary of how the estimate was calculated follows, and a more detailed description of the steps taken is presented in the appendixes.

  First, the 60 circles were plotted on the sourcing maps referenced above. This mapping revealed that 34 of the 60 circles overlapped areas planned for harvest. Of these 34, 9 were among the sites already identified as taken when the stand was entered for harvest. The remaining 25 circles were then analyzed in terms of how the stands would change and how much harvesting would occur within each over the next 10 years. This analysis was based on the data collected in 1990-91 on age-classes and cover types within each circle, which made it possible to project the amount of habitat within two age-classes within each circle in 2001. The two age-classes of concern are (1) stands 46 years or older (46+), which are considered the best potential nesting habitat on the property; and (2) stands 31 years and older (31+), which would include the best potential nesting habitat, marginal nesting habitat, and foraging habitat. The mean minus one standard deviation for each of the two age-classes in all 60 circles as of 1990-91 was then used as a threshold for determining potential displacement. If the amount of 31+ was below 233 acres or the amount of 46+ was below 89 acres, owls in that circle were considered displaced and therefore taken. This analysis indicated that owls in 9 (15 percent) of the 60 sites would be displaced. This proportion (15 percent) was then applied to all 146 owl sites identified on and adjacent to Simpson's property, yielding a total of 22 sites during the decade, or approximately 2 owl pairs per year, potentially displaced by adjacent harvests.

This estimate of owls potentially displaced by indirect impacts (2 pairs per year) is considered high because of the following assumptions that were built into the calculation: (1) the thresholds used to determine take are higher than those indicated by a landscape analysis of spotted owl sites on the property; (2) sites adjacent to the ownership property were included in the calculation even though it is not likely they would be affected to the same degree as sites on the property; and (3) sites were assumed to be occupied by a pair even if currently occupied by only one owl.

It also should be noted an attempt was made to calculate take due to habitat removal using a discriminant function analysis of multiple habitat variables identified in the 1990-91 nest site study (see appendixes). This analysis did not yield a reliable measure of take but does represent an additional attempt by Simpson to identify and quantify potential impacts to spotted owls.

As noted above, steps will be taken to avoid indirect displacement of owls and to minimize and mitigate its impacts when it occurs. These steps include the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed (see "Mitigation Measures" below).

- **Total Estimated Take.** To complete its worst case calculation of take, Simpson combined the estimates of direct and indirect take. Under this scenario, displacement would range from 3 to 5 pairs per year, with 5 representing the worst case.

  As a share of the rangewide population, 5 pairs represent approximately 0.25 percent of the minimum number of pairs (2,000) thought to exist in the species' range when the owl was listed. If, under the worst-case scenario, 50 pairs were displaced over 10 years approximately 2.5 percent of the minimum number of pairs would be affected by Simpson's operations. It also should be noted that 3,000 to 4,000 pairs was considered to be a more reasonable estimate at the time of the listing, as cited by the Interagency Scientific Committee. Under this estimate, the number of pairs affected by Simpson's operations would likely be an even smaller percentage of the actual number in the species' range.

  Within the permit area, 3 to 5 pairs represent 2.5 to 4.5 percent of 112 owl sites known to be on Simpson's property as of June 30, 1991 and 0.8 to 1.3 percent of the 377 owl sites reported in Del Norte and Humboldt counties to California Department of Fish and Game (CDFG) as of April 1991.

It should be noted that the two-county total does not include the results of the 1991 surveys or those of other property owners in the area. Consequently, the number of owls and owl sites affected on Simpson's property would likely be an even smaller portion of the total number in the immediate region.

As under the other scenarios, steps will be taken to avoid direct and indirect displacement of owls and to minimize and mitigate its impacts when it occurs (see "Mitigation Measures" below). Those steps include nest site protection during the nesting and fledging season and establishment of set-asides where no harvesting would be allowed.

- **Risk to Unknown Sites.** Regarding the possibility that unknown owls might be taken through timber harvest, the three years of surveys conducted for the preparation of this HCP and those required for individual timber harvesting plans (THPs) minimize the likelihood that such instances would occur. In addition, currently unknown owl sites are not likely to occur in areas that would affect the estimated annual rate of displacement. Simpson's surveys over the past three years have been concentrated in areas where merchantable timber (the best owl habitat) occurs and harvests are being planned. Unknown owl sites would likely be found in unmerchantable stands that are not being planned for harvest in the near future and have not been surveyed for owls because the areas did not meet even the most minimum standards of owl habitat. Some owls already have been found roosting and nesting in such areas. Additional owls found in such stands would increase the total number of owl sites in the plan area but would not be directly affected by timber harvests in the near future. Moreover, the increase in owl sites would further reduce the proportion of owls displaced.

c) Other Potential Impacts

Simpson also has estimated habitat loss, together with other potential impacts.

- **Habitat Loss.** Regarding habitat loss, it was assumed that all stands in age-class 46+ represent potentially suitable habitat. This assumption is further supported by the landscape analysis of spotted owl sites on Simpson's property as of June 30, 1991 (see Section 2.G and 2.H). Under this assumption, 3,000 to 6,000 acres of potential habitat would be harvested annually. This loss, however, would be offset by the maturing of younger stands into the 46+ age-class. At the end of the first decade, there will be 8 percent more 46+ than at present. At the end of the second decade, there will be 80 percent more than at present; and at the end of the third decade, 109 percent more than at present. Both the amount and long-term availability of potential habitat would benefit spotted owls in the plan area, including those displaced by timber harvesting.

However, most of the 46+ stands that will exist at the end of the 30-year permit period will have resulted from silviculture practiced before the HCP was implemented. How these stands will compare to those that are currently 46+ is largely unknown due to a number of differences between the way current and future stands of this age were produced. Some stands currently in the 8-30 age-class may have fewer snags and residual trees and less dead and down woody materials than current 46+ stands used by owls. However, since 1976, Class I and II streams have been protected with stream protection zones, which means that future 46+ stands will likely have more structure in the lower parts of the drainages--the areas most used by spotted owls. Future 46+ stands also will likely develop structural features faster than those in the past due to intensive forest management (e.g., stocking requirements, enhanced growth from brush management, precommercial thinning, and fertilization).

Simpson believes, but cannot guarantee, that most stands 46+ will be used by owls in the future as they are now. Therefore, monitoring measures will be implemented to track the ages of stands in relation to their use by spotted owls so that appropriate mid-course changes to the conservation strategy can be made if necessary. Habitat management measures also will be implemented to minimize and mitigate the impacts of habitat loss (see "Mitigation Measures" and "Plan Implementation" below).

- **Other Impacts**. Other potential impacts of concern are those cited by USFWS when the spotted owl was listed. These include the potential effects of forest fragmentation, the loss of management options, possible increases in predation and competition, possible increases in disease and parasitism, and added risk of harm due to natural occurrences. The level of take likely to occur is not expected to add to the individual or cumulative effects of these decline factors. Simpson also evaluated potential impacts to 39 other species of concern and expects that implementation of the HCP will have beneficial effects for at least 18 of the species; effects on the other species are expected to be neutral, that is, neither adverse not beneficial (see appendixes).

2) Mitigation Measures

To avoid, minimize, and mitigate the impacts of take, Simpson will implement a four-point conservation program that includes habitat management and nest site protection, a spotted owl research program, establishment of set-asides in selected habitat areas, and employee/contractor training. The program will be integrated with Simpson's operating plan for the next 30 years (1992-2022) and will be updated and modified over time. Mechanisms for adjusting the measures with USFWS review and approval are included in the program.

a) Habitat Management and Nest Site Protection

Habitat management and nest site protection measures will be implemented primarily through the THP process mandated by state law and administered by CDF. Simpson will use the submitted HCP to guide the development of individual THPs and to establish long-term planning objectives; site specific conservation measures will be identified in THPs for each harvest area. Timber harvesting will be planned and implemented to (1) protect spotted owl nest sites during the nesting and fledging season; (2) maintain suitable foraging, roosting, and nesting habitat on the ownership; and (3) accelerate the development of replacement habitat following harvesting.

Stands scheduled to be cut between March 1 and August 31 will be surveyed for spotted owls prior to entering the area for harvest. A 1,000-foot buffer around each stand will also be surveyed to include adjacent areas potentially affected by timber harvest.

During the layout of each harvest area, foresters will look for evidence of spotted owls (e.g., whitewash and pellets) and spot call at strategic locations to ensure coverage of the area. Immediately prior to entry, the area will be surveyed again for owls. If no owls respond, the area will be revisited a maximum of three times. If an owl responds, it will be moused to determine its reproductive status and, if paired, its nest site.

If a nest is found, the nest tree will be marked and no timber falling or yarding will be allowed within an 0.25-mile radius of it until it has been determined that the young have fledged or that the nest has failed. After the young have fledged, the radius of protection will be 500 feet from the nest tree and connectivity to continuous habitat will be maintained. When the young have dispersed or it has been determined that the nest has failed, falling and yarding will be allowed within a 500-foot radius.

When planning harvests, Simpson also will identify ways to retain resource values that will provide a core for future owl habitat. Such resource values include patches of hardwoods and conifers, habitat structure along watercourses, hard and soft snags, standing live culls, and small areas of undisturbed brush. Not all areas have owl habitat values that can be retained, and in those that do, existing natural conditions, other wildlife considerations, and worker safety issues are likely to vary. Site-specific measures will be identified in the THP for the area, and the amount of residual trees and snags will be estimated and reported before and after harvest. Simpson also will seek to retain resource values of benefit to other species of concern through the THP process.

b) Spotted Owl Research Program

To gather additional data on owl behavior and habitat needs and to help guide the implementation of the conservation program, Simpson will conduct the following spotted owl studies.

- Owl surveys will be conducted annually as part of THP preparation and ongoing owl research projects. Banding of spotted owls will continue where appropriate to facilitate population estimates and to gather additional demographic information. (As of October 24, 1991, Simpson has banded 358 spotted owls.)

- Each year a minimum of 50 spotted owl pairs (selected at random but in proportion to the distribution of known pairs) will be monitored to determine reproductive success of the spotted owl population on the property. Reproductive success of the pairs in the monitored nests will be compared with the regional average, as determined by the ongoing Willow Creek project (see "Thresholds" below).

- Nest site characteristics will be further studied to quantify the vegetative and habitat mosaic characteristics of spotted owl habitat. The results will be used to refine the nesting mosaic model and also will help document the extent to which second-growth forests in the coastal redwood zone are able to sustain a breeding population of spotted owls.

- The abundance and distribution of key prey species will be quantified among stands of different ages and cover types.

Simpson will identify annual budgets for the above research in annual reports submitted to USFWS and will consider other research projects as time and funding allow.

c) Set-Asides

To protect existing owl sites in select areas (and thereby also avoid take) and to promote development of suitable owl habitat following harvesting, Simpson will establish 39 set-asides in which timber harvesting will not be allowed. Combined, the 39 set-asides contain 13,242.5 acres and, as of June 30, 1991, 39 owl sites. The 39 locations were selected based on their current and potential function as nesting and roosting habitat, their size, their proximity to known owl sites on adjacent property, and their location in relation to planned timber harvests.

Land use constraints within and adjacent to set-asides will be as follows. Construction and maintenance of access roads in the set-asides will be allowed, provided that such activities are not within 500 feet of nest stands during the nesting and fledging season and are conducted in accordance with state and federal requirements. If a nest is found in a set-aside near a stand scheduled for harvest, no timber falling or yarding will be allowed within 0.25 mile of the nest tree until it has been determined that the young have fledged or that the nest has failed. After the young had fledged, the radius of protection will be 500 feet from the nest tree and connectivity to continuous habitat will be maintained. When the young have dispersed, or it is determined that the nest has failed, falling and yarding will be allowed within a 500-foot radius of the nest tree.

The set-asides also will be monitored annually to determine occupancy by spotted owls, and a comprehensive review will be conducted at the end of 10 years to assess the individual and collective efficacy of the sites as part of the conservation program.

d) Employee/Contractor Training

To facilitate implementation of the HCP, Simpson will institute a training program for its registered professional foresters, engineers, and timber falling contractors. The program will train the employees and contractors in survey and monitoring protocols, familiarize them with the details of the HCP, and encourage their involvement in data collection and plan implementation.

3) Plan Implementation

Plan implementation and monitoring will be governed by an agreement between Simpson Timber Company and USFWS and funded by Simpson as part of the company's ongoing operations. The agreement will identify the conditions of the incidental take permit, including reporting requirements, thresholds that will trigger corrective actions, and the scope of the comprehensive 10-year review. Simpson also will institute a detailed record-keeping process and develop a contingency plan to ensure prompt response to unforeseen events.

a) Annual Reports

At the end of each year, Simpson will prepare an annual report and submit it to USFWS for review. Copies of the report also will be made available to CDF and CDFG. The report will:

- Specify actual instances of owl displacement over the preceding year, including the number of spotted owl sites removed, the number of spotted owls displaced, and any inadvertent harm or injury to individual owls that may have occurred;

- Determine the proportion of habitat lost within owl sites for several areas of influence (e.g., within 1000-foot, 0.5-mile, and 0.7-mile radii);
- Compare actual and estimated levels of owl displacement for the past year;
- Estimate levels of owl displacement for the upcoming year;
- Estimate the current number of owl sites and amount of owl habitat on the property and note any significant changes from the previous year;
- Report pre- and post-harvest estimates of snags and residual trees in timber harvest plan areas;
- Report the results of the nest and set-aside monitoring efforts; and
- Assess the efficacy of the conservation measures to date based on thresholds specified in the implementation agreement.

The report also will identify any corrective measures or other changes that may be necessary to improve the efficacy of the plan.

b) Thresholds

The primary threshold for triggering corrective action will be the reproductive success rate of a sample of the spotted owl population on Simpson's property measured against regional averages. If an annual report indicates that the rate has fallen significantly ($P \leq 0.05$) below the rate of the Willow Creek study area for three consecutive years, Simpson will propose corrective measures for review and approval by USFWS. The Willow Creek study area was chosen for comparison because it is the only study area in the region with long-term data on the reproductive success of northern spotted owls. Lambda (the finite rate of population change) also will be calculated annually to monitor for long-term population declines.

c) Contingency Plan

Simpson will work directly with USFWS staff to develop a contingency plan that identifies specific actions that Simpson will take if thresholds are exceeded or unforeseen events occur. The contingency plan will be prepared and submitted with the first annual report and revised as appropriate over the permit period at the direction of USFWS.

d) 10-Year Comprehensive Review

To further ensure the ultimate efficacy of the conservation measures, a comprehensive review of permit conditions and plan implementation will be conducted at the end of the first 10 years. The need and timing of any subsequent comprehensive reviews will be determined at that time. The review at the 10-year mark will include:

- A comparison of actual and estimated levels of owl displacement;
- A comparison of actual and estimated distribution of owl habitat;
- A reevaluation of the biological basis for the conservation strategy based on the data collected through the research program and other sources;
- A detailed analysis of efficacy of the set-asides and the long-term viability of the owl population on the property; and
- An estimate of annual owl displacement for the remainder of the permit period.

e) Record Keeping and Reporting

Pre-harvest surveys and actual instances of take will be reported on standardized forms that Simpson will maintain for the duration of the permit period. Simpson will designate a resource manager or wildlife biologist to review the forms, compile reports, and maintain files. The information recorded on the forms will be summarized in annual reports to USFWS and made available on request to USFWS, CDF, and CDFG. In addition to providing the above records and reports, Simpson will notify USFWS of any direct harm to a spotted owl on the property, any catastrophic event that destroys owl sites or owl habitat, and any unexpected shift in the number or distribution of known owl sites on the property. Such notice will be made in writing within reasonable time limits.

f) Plan Amendments

Corrective measures and other necessary changes will be developed in coordination with USFWS. Significant changes will be submitted to USFWS as proposed amendments to the permit. Such amendments will be subject to assessment under the ESA and to appropriate environmental documentation.

g) Funding

Simpson will fund implementation of the HCP and will identify budgets for monitoring and research in the annual reports submitted to USFWS. Simpson's financial responsibility for specific measures also will be identified in the implementation agreement with USFWS.

E. Postscript

This plan has been submitted with the requisite application form to USFWS for review and approval. Prior to acting on the permit, USFWS will prepare the appropriate environmental documentation as required by the National Environmental Policy Act (NEPA). Notice of receipt of the permit application and the availability of the environmental documentation will be published in the *Federal Register.*

Inquiries regarding this document should be directed to:

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The Planning Context and the Plan Area

A. Introduction

Preparation of this HCP began shortly after the federal listing of the spotted owl as a threatened species in July 1990. At that time, Simpson was in the process of completing a second year of spotted owl field surveys and related research. A third year of surveys and research was completed in 1991, which, together with the 1989 and 1990 efforts, yielded the detailed, site-specific data base used in this plan. The significance of the data base, however, needs to be viewed in three contexts: the regulatory framework of this HCP, the general characteristics of California's coastal redwood region, and the specific characteristics of Simpson's California timberlands. This section of the HCP describes those contexts and summarizes the circumstances that led to Simpson's decision to seek a Section 10(a) permit.

B. The Regulatory Framework

1) Federal Listing of the Species

The federal listing of the northern spotted owl began in January 1987 with Greenworld's petition to list the species as endangered and ended more than three years later when USFWS issued a final rule listing the owl as threatened throughout its range. The final rule was published on June 26, 1990 in an 80-page report in the *Federal Register* and went into effect on July 23, 1990. During the rule-making process, Simpson conducted field surveys for spotted owls on portions of its property and submitted the results to USFWS as part of Simpson's comments on the proposed listing. Following the listing, Simpson continued its survey and research effort and began evaluating ways to reconcile its timber harvest plans with the restrictions on take imposed by the listing of the owl.

a) Restrictions on Take

When a species is listed by USFWS, the federal ESA prohibits any taking of that species. As defined in the ESA, "take" means:

> to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (Section 3[19]).

Definitions of "harass" and "harm" are not included in the ESA but are provided in federal regulations.

- "Harass" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

- "Harm" means an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

The taking prohibition has precedence over state and local statutes and applies equally to the activities of public agencies, private enterprise, and individuals. Violations that involve a threatened species are punishable by fines up to $25,000 and up to six months in jail.

In addition to the taking prohibition, the federal ESA includes provisions for the issuance of special permits for the trapping and handling of a listed species and for take that is incidental to but not the purpose of otherwise lawful activities. The former is authorized under Section 10(a)(1)(A) of the ESA "for scientific purposes, or to enhance the propagation or survival of the affected species." The latter is authorized under Section 10(a)(1)(B) and is commonly known as a "Section 10(a) permit."

Simpson applied for and received a Section 10(a)(1)(A) permit in August 1990 to allow banding of spotted owls on its property. The decision to seek a Section 10(a)(1)(B) permit for incidental take was made in October 1990 following discussions with USFWS.

b) Designation of Critical Habitat

When a species is listed as threatened or endangered, USFWS is required to identify habitat areas considered essential for the conservation of that species. Designation of this critical habitat for the spotted owl was first proposed in May 1991. A revised proposal was announced on August 5, 1991 by USFWS, which recommended that 8.2 million acres of land be designated as critical habitat:

- 1.8 million acres in 61 locations in California,
- 3.8 million acres in 77 locations in Oregon, and
- 2.7 million acres in 43 locations in Washington.

The final rule on critical habitat was published in the *Federal Register* on January 15, 1992 (Volume 57, Number 10, pp. 1796-1838). The final rule designates 6,887,000 acres as critical habitat:

- 1,409,000 acres in 61 locations in California,
- 3,257,000 acres in 76 locations in Oregon, and
- 2,221,000 acres in 53 locations in Washington.

None of the lands covered by this HCP are designated as critical habitat.

c) Recovery Plan

The federal ESA also requires that USFWS develop and implement recovery plans for the survival of a listed species, unless it is determined that such a plan will not promote conservation of the species. Required components of recovery plans include:

1. A description of such site-specific management actions as may be necessary to achieve the plan's goal for the conservation and survival of the species;

2. Objective, measurable criteria which, when met, would result in a determination, in accordance with the federal ESA, that the species be removed from the list of endangered and threatened species; and

3. Estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal.

Recovery teams are appointed to prepare the plans, and the development and implementation of the plans must be reported to the U.S. Senate Committee on Environment and Public Works every two years. Draft plans also are subject to public review and comment prior to final approval.

A recovery team for the spotted owl was appointed and completed a draft plan in late 1991. As of March 1992, however, the plan has not been released by the Secretary of Interior for public review and comment. Consequently, the conservation measures proposed in this plan cannot be compared with or evaluated in the context of recovery plan goals. It should be noted, however, that the uncertain status of the recovery plan does not have a direct bearing on the evaluation of this plan by USFWS. Criteria for approval of HCPs as stated in the federal ESA and draft guidelines prepared by USFWS for HCPs ensure that approved HCPs will be consistent with recovery goals. Specifically, the ESA indicates that an approved HCP must demonstrate that the permitted acts "will not appreciably reduce the likelihood of the survival and recovery of the species in the wild." This statement is further clarified in the draft HCP guidelines which state that an HCP is not a recovery plan and that:

> . . . the activities proposed within a conservation plan must mitigate and minimize the proposed incidental take to the maximum extent practicable, not necessarily recover the species. Therefore, even though some species do not have an approved or current recovery plan, an approved conservation plan is still possible.

2) HCP Requirements and Guidelines

A Section 10(a) permit for incidental take can be issued for an area in which several projects will occur, for activities connected to a single project, or for takings as small as a single specimen. To qualify for the permit, the applicant must prepare an HCP which, among other things, must specify the level and location of take and show how the impacts on the species will be minimized and mitigated to the maximum extent practicable. Preparation of an HCP is a requirement for all Section 10(a) permit applications, regardless of the magnitude of the proposed take or the scale of the project.

In cases that entail federal land or federal action, incidental take also may be authorized through the consultation process stipulated in Section 7 of the ESA. Section 7 requires all federal agencies to consult with USFWS regarding any federal action that might affect a listed species. Such consultations require preparation of a biological assessment and other documentation that are similar but need not be identical to an HCP.

a) Permit Application and Approval Process

An application for a Section 10(a) permit must be submitted on an official form (Form 3-200) and be accompanied by the following attachments:

1. A complete description of the activity for which the permit is being sought;

2. The common and scientific names of the species to be covered by the permit; and

3. A "Habitat Conservation Plan" that specifies:

    a. The impact that will likely result from the proposed taking of the species;

    b. Steps the applicant will take to monitor, minimize, and mitigate such impacts;

    c. The level and source of funding available to implement such steps;

    d. Procedures that will be used to deal with unforeseen circumstances;

    e. The names of the responsible party or parties;

f. Alternatives to the taking and the reasons why they were not pursued; and

g. Other measures required by USFWS as necessary or appropriate.

The application is submitted to the USFWS Director, who, after a public comment period, issues the permit if it is found that:

1. The take will be incidental;

2. The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the take;

3. The applicant will ensure that adequate funding for the plan will be provided;

4. The take will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and

5. Other measures required by USFWS will be met.

b) Planning Guidelines

Draft guidelines issued by USFWS in 1990 emphasize that the identification of the impacts likely to result from the proposed incidental take is "the most perplexing and difficult problem confronting all Section 10(a) permit applicants." The guidelines then define three critical subtasks that must be completed to determine probable impacts:

1. Delineation of plan boundaries, which, as stated in the guidelines, "typically should encompass all areas to be affected during the length of the permit by activities that may result in the incidental take of a listed wildlife species";

2. Collection and synthesis of existing information on the distribution, occurrence, and ecology of federally listed species and other species of concern within the plan boundaries; and

3. Detailed description of the activities to be covered by the Section 10(a) permit, including activities that have already been proposed and those that are "reasonably certain" to occur.

Regarding mitigation measures in the HCP, the draft guidelines note that they can take many forms:

1. Preservation (via acquisition or conservation easement) of existing habitat;
2. Enhancement or restoration of degraded or former habitat;
3. Creation of new habitat;
4. Establishment of buffer areas around existing habitat;
5. Enactment of local ordinances or alteration of local zoning to reduce or eliminate some future impacts;
6. Habitat management plans;
7. Restrictions on vehicular access or on pesticides and herbicides; and
8. Education of the local public.

Regarding funding, the guidelines indicate that the applicant must specify the funding that will be made available for the proposed mitigation measures and the funding must be sufficient over the life of the permit.

Regarding "additional measures," the guidelines note that the plan must demonstrate how monitoring and mitigation will be implemented and what steps will be taken to ensure that incidental take does not exceed what the plan specifies.

3) Other Legal Requirements

In preparing this HCP, Simpson also has taken into account other legal requirements that directly or indirectly apply. These include the National Environmental Policy Act, California Environmental Quality Act (CEQA), California Forest Practice Act, California Endangered Species Act, and local plans and ordinances.

a) National Environmental Policy Act

The National Environmental Policy Act of 1969 requires federal agencies to evaluate the effects of their proposed actions on the human environment in a written statement that addresses:

1. The environmental impact of the proposed action;

2. Any adverse environmental effects that cannot be avoided should the proposed action be implemented;

3. Alternatives to the proposed action;

4. The relationship between short-term uses of the human environment versus the maintenance and enhancement of long-term productivity; and

5. Any irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

Compliance with NEPA generally begins with an internal "scoping" process. If a preliminary review indicates that the proposed action has no or minimal environmental impacts, then a "categorical exclusion" may be determined and no further environmental documentation is required. If the review indicates that the proposed action may have significant impacts, then an environmental assessment (EA) or an environmental impact statement (EIS) must be prepared. An EA is prepared when the preliminary review indicates that the proposed action is not likely to have significant impacts; an EIS is prepared when the expected impacts are significant.

With respect to HCPs in general, compliance with NEPA is not a direct obligation or requirement of the applicant for the Section 10(a) permit; however, USFWS must comply with NEPA in making its decision on the application. Consequently, the appropriate environmental documentation must be prepared before a Section 10(a) permit can be issued.

b) California Environmental Quality Act

The California Environmental Quality Act of 1970 requires permitting agencies to take into account the environmental effects of public and private projects before rendering a permit decision. It also requires that the appropriate agency prepare the environmental documentation used in the review and evaluation process. The documentation begins with an initial study of the likely environmental impacts of the proposed project. If one or more significant impacts are identified, a detailed environmental impact report (EIR) is required. If no significant impacts are determined or if all of the significant impacts can be mitigated, a negative declaration is prepared.

With respect to this HCP, it has been determined that no state permit, approval, or other action is required of the HCP, which technically is a document prepared as part of a federal permit application; consequently, there is no action by a state agency that would trigger the CEQA process. In addition, the intended use of the approved HCP as documentation of compliance with the state's "interim" timber harvest rules provides an indirect link of the plan with CDF's approval of THPs. CDF's THP review process is a certified "functionally equivalent" program that is subject to the broad policy goals and certain other provisions of CEQA but is exempt from the CEQA requirement that an environmental impact report be prepared.

c) California Forest Practice Rules

In general, commercial timber operations in California are governed by the Z'berg-Nejedly Forest Practice Act of 1973 and the State Forest Practice Rules (Title 14 of the California Code of Regulations [14 CCR]).

The Forest Practice Rules reflect a unique two-tier environmental review process for timber operations in California. The first tier of environmental review occurs during CDF's and the Board of Forestry's programmatic consideration of environmental issues common to timber operations, resulting in the adoption of the Forest Practice Rules themselves. This process involves (1) continuous scoping of environmental issues by the Board and CDF; (2) review by Board-supervised interdisciplinary task forces of significant environmental issues; (3) development by those task forces of proposed regulations which are designed to mitigate or avoid potentially significant impacts of timber harvesting on specific resources when applied in individual THPs; and (4) consideration of those proposals by the Board in rule-making, with full agency and public participation.

The Forest Practice Rules are applied in the preparation of each THP, with the result that the overarching first-tier review is incorporated in the THP and potential impacts of harvesting contemplated by the rules are mitigated or avoided in the preparation and review of the THP. A THP is prepared by a registered professional forester and reviewed by an interdisciplinary review team, which also inspects the plan site if needed. The THP and its review process are designed to ensure that the Forest Practice Rules are applied correctly, thereby mitigating or avoiding many environmental impacts in advance and addressing carefully each THP's potential site-specific environmental impacts.

Many of the Forest Practice Rules designed for mitigation or avoidance of environmental impacts also provide habitat protection for the owl. Those include:

- Watercourse and lake protection rules which require specifically sized buffers to streams and other bodies of water (up to 150 feet for certain streams, except for special circumstances), as well as maintenance of specified percentages of overstory canopy and understory vegetation in the buffers (at least 50 percent of both are required to be left standing and well distributed within the protection zone on certain streams);

- Snag retention requirements (retention of all snags except under specified circumstances);
- Nest site protections for Board-designated bird species of special concern;
- Harvesting unit size constraints where clear-cutting and other even-aged management is involved;
- Restocking requirements (planting to achieve a density of 300 trees per acre); and
- Limitations on the adjacency of clear-cut areas within the same ownership (clear-cuts must be separated by an area or a "logical logging unit" at least 300 feet in width).

The Board of Forestry currently is considering new rules which would further restrict timber harvesting on private lands. Regulations under consideration include additional limits on watershed entry and even-aged management, requirements for old-growth and ancient forest preservation and long-term planning, more stringent protection of watercourses, and additional controls on silvicultural practices.

Simpson's timber operations in California are subject to these regulations, including the special rules that apply to CDF's Coast Forest District and "interim" rules added to prevent take of spotted owls.

CDF's "interim" spotted owl rules were adopted on an emergency basis in July 1990 and in their final form in February 1991. They are considered interim because CDF ultimately intends to replace the measures with a conservation plan that would cover the northern spotted owl's range in California (see "Other Plans and Programs" below). In general, the interim rules add requirements to the THPs already mandated by state law and identify alternative methods for compliance. Specifically, the rules:

1. Add the northern spotted owl to the list of birds whose nest, screening, perch, and replacement trees must be protected during their breeding season and whose presence must be reported to both CDF and CDFG.

2. Define owl habitat in terms of its structural (Types A, B, and C based on canopy layers, canopy cover, and size of trees) and functional (feeding, breeding, nesting, and sheltering) characteristics.

3. Require a finding of "harm" if the proposed habitat modification significantly impairs owl feeding habits, breeding success, nesting behavior, or sheltering.

4. Require a finding of "harassment" if the proposed habitat modification significantly disrupts owl feeding habits, breeding success, nesting behavior, or sheltering.

5. Require that THPs for lands in the owl's range either:

   a. Demonstrate that the owl is not present,

   b. Demonstrate that no take will occur,

   c. Be accompanied by a Spotted Owl Resource Plan (SORP) that demonstrates how take will be prevented,

   d. Be accompanied by a Section 10(a) permit, or

   e. Be accompanied by documentation of authorization to proceed as a result of consultations with USFWS.

In those cases where the timber operator seeks to demonstrate compliance in the THP through a SORP, the rules also specify procedures for surveys and mapping and requirements for habitat retention and configuration. Adherence to the procedures and requirements is subject to review by a state-employed biologist designated by CDF who is accepted by CDFG and USFWS "as having sufficient knowledge and education to determine harm or harassment" of the owl (CDF 1990).

d) California Endangered Species Act

The California Endangered Species Act (CESA) prohibits the import, export, take, possession, purchase, or sale of any endangered, threatened, or candidate species listed by the California Fish and Game Commission. As in the federal ESA, "take" under state law means to hunt, catch, capture, or kill or to attempt the same. Unlike the federal law, however, there is no provision for "incidental" take in the CESA. Instead, Section 2081 of the state law authorizes CDFG to approve "management" agreement and permits. The state law also requires state lead agencies as defined by CEQA to consult with CDFG regarding any project with potential impacts on a state listed species. The current policy being followed by CDFG in such consultations is that the project should result in no net loss of the species' habitat. CDFG also coordinates consultations for actions involving species that are federally as well as state listed and is required, whenever possible, to adopt the federal biological opinion in such consultations. In addition, under the terms of a memorandum of understanding with USFWS, CDFG is authorized to enforce Section 9 of the federal ESA.

Since the northern spotted owl is not a state listed species, a Section 2081 permit/agreement and formal consultation with CDFG are not required. However, in recognition of CDFG's concern in these matters, Simpson sought comments from CDFG on the conservation measures proposed in this HCP.

e) Local Plans and Ordinances

THPs are subject to comment by local agencies and the public but are not subject to the approval of local governments. Local agency approval also is not required of the HCP, for which Simpson has sole responsibility for implementation.

4) Other Plans and Programs

Two other owl conservation strategies also are part of the regulatory context for Simpson's HCP. The first is the Interagency Scientific Committee Report on the spotted owl that was prepared concurrent with the listing of the species. The second is the California HCP initiated by CDF. In addition to these two plans, California's Resources Agency initiated a "natural community conservation plan" (NCCP) program during the preparation of this HCP. The NCCP program does not have a direct bearing on this HCP but is referenced because of its potential bearing on the development of plans for other species of concern.

a) Interagency Scientific Committee Report

Prior to the final listing of the spotted owl as a threatened species, an agreement between four federal agencies--USFWS, Bureau of Land Management (BLM), Forest Service, and National Park Service--established a committee of experts to develop a scientifically credible conservation strategy for the spotted owl. The six-member scientific committee was chaired by Jack Ward Thomas of the Forest Service and worked as a team with advisors from the four federal agencies, the three involved states, the timber industry, environmental groups, and academia.

The committee began work in October 1989 and issued its findings and recommendations in May 1990. Its report, commonly referred to as the "Thomas report," was submitted to USFWS in connection with the listing of the owl and is cited repeatedly in the final rule. The primary purpose of the report, however, was to provide a common scientific basis for conservation measures on federal, state, and private lands.

The report outlines a two-part conservation strategy by which a network of habitat conservation areas would be established and managed for the spotted owl. Ideally, each habitat conservation area (HCA) would include blocks of habitat capable of supporting 15 to 20 owl pairs. HCAs would be no more than 12 miles apart, thereby allowing the owls to intermix; and habitat between the blocks would be maintained in a condition that would not necessarily be suitable for breeding but would permit owl dispersal between HCAs.

The committee realized that actual conditions would be less than ideal and further developed four categories of HCAs: three based on the number of owl pairs within the HCA and one for potential nesting habitat and/or movement corridors. Nearly 200 HCAs were mapped, ranging in size from 50 to over 600,000 acres and with estimated owl populations of 1 to 130 pairs.

The committee also emphasized that the HCA strategy applied primarily to federal lands. In fact, 1,469 (84 percent) of the estimated 1,743 owl pairs within the mapped HCAs are on Forest Service, BLM, and National Park Service lands. Moreover, the committee estimated that, with proper management, the HCAs on these same lands could support an additional 290 pairs by the year 2100. These estimates are significant because, in the words of the committee:

> We are somewhat reassured that the resulting number of pairs known to occur in HCAs on Federal lands, alone, presently exceeds the minimum number [1,100-1,200 pairs] accepted by the Audubon Panel. We are even more optimistic about the future because implementing this strategy promises to significantly increase the number of owls as younger forests in the HCAs are allowed to mature and become superior habitat for spotted owls (Thomas et al. 1990).

Regarding habitat conditions and conservation strategies in California, the committee stated:

> Land ownership patterns in the Coast Range of California limit our ability to establish 20-pair HCAs. We have tried to do so wherever possible, but we encourage California to work with private land owners to apply innovative silviculture techniques to maintain or develop additional owl habitat for dispersal or breeding (Thomas et al. 1990).

It should be noted that the data base for the Thomas report, which was considered the best available information on the number and distribution of spotted owl pairs in North America, relied heavily on surveys and studies conducted on federal lands in Washington and Oregon. It also should be noted that the HCA strategy has not been implemented as proposed. The proposed HCAs, however, were used by USFWS in its initial designation of critical habitat.

b) California Habitat Conservation Plan

The primary California conservation strategy cited in the Thomas report is the plan that is being prepared by CDF at the request of California Board of

Forestry. As initially proposed, the California HCP is intended to cover state and private lands. The objectives of the plan are to:

- Provide for the continued existence of the owl throughout its range through the conservation, management, enhancement, replacement, and creation of suitable habitat, recognizing both the immediate and long-term needs of the species;

- Insure that the recovery or recoverability of the owl is not appreciably reduced due to the implementation of the plan, recognizing that the federal government will maintain a well distributed, viable population on federal lands in California;

- Provide, wherever possible and feasible, for the habitat requirements of other species of concern within the plan area as identified by USFWS and CDFG;

- Develop and use a consistent, specific set of criteria, including time periods and levels of risk, for evaluating the impacts of various alternatives on the owl;

- Minimize and mitigate impacts of take, as defined by ESA, to the maximum extent practicable;

- Reconcile public and private forestland uses within the area with the wildlife, habitat, and conservation goals of the HCP; and

- Minimize impacts to landowner property rights and ability of landowners to meet their objectives.

Public workshops were held in November 1990 to discuss various approaches to the HCP, and a Steering Committee and Scientific Committee were formed to help oversee preparation of the plan. Subgroups of the Scientific Committee also have been formed to define and describe alternative conservation strategies. A draft HCP is expected in the summer of 1992. However, as of March 1992, no documentation has yet been prepared. Consequently, the conservation measures proposed in this HCP cannot be compared with or evaluated in the context of the state-sponsored plan. It should be noted, however, that Simpson is participating in the preparation of the California HCP and is represented on both the Steering and Scientific committees. Simpson also has sought comments from committee members on the conservation measures in this HCP.

c) Natural Community Conservation Plans

In July 1991, the California Resources Agency initiated a program to develop plans that would preserve biodiversity and reconcile urban development and wildlife needs on a local and regional level. CDFG is the lead agency for the NCCP process and is responsible for designating "significant natural areas" (SNAs) that comprise the natural communities and species of interest for NCCPs. CDFG also is responsible for the development of planning guidelines, coordination of the overall NCCP program, and approval of final plans. Planning criteria and conservation strategies for specific species and communities will be developed by scientific review panels appointed by the State Secretary for Resources to work under the direction of CDFG.

The planning process itself is designed to encourage public/private sector cooperation, maintain local control over land use decisions, and meet the objectives of the state and federal ESAs by preserving species and ecosystems before they are on the verge of extinction. When federally listed species are involved, NCCPs also are intended to meet the requirements of a Section 10(a) permit. As currently envisioned, NCCPs would have components similar to those required in HCPs but would address urban development issues more directly. As proposed by the Resources Agency, the contents of an NCCP would include:

1. Biological data regarding the distribution, occurrence, and ecology of the species to be covered within the plan area;

2. Analysis of the potential effects of proposed development activities on the short-term and long-term conservation of those species and the ecosystem on which they depend;

3. A plan for conservation of those resources in long-term viable landscape units, with adequate buffers and reasonable levels of human use of surrounding areas;

4. Permanent management and stewardship mechanisms and monitoring programs to ensure the success of the program;

5. Delineation of appropriate areas for development; and

6. Agreement to initial and ongoing funding of the program from appropriate sources.

Prior to approval of an NCCP, all habitat modification within an SNA would require full review under CEQA; interim agreement with landowners also would be developed to allow some uses to continue to proceed during the NCCP planning process.

The NCCP program has been approved by the state legislature, and a pilot program that focuses on coastal sage scrub has been initiated to serve as a model for the NCCP process. A scientific review panel has been appointed for a coastal sage scrub plan, and a series of meetings in counties with this type of habitat have been convened. Assuming successful completion of the pilot project, the NCCP process is expected to have statewide application. Although geared primarily to address urban-area needs, the process could be modified in the future to suit nonurban land uses.

C. The Regional Setting

1) Regional Overview

The range of the northern spotted owl in California includes all or part of 14 California counties and encompasses over 16 million acres (Figure 1). It stretches south from the Oregon border for about 360 miles and, at its widest point, extends nearly 150 miles east from the coastline. It defines a region that is bordered on the west by the Pacific Ocean, on the north by Oregon, on the northeast by the Modoc National Forest, on the southeast by the Sacramento Valley, and on the south by the San Francisco Bay area.

The coastal portion of the region is the southernmost part of the northwest coastal forest that extends for more than 2,000 miles from Alaska to central California. It is marked by a rugged coastal edge, closely adjacent valley areas, coastal foothills, and low mountains. Climate in the area is generally temperate, with mild, wet winters and relatively warm long summers that promote maximum tree growth. Along the coastal edge, marine climate conditions dominate, including fog, humidity, and persistent winds. Twenty miles inland conditions change, and the climate is notably warmer, sunnier, and drier.

The inland portion of the region is part of the Sierra montane forest that occurs on the higher mountain ranges of the Pacific Coast, from southern Oregon to northern Baja California. It includes the Klamath Mountains, Coast Range, and California Cascades, with elevations ranging from 1,300 to 6,500 feet. Inland climate varies with elevation and is warmer and drier in the summer than along the coast.

2) Vegetation of Forested Areas

In 1989, the Timber Association of California (TAC) and VESTRA Resources completed a preliminary analysis of major vegetation types of the region's forested areas. The analysis was developed from the CALVEG Plant Community study and put in digital form by CDF's Forest and Rangelands Resources Assessment Program (FRRAP). It shows the large-scale distribution of vegetation in currently forested areas, with 400 contiguous acres being the minimum scale used to identify vegetation types. Three primary vegetation types were identified: conifer forest, hardwoods, and shrubland. Hardwoods were further divided into commercial and noncommercial types. Areas without forest cover (i.e., urban, agricultural, range, and nonvegetated lands) were not included in the analysis.

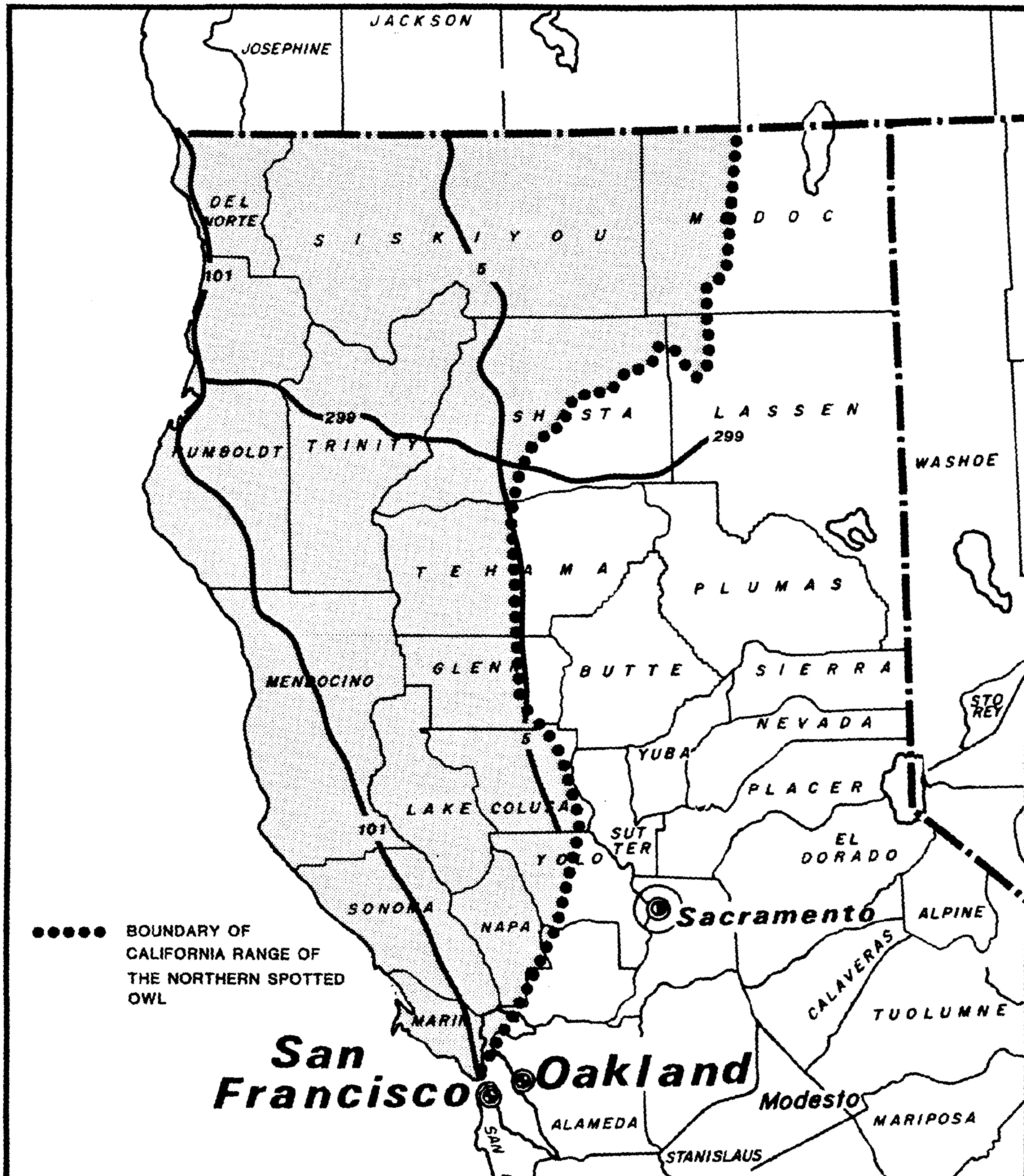

Figure 1. California Range of the Northern Spotted Owl

Preliminary results of the analysis indicate that the region contains 14.8 million forested acres, of which 10.7 million are conifer stands and 2.5 million are predominantly hardwood stands (Table 1 and Figure 2). These forested areas are extensive and for the most part contiguous. Non-forested land covers approximately 1.5 million acres or about 9 percent of the region.

3) Land Ownership and Use

The TAC/VESTRA report also indicates that land in the region is nearly equally divided between public and private ownership. Fifty-three percent of the land is in private ownership, and 47 percent is managed by federal or state agencies (Table 2 and Figure 3).

- The U.S. Forest Service has the largest holding, with about 6.6 million acres managed as part of the National Forest system.
- Collectively, timberlands owned by individuals but not necessarily used for timber production constitute the next largest holding at 5.9 million acres.
- Timberlands controlled by industries primarily engaged in commercial harvesting comprise 2.5 million acres.
- The U.S. Bureau of Land Management, U.S. Bureau of Indian Affairs, California Department of Forestry, and California State Lands Commission manage 613,544 acres.
- State and federal parks cover 375,780 acres.
- Timberlands controlled by private firms but not used strictly for timber operations account for 210,170 acres.

Private ownerships are interspersed with federal or state ownership, especially in the inland area where the checkerboard pattern left from railroad and school system grants is notable.

4) Population and Employment

The combined population of the 14 counties in the region (including those portions of counties outside the spotted owl's range) is estimated at 1.3 million persons based on the 1990 census (Table 3). More than one-half of this population (56 percent) is concentrated in the southern portion of the region in the counties of Napa, Sonoma, and Marin. Sonoma County has the largest population, with 388,222 persons; Modoc has the smallest, with 9,678 persons.

TABLE 1
REGIONAL VEGETATIONAL COVER TYPES IN ACRES AND BY PERCENT

Vegetation Type	Acres	Percent of Total
Conifer Forest	10,686,956	72.3
Hardwood Forest	2,527,356	17.1
Shrubland	1,570,273	10.6
TOTAL FORESTED	14,784,585	100.0
Non-forest	1,541,378	
TOTAL AREA	16,325,963	

SOURCE: TAC and VESTRA, California Timberland Wildlife Habitat Study (1989).

Figure 2

color oversize

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Figure 3

oversize

(count as 2 pages)

TABLE 2
REGIONAL LAND OWNERSHIP IN ACRES AND BY PERCENT

Ownership	Acres	Percent of Total
Private		
Small Private Lands	5,888,916	36.4
Industrial Lands	2,514,583	15.6
Large Private Lands	210,170	1.3
Subtotal	8,613,669	53.3
Federal & State		
U.S. Forest Service	6,550,237	40.6
Other Government Lands	613,544	3.8
Parklands	375,780	2.3
Subtotal	7,539,561	46.7
TOTAL	16,153,230	100.0
Lakes	172,733	
TOTAL AREA	16,325,963	

SOURCE: TAC and VESTRA, California Timberland Wildlife Habitat Study (1989).

Small Private Lands = Individual holdings not necessarily used for timber production

Industrial Lands = Held by commercial timber companies and used primarily for timber harvest

Large Private Lands = Held by commercial timber companies but not used strictly for timber

U.S. Forest Service = National Forest system lands

Other Government = BLM, Bureau of Indian Affairs, CDF, and California State Lands

Parklands = National and State park systems

TABLE 3
REGIONAL POPULATION IN 1980 AND 1990
AND EMPLOYMENT IN 1991 BY COUNTY

County	1980 Population	1990 Population	1991 Employment
Colusa	12,791	16,275	6,000
Del Norte	18,217	23,460	6,950
Glenn	21,350	24,460	8,350
Humboldt	108,514	119,118	44,800
Lake	36,366	50,631	14,800
Marin	222,568	235,096	121,200
Mendocino	66,738	80,345	30,900
Modoc	8,610	9,678	3,175
Napa	99,199	110,765	51,200
Shasta	115,715	147,306	54,425
Siskiyou	39,732	43,531	15,075
Sonoma	299,681	388,222	200,800
Tehama	38,888	49,625	14,800
Trinity	11,858	13,063	4,275
TOTAL	1,100,227	1,311,575	576,750

SOURCES: U.S. Department of Commerce, Bureau of the Census (1991); California Employment Development Department (April 1991).

Compared with 1980 population estimates, the region has gained 211,348 persons over the past decade--a 19.2 percent increase. The highest growth rate was in Lake County, which increased 39.2 percent from 36,366 to 50,631 persons. Sonoma County had the second highest rate of increase, growing by 29.5 percent from 299,681 to 388,222 persons, and the largest net gain (88,541 persons). Marin County had the lowest growth rate, increasing 5.6 percent from 222,568 to 235,096 persons. Modoc County had the lowest net gain, increasing by only 1,068 persons.

The combined employment in the 14 counties (including those portions of counties outside the owl's range) currently is estimated at 576,750 by the California Employment Development Department (see Table 3). Most of this employment (56 percent) is concentrated in Marin (121,200) and Sonoma (200,800) counties. Modoc County has the least amount of employment (3,175); and four other counties (Colusa, Del Norte, Glenn, and Trinity) have employment totals under 10,000.

Except for Marin, Napa, and Sonoma, the counties currently show "double-digit" unemployment rates, ranging from 10.9 percent in Humboldt to 23.8 percent in Colusa. These estimates by the California Employment Development Department are based on unrounded data for February 1991 and are not seasonally adjusted.

D. The Plan Area

1) Simpson's California Timberlands

Simpson owns and manages 765,000 acres of industrial forestland in the coastal areas of Washington, Oregon, and California. Of this total, approximately 383,000 acres (50 percent) are in California. Only Simpson's California holdings are covered by this HCP.

a) Location and Size of Holdings

As part of the region defined by the California range of the spotted owl, Simpson's 383,106 acres constitute 2.3 percent of the region's total area, 4.4 percent of its private land, and 15.2 percent of its industrial timberlands.

Simpson's California properties are located primarily in Del Norte and Humboldt counties, with relatively minor acreage in Mendocino and Trinity counties (Figure 4). The bulk of the ownership is within 20 miles of the coast, with the easternmost tract located 55 miles inland. All of it falls within the "Coast Forest District" as defined by CDF and the "Northern California Coast Range Province" as defined in the Thomas report.

Simpson's holdings range in size from blocks of over 50,000 acres to isolated parcels of about 40 acres. Most of the acreage has been owned and managed by Simpson for at least 20 years and in some cases for more than 40. All but approximately 2 percent of the forested areas have been logged within the past 100 years.

b) Subareas

For purposes of this HCP, Simpson's ownership has been divided into north and south holdings (see Figure 4). The northern portion of the property includes approximately 215,000 acres and has been further divided into two subareas--Smith River and Klamath. The southern portion of the property includes approximately 168,000 acres and has been further divided into five subareas--Korbel, Mad River, Upper Mad River, Fortuna/Carlotta, and University Hill.

c) Adjacent Ownerships and Uses

As in the region as a whole, much of the land adjacent to Simpson's property is controlled by federal agencies. National Forests and Wilderness Areas flank

Figure 4

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Simpson's holdings along the east. To the west, the Redwood National Park abuts Simpson's property in northern Humboldt County. BLM and Hoopa Valley Indian Reservation lands are adjacent to and interspersed with Simpson's holdings in Humboldt County (see Figure 4).

Other industrial timberlands comprise the next largest category of adjacent ownership, including the holdings of Sierra Pacific, Rellim Redwood, Champion International, Louisiana Pacific, and Pacific Lumber. Other private lands with multiple owners and uses are interspersed with the industrial timberlands and federal holdings.

Adjacent state lands are primarily parklands to the west and south of Simpson's holdings.

Adjacent land uses vary from area to area but generally follow land ownership patterns. Commercial timber operations predominate on private land in the area, interspersed with a limited amount of ranching and other uses. Various levels of timber harvesting also are allowed in designated areas of National Forests, which are managed for multiple uses. Federal Wilderness Areas, National Parks, and State Parks are managed for conservation and recreation uses.

2) Cover Types

Nearly nine out of every ten acres (86 percent) of Simpson's California holdings are conifer forest; the remainder is either hardwood or non-forest vegetation (Table 4). Simpson's conifer stands represent about 3 percent of the conifer forests identified in the region by TAC and VESTRA. The hardwoods constitute less than one percent of the region's hardwood forests. It should be noted that the description of cover types in this section is based on Simpson's forest inventory and is not a biological evaluation of habitat. Descriptions and analyses of the biological value to spotted owls of the stands on Simpson's property are contained in Sections 2.F, 2.G, 2.H, 3.B, and 3.C of this HCP.

a) Conifers

The conifer element of Simpson's holdings consists largely of coastal redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*). Redwood is found closest to the coast, Douglas-fir in the more inland areas. Second or "young" growth conifer stands cover about 330,000 acres (86 percent) of Simpson's ownership. Of these second-growth stands, about 10,000 acres (3 percent) contain a residual component (10 to 30 percent) of old growth. Less than 7,000 acres (less than 2 percent) of Simpson's ownership are stands in scattered locations that have never been logged ("virgin" old growth).

TABLE 4
ACRES AND PERCENT OF VEGETATIONAL COVER TYPES ON SIMPSON TIMBERLANDS

Vegetation Types	Acres	Percent of Total
Conifers	330,639.4	86
Hardwoods	30,102.4	8
Non-forested	22,364.0	6
TOTAL OWNERSHIP:	383,105.8	100

b) Hardwoods

About 8 percent of Simpson's California property are hardwood stands. Species include:

- Red alder (*Alnus rubra*), which occurs on moist, cool sites and is a major overstory component in riparian zones and some lower-slope conifer stands;
- Tanoak (*Lithocarpus densiflorus*) and Pacific madrone (*Arbutus menziesii*), which occur together as natural stands on major ridgelines and mid-slopes and are common components of conifer stands on mesic sites.
- Oregon white oak (*Quercus garryana*) and California black oak (*Quercus kelloggii*), which occur in mixture or as pure stands and occupy transition zones between natural prairies and inland Douglas-fir stands.

c) Non-Forested Lands

Non-forested lands cover about 6 percent of Simpson's holdings and include grasslands, wetlands, rock outcrops, and river bars. Grasslands comprise about 40 percent of the non-forest cover and are present largely because of the area's history of periodic wildfires and livestock grazing. Both conifers and hardwoods encroach on grasslands along their margins and along the banks of watercourses that cut through them.

3) Age-Class Distribution and History

The current age-class distribution of Simpson's timberlands reflects the 100-year logging history of the property which has produced a mix of essentially even-aged stands. This section of the HCP summarizes the age-class characteristics and history of the ownership. A description and analysis of timber age-classes in the context of biological value for spotted owls is contained in Sections 2.F, 2.G, 2.H, 3.B, and 3.C of this HCP.

a) Stands Aged 0-25 Years

Stands 0 to 25 years old are largely the result of clear-cutting, which has been a standard silvicultural practice since the mid-1960s. Many of the 0- to 13-year-old stands are "third growth" after the harvest of older second growth and reflect the site preparation and reforestation practices usually associated with intensive forest management. The stands are essentially even-aged but mimic the variability of the natural landscape. This variability is the result of the terrain, the planting of a mix of native species, the distribution of stumps and logging slash, and the encroachment of grasses, forbs, brush, and hardwoods.

b) Stands Aged 26-50 Years

Stands 26 to 50 years old are the result of logging that occurred between the early 1940s and mid 1960s and are largely areas where various intensities of selective logging were used. "Selective logging" is distinct in both name and application from the classically defined "selection system" of silviculture, as the determination of which trees would be cut was based solely on economics, with no consideration given to revegetation or stand structures. It reflected the changes that were introduced at the outbreak of World War II, including the use of tractors, log trucks, and high-lead cable yarders instead of logging railroads and steam-powered skyline yarders. These changes gave loggers the ability to yard logs from individual trees relatively short distances to inexpensively constructed truck roads.

Selective logging typically removed all old-growth timber from a particular site in two to four harvests over 10 to 20 years and was not always successful in establishing a replacement crop of conifers. (Most areas owned by Simpson during this period were artificially regenerated with planted conifer seedlings or aerially seeded with Douglas-fir.) Artificial regeneration efforts and the relatively short time span needed to complete the harvesting and reforestation cycle produced roughly even-aged replacement stands. However, there are some gaps in conifer stocking in these areas due to brush invasion and soil compaction.

c) Stands Aged 51-90 Years

Stands 51 to 90 years old are the result of logging between 1890 and the early 1940s. Most of the stands are at least 60 years old (only a small portion are 51 to 59 years old, due to limited harvesting during the Depression) and have their origin in the earliest timber harvesting on Simpson's property. Beginning in the 1890s, whole drainages of redwood were clear-cut in a continuum of operations as logging railroads and steam-powered logging equipment marched inland from the coast. Reforestation was not practiced. Efforts at deforestation through burning, grass seeding, and slashing of redwood coppice sprouts were widespread as timberland owners attempted to convert logged areas to grazing land. Ultimately the conversion efforts were abandoned, and persistent redwoods rapidly reclaimed the area.

Prior to their acquisition by Simpson, some of these naturally regenerated second-growth stands were selectively logged, creating a subtype characterized by a more open canopy and a dense understory of 15- to 30-year-old hardwood, brush species, and suppressed conifer regeneration.

d) Stands with Residual Old Growth

Stands with residual old growth are areas that were selectively logged between the early 1940s and 1960s and have 10 to 30 percent of their original timber volumes. Such areas are concentrated in the inland portions of Simpson's holdings and constitute less than 3 percent of the ownership.

e) Virgin Old-Growth Stands

Virgin old-growth stands are scattered throughout the ownership and consist of redwood stands under 150 acres, Douglas-fir stands under 300 acres, and smaller stands of either species surrounded by young (0 to 40 years) second growth. As previously noted, these areas combined comprise less than 2 percent of Simpson's ownership.

4) Subarea Profiles

The cover types, age-class distribution, and silvicultural history of the subareas defined for this HCP are as follows.

a) Smith River

The Smith River subarea is located in Del Norte County. Its dominant vegetation is coastal redwood and Douglas-fir with higher, drier sites containing more fir than redwood. Stand ages vary from less than 5- to 70-year-old second growth. Virtually all old growth has been removed, except scattered residuals. The area has a diverse topography, ranging from nearly level terrain in broad alluvial flats to very steep slopes in some creek drainages. Railroad logging began in the 1920s and most of the old growth was removed by 1960. Second growth has been harvested since the 1970s. Artificial regeneration, primarily planting, began in the 1960s and continues today.

b) Klamath

The Klamath subarea includes over 100,000 acres adjacent to Klamath River in Humboldt and Del Norte counties. Its dominant vegetation near the coast is redwood and Douglas-fir. Further inland and at higher elevations, redwood remains a stand component but gives way in size and density to Douglas-fir. Hardwoods comprise a major stand component in the inland areas and along stream courses. Tanoak is the most common hardwood on drier locations, and red alder is the most abundant on wetter sites. Most of the stands are less than 50 years old. Most old growth has been logged and that which remains occurs mostly in stands under 60 acres. The area has a rugged topography with steep slopes and deeply incised drainages. Timber harvesting began in the 1890s and continues today.

c) Korbel

The Korbel subarea is located in Humboldt County. The dominant vegetation in the coastal area is redwood and Douglas-fir. Inland, redwood is replaced by more drought resistant vegetation, with intrusions of large, natural grassland prairie that occur mostly on southerly and westerly aspects. Stand ages range from 0 to 80 years. Old growth remains only as scattered residuals. Logging has been conducted in the overall study area for more than 100 years, and logging of second growth is a major ongoing activity.

d) Mad River

The Mad River subarea is contiguous with the Korbel area. Stand age varies from 0 to 80 years in the north and from 0 to 55 years in the south. The area was railroad logged from the 1880s to the early 1930s, with the first harvest of second growth occurring in the late 1970s. Since then, extensive road construction and harvesting have been conducted in the area and presently less than one-half of the original second-growth canopy remains in contiguous timber stands.

e) Upper Mad River

The Upper Mad River subarea includes approximately 39,000 acres, all in Humboldt County. This property is part of a drier inland regime that supports a mixture of Douglas-fir/hardwood stands and natural prairies. It was logged extensively between the late 1940s and the early 1970s, removing all of the old growth from the northern one-half of area and leaving scattered residual stands of old-growth Douglas-fir in the southern one-half. Lack of reforestation efforts resulted in 30- to 40-year-old hardwood stands taking over the northern one-half, while hardwoods, brush, and grass claimed much of the understory in the southern one-half. Approximately 20 percent of the area is grassland that is leased to local cattle ranchers.

f) Fortuna/Carlotta

The Fortuna/Carlotta area includes approximately 10,000 acres in Humboldt County. The dominant vegetation of this area is second-growth redwood and Douglas-fir. Stand ages vary from 0 to 60 years. Old-growth stands in this area were harvested between 1920 and 1930, and the current tree cover resulted from natural seeding and redwood sprouting. Current logging focuses on stands older than 55 years and is followed by regeneration by planting.

g) University Hill

The University Hill subarea, approximately 13,000 acres, is located 50 miles inland on slopes facing the south fork of the Trinity River. The area is isolated from Simpson's other holdings and is the only part of Simpson's ownership covered by the Douglas-fir/true fir type (white fir and red fir). Ponderosa pine, incense-cedar, and sugar pine also are native to the area. Hardwood species in the subarea are tanoak, chinkapin, Pacific madrone, Oregon white oak, and California black oak. Elevations range from 1300 feet to 5800 feet. The area is surrounded by the Six Rivers and Trinity National Forests.

Nearly all of this property was logged between the 1950s and 1974. Most of the area was cut to a seed tree leave (four to six residual old-growth trees per acre), leaving few merchantable stands of timber. Natural regeneration seems to have been successful in most areas, with invasion by whitethorn ceanothus becoming a problem on some sites.

Simpson acquired the property in 1989 and is currently operating THPs covering around 700 acres. Most of this harvesting is being done as an overstory removal, leaving the logged area stocked with young-growth conifers of various ages. Clear-cut acreage and understocked sites within overstory removal areas are being planted with appropriate conifer stock the first winter following logging.

5) Resource Management Practices

Simpson manages its properties for the primary purpose of growing and harvesting commercial timber. Implicit in this goal is achievement of a sustained yield in perpetuity, that is, the harvesting of timber at a rate in keeping with the ability of the land base to grow replacement trees. To preserve and enhance the productivity of its timberlands, and to protect other natural resources, Simpson has adopted management practices that are well above the minimum legal requirements. Examples of this commitment can be found in Simpson's policy of leaving stream protection zones that exceed requirements of the Forest Practice Rules, its use of optional harvesting techniques that minimize erosion and soil compaction, and its efforts to improve the growth of its forests through discretionary investments in tree improvement, pre-commercial thinning, and fertilization.

a) Rate of Harvest

Logging is a continuous, year-round process with numerous harvesting units in various stages of activity at any given time. It typically is not measured in terms of annual acreage; however, since replanting usually occurs within one year after logging, annual planting records provide an approximate measure of annual timber harvests. Such records for the period 1984 through 1989 indicate that Simpson planted an annual average of 4,200 acres, excluding replantings due to excessive seedling mortality and planting in areas damaged by wildfire in 1988. This average is representative of currently planned harvest levels.

An alternative calculation of annual rates is based on the rotation ages of merchantable trees. It assumes a 50-year rotation for redwood-dominated stands and a 60-year rotation for Douglas-fir, which yields a weighted rotation age of 54 years for Simpson's overall property. Assuming that approximately 330,000 acres (which excludes most hardwoods, extremely slow-growing conifer stands, and non-forest land) of Simpson's property are merchantable, the area that would hypothetically be cut each year then becomes approximately 6,100 acres. This estimate is considered to be in the high range of timber harvests likely to occur over the next 50 years.

b) Harvest Methods

Consistent with its sustained yield objective, Simpson uses clear-cutting in most of its harvest operations. Clear-cutting requires entry to the land for harvesting only once every 50 to 60 years and, pursuant to current California Forest Practice Rules for the Coastal Forest District, cannot exceed 80 acres.

Wherever possible, Simpson combines single-entry harvest with cable logging or short-span skyline systems, thereby minimizing soil disturbance in the regrowth area. Truck roads and landings also are engineered to minimize disturbance. Clear-cutting is not used in residual old-growth areas that have little remaining merchantable timber volume or where the proximity of neighboring residences or public roads requires that screens of standing timber be left. In residual old-growth stands, the harvest practice is best described as "seed tree removal" or "overstory removal" which leaves the understory of conifers as undisturbed as possible. Such operations average about 300 acres per year. Selective logging near residences or roads typically occurs in second-growth areas where urban development abuts coastal timberlands; the total acreage involved is insignificant.

c) Reforestation

The first season after harvest, logged areas are prepared for replanting. Simpson's usual method of site preparation is controlled broadcast burning of the debris and brush left over from logging. This step is followed by hand planting of conifer seedlings at a density of 400 to 500 trees per acre (State rules require 300 seedlings per acre) within five years of harvest completion.

d) Growth Enhancement and Maintenance

The summer following the initial planting, Simpson surveys the area to determine seedling survival rates and, where necessary, replants seedlings.

- At age 2, a more detailed stocking survey is done, and replanting is repeated if necessary. The results of the surveys also are used to report compliance with State Forest Practice Rules.
- Between age 2 and 10, invasive species are checked with the selective use of herbicides.
- Between age 10 and 20, pre-commercial thinning occurs to enable the remaining trees to achieve reasonable diameter growth.
- Around age 25, the stand is surveyed and measurements are taken to enable tracking for management purposes.
- Beginning at age 30, conifer stands are aerially fertilized using pelletized (urea) nitrogen. This treatment is repeated every 7 years until a stand reaches age 40 or 50.

Simpson owns and operates two tree nurseries, one at Korbel and the other on Highway 101 close to the Smith River, which raise several million seedlings per year. Most of these seedlings are used to reforest Simpson's property in California, although some are produced for outside sale. Principal planting stock includes redwood, Douglas-fir, spruce, and ponderosa pine. Most of the seed is gathered from Simpson's own timberland and is carefully catalogued and tracked to ensure that seedlings are planted in the same zone from where their seed was collected.

The nursery also is engaged in a program involving genetic improvement of basic stock. This program includes selection of superior trees and conventional cross-breeding for both Douglas-firs and redwoods. In addition, tissue culture experiments are being undertaken wherein superior redwoods are cloned. The objective of the tree improvement program is to develop a stock that is healthy, fast growing, and free of defect.

6) Resource Information System

Simpson has used computer technology to monitor and plan for the management of its forest and wildlife resources since 1975. It was the first private timber company in northern California to initiate development of a geographic information system (GIS) for resource management and currently has one of the most powerful inventory systems in the industry.

a) Computer Hardware and Software

Simpson's GIS hardware consists of a Digital Equipment Corporation MicroVAX II with 9 megabytes (MB) of memory and three 337 MB fixed-media disk drives. Data input and output is primarily via two Intergraph dual-screen terminals. The GIS software consists of Intergraph Nucleus Software and FORTRAN computer programs developed by Simpson employees. The Intergraph software is used to input, store, and retrieve spatial (map) information such as property boundaries, watercourses, roads, ridges, cover type boundaries, THP boundaries, and tax parcel boundaries. Intergraph software also is used to manage attribute information such as stand volume, species composition, stand age, site productivity, and stand density and to generate overlays of graphic information. Supplementary FORTRAN programs are used for a variety of tasks, such as estimating the rate at which forest stands are growing, summarizing and comparing year-end depletion and production volumes, and simulating harvest plans.

The power and utility of Simpson's GIS are its abilities to integrate graphic and attribute information to produce maps and reports about specific areas. For example, a forester may need a map showing the location of all Douglas-fir stands between the ages of 30 and 50 years to develop a fertilization plan. The system identifies the stands that meet the species and age requirements, generates a map showing the location of the stands, and tabulates their acreage and volume. Moreover, the system can project over time the distribution of stands that will meet those same requirements.

b) Harvest Simulation Model

Most long-term harvest projections for large timberland ownerships are based on traditional inventory summaries of acreage and volume by age-classes. The acreage and volume figures for each age-class are statistical aggregates for the entire forest, and the harvest calculation program maintains either no or only a very gross linkage to what occurs on the ground.

In contrast, Simpson's harvest simulation model is based on individual cover types. Each type has its own set of stand attributes and a unique geographic location. The model "grows and harvests" these cover types in order to develop a harvest schedule. Long-term harvest schedules are generated through the following steps.

1. Cover types are sorted in order of preferred harvest, giving highest priority to types whose current age minus target rotation age is greatest.

2. As each cover type comes up for harvest, the maximum portion that can be cut in the current year is determined. This maximum takes into account CDF requirements regarding the adjacency and size of clear-cut areas.

3. Growth and yield models (developed from permanently located research plots) are used to estimate the volume by species for the cover type to be harvested. Growth is calculated from the starting year of the simulation to the current year. Since growth is projected separately for each cover type, a more accurate projection can be made than would be possible for an aggregated age-class.

4. The appropriate number of acres is harvested from the cover type under consideration, and then the cover type with the next highest priority rating is considered for harvest. Once the desired harvest level has been attained for the current year, harvested stands are regenerated, time is incremented, and the process is repeated. The simulation is terminated at the end of the planning period.

The model generates a detailed report that lists the cover types harvested during each year of the simulation. This information is loaded into the GIS data base and can be used to produce a variety of maps that display the simulation model's output.

Simpson's Spotted Owl Surveys and Studies

A. Introduction

Before 1989, little was known about the status of northern spotted owls on Simpson's lands or other privately owned timberlands in California. Most areas had not been surveyed for spotted owls, had been logged at least once, and were now occupied by stands considerably younger than the old growth (200+ years) commonly associated with the owl. Some information was available from individual studies conducted in the region, but the overall data base on spotted owls in coastal redwoods was sketchy at best. With the proposed listing of the species, that situation began and continues to change.

Simpson's spotted owl surveys and studies began in May 1989 and, together with other industry-sponsored efforts, added new information to the data compiled during the listing of the owl. USFWS's final rule makes several references to the reports of relatively large populations of owls in coastal redwoods, noting that:

> Recent field investigations in northern California documented the presence of northern spotted owls in 30- to 80-year-old forests that contain suitable structural characteristics (USDI 1990a).

However, both USFWS and the Thomas report cautioned against misinterpretation of the new data and emphasized that, as phrased in USFWS's final rule,

> The coastal redwood zone constitutes only 7 percent of the owl's overall range and caution is urged in assuming that unique growing conditions will occur elsewhere (USDI 1990b).

This concern was expressed within the context of the proposed listing of the owl as threatened due primarily to habitat loss. Unfortunately, the controversy surrounding the listing has tended to deflect attention from the significance of the coastal zone's unique conditions in relation to habitat conservation.

To prepare this HCP, Simpson has focused on what makes the coastal redwoods unique and more specifically on what constitutes owl habitat in this portion of the owl's range. This section of the HCP summarizes the studies and surveys conducted by Simpson to date, including (1) a review of existing literature on the owl; (2) field surveys conducted in 1989, 1990, and 1991; (3) analyses of spotted owl food habits, nest sites, nest stands, and nesting habitat mosaics; and (4) a discussion of the results of the 1989-1991 surveys and studies.

B. Review of Existing Literature

This section of Chapter 2 summarizes existing sources of information on the biology of the spotted owl. Most of the literature is based on studies conducted in Washington and Oregon. Studies of spotted owls in northern California are noted in the summary and then discussed in more detail in the sections that present Simpson's 1989, 1990, and 1991 studies.

1) Physical Characteristics and Behavior

The northern spotted owl (*Strix occidentalis caurina*) is a medium-sized owl with a round head, dark eyes, dark-brown plumage, white spots on the head and nape, and white mottling on the breast and abdomen (Johnsgard 1988) (Figure 5). It is one of three subspecies of spotted owls recognized by the American Ornithologists Union (Johnsgard 1988). The other two subspecies are the California spotted owl (*S. o. occidentalis*) and the Mexican or Arizona spotted owl (*S. o. lucida*).

a) Age and Sex Characteristics

Spotted owls have an average life span of eight years in the wild (Thomas et al. 1990), although some may live 15 to 20 years (Miller 1989). Miller (1989) reported a captive owl to be 19 years old.

Newly hatched owlets are sparsely covered with white natal down. After about 10 days, soft, buffy pale brown contour feathers with darker brown transverse barring begin to replace the natal down (Forsman 1981); birds with such plumage are referred to as juveniles (Franklin et al. 1990a). In about five months, juveniles acquire plumage similar to that of adult owls (Basic I plumage) except the tail feathers are white and sharp-tipped (Forsman 1981). Birds at least one year old with white tail feathers are termed subadults (Franklin et al. 1990a). On adult owls (>26 months old), the tail feathers are brown mottled and blunt-tipped (Forsman 1981).

Spotted owl sexes can be distinguished by general behavior and calls, with male vocalizations generally lower pitched than females (Forsman et al. 1984). In addition, females on average are larger than males (Johnsgard 1988).

b) Roosting

During the day, spotted owls are generally inactive in roost trees. Occasionally they take diurnal prey, retrieve cached prey, drink or bathe from streams, or change roosts (Forsman et al. 1984). They have been observed roosting low in the understory canopy in warm weather and high up in large trees in cool or rainy weather (Barrows and Barrows 1978; Solis 1983, Forsman et al. 1984; Sisco and Gutierrez 1984); on north (Gould 1977; Solis 1983) or south (Forsman et al. 1984) facing slopes or randomly according to slope aspect (Forsman et al. 1984, Blakesley et al. 1991); close to water (Gould 1977; Solis 1983; Carey 1985); and on the lower third (Blakesley et al. 1991) or two-thirds (Solis 1983) of slopes. Spotted owls also may use roost trees repeatedly throughout the season (Barrows 1981).

c) Foraging

Spotted owls usually leave daytime roosts within an hour of sunset to forage. They most commonly attack prey by diving upon them from an elevated perch and seizing and immobilizing them with their feet (Forsman et al. 1984).

Based on analyses of regurgitated pellets, small mammals comprise the greatest percentage of spotted owl diets, both in terms of frequency (70 to 95 percent) and biomass (>90 percent) (Barrows 1980; Solis 1983; Forsman et al. 1984; Kerns 1989a). Furthermore, only two or three species account for most of the biomass (Thomas et al. 1990).

Predominant prey species include northern flying squirrels *(Glaucomys sabrinus)*, dusky-footed woodrats (*Neotoma fuscipes*), red tree voles (*Arborimus longicaudus*), and lagomorphs such as brush rabbits *(Sylvilagus bachmani)*. Deer mice (*Peromyscus* spp.), red-backed voles *(Clethrionomys californicus)*, and pocket gophers (*Thomomys* spp.) also may be important food items in some areas (Forsman et al. 1984; Thomas et al. 1990).

Studies indicate that the relative abundance of key prey in owl pellets may vary according to region (Forsman et al. 1984; Paton et al. 1989; Ward 1990), reproductive status of owl (Ward 1990), year (Barrows 1985), elevation (Forsman et al. 1984; Paton et al. 1989), and season (Forsman et al. 1984; Ward 1990). Flying squirrels appear to predominate the diets of owls in mesic Douglas-fir and western hemlock stands or higher elevations; whereas dusky-footed woodrats seem to predominate in xeric, mixed hardwood and mixed conifer stands or lower elevations (Forsman et al. 1984; Miller 1989; Thomas et al. 1990). Woodrats represent the greatest proportion of prey species for spotted owls in northern California, both in terms of numbers and biomass (Solis 1983; Kerns 1989a; Ward 1990). Variations also may reflect differences in prey availability, which has not been assessed in most owl diet studies.

Figure 5

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d) Breeding and Nesting

Spotted owls may breed as subadults, but subadults typically fledge fewer young than adults (Franklin et al. 1990a). Females may be more likely to breed as subadults than males (Miller 1989).

Outside of the breeding season, individual owls mostly live a solitary existence. In February, pairs begin to communicate and roost together near the eventual nest site. Nest initiation varies according to region but typically begins between mid-March and mid-April (Forsman et al. 1984). During the breeding season, paired birds, especially males, are more likely to respond to actual or mimicked owl calls than are nonterritorial and nonbreeding owls (Thomas et al. 1990).

Rather than build their own nests, spotted owls modify existing structures (Carey 1985). Three types of nest structures are used: broken tree-top cavities, lateral tree cavities, and debris platforms.

Broken tree-top cavities and lateral tree cavities are formed when weakened tops or branches of trees snap off, eventually leaving a cavity at the top or side of trees (LaHaye 1988). Usually secondary crowns are found growing above broken top nests (Forsman et al. 1984; LaHaye 1988). Debris platforms are created by natural accumulations of twigs, foliage, and other materials; diseases; parasitism (e.g., dwarf mistletoe [*Arceuthobium* spp.]); birds; or mammals. Bird and mammal nests include those of goshawks (*Accipiter gentilis*), Cooper's hawks (*Accipiter cooperii*), red-tailed hawks (*Buteo jamaicensis*), woodrats (*Neotoma* spp.), and western gray squirrels (*Sciurus griseus*) (Forsman et al. 1984).

Pairs have been observed reusing the same structure in subsequent years (Forsman et al. 1984). Studies also indicate regional differences in the proportions of structures used (Forsman et al. 1984; LaHaye 1988; Thomas et al. 1990), but the studies did not assess the availability of structures. Researchers also have observed that a majority of owls nest on the lower one-half of slopes (Forsman et al. 1984; LaHaye 1988; Blakesley et al. 1991).

Once the nest is formed, one to four eggs (usually two) are laid and incubated by the female for about 30 days. During incubation and 8 to 10 days after hatching, the female leaves the nest only for short periods and is dependent on the male for food (Forsman et al. 1984).

Two to three weeks after hatching, the female leaves the nest for longer periods and forages further from the nest site. The owlets fledge at 34 to 36 days (mid-May to mid-June) and may be able to make short flights two weeks after fledging. They may remain near the nest site all summer, and the parents continue to provide food for them until late August to early September (Forsman et al. 1984).

e) Reproductive Success

Studies suggest that reproductive success among spotted owls may vary widely between geographic areas (Carey 1985) and years (Forsman 1988; Franklin et al. 1990a). In some years most pairs attempt to breed and in others, few. The number of pairs attempting to nest annually varies from 40 to 60 percent (USDI 1990a). Numbers of young fledged per pair also may vary dramatically (Miller 1989).

Barrows (1985) reported that successful breeders had diets with a high frequency of large prey, but prey availability was not determined. Ward (1990) suggested that successful pairs may benefit from variable supplies of food patches abundant with large prey.

f) Home Range

Based on radio telemetry studies summarized by Thomas et al. (1990), the home ranges of northern spotted owls in the United States vary within the species' range. The minimum home range reported in Washington was 1,927 acres; the maximum was 30,961 acres; and the median was 6,308 to 9,930 acres. In Oregon, the minimum reported home range was 1,035 acres; the maximum was 10,189 acres; and the median was 1,411 to 6,360 acres. In California, the minimum reported home range was 1,258 acres; the maximum was 7,823 acres; and the median was 1,692 to 3,314 acres. Thomas et al. (1990) also noted that home ranges are largest in Washington, supporting the suggestion by Forsman et al. (1984) that home range size increases with latitude.

Home ranges of individuals in a pair may overlap more than 90 percent (Forsman et al. 1984; Paton et al. 1989; Carey et al. 1990), and overlap between pairs may occur (Forsman et al. 1984). Studies also indicate that home ranges are typically smaller during the breeding season (Forsman et al. 1984; Sisco and Gutierrez 1984; Carey et al. 1990).

Regarding differences in home range sizes, Paton et al. (1989) suggested that densities and types of available prey explained variations in the Klamath physiographic province. Studies also have found correlations between home range size and total area of old (>200 years) growth (Sisco and Gutierrez 1984; Gutierrez 1985) or mature/old growth (Solis 1983) within the range. Forsman et al. (1984) concluded that owls may compensate for sparse coverage of old growth by increasing the size of the home range to include more old-growth area. Thomas et al. (1990) calculated median amounts of old growth per home range to be 615 to 4,519 acres.

g) Juvenile Dispersal

Dispersal of juvenile spotted owls from the nest area usually begins between mid-September and mid-October (Miller 1989). Initial dispersal is usually rapid (Gutierrez et al. 1985; Miller 1989) and in random directions, with most movements taking place in the first few weeks (Miller 1989). Studies suggest that the young birds may use a wide variety of habitats and forest types during dispersal (Gutierrez et al. 1985; Miller 1989). Most dispersing owls "settle" into relatively well defined areas for their first winters and may resume moving in late winter or early spring (Miller 1989).

Juveniles exhibit a low survival rate (Gutierrez et al. 1985, Miller 1989) and are particularly vulnerable to starvation (Miller 1989) and predators such as great horned owls (*Bubo virginianus*) (Forsman et al. 1984; Miller 1989) and goshawks (Miller 1989). Based on studies conducted in various regions, they travel a median distance of 27 miles, with some birds dispersing over 50 miles (Thomas et al. 1990).

2) Habitat Characteristics

Northern spotted owls are commonly associated with mature and old-growth coniferous forests of the Pacific Northwest. However, consensus among owl authorities holds that habitat structure is more important than age.

a) Habitat Age and Structure

Numerous studies summarized by Forsman (1988), Thomas et al. (1990), and USDI (1990a) indicate that the structural characteristics of suitable habitat for spotted owls include:

- A multilayered, multispecies canopy cover open enough to allow owls to fly within and beneath it;
- An overstory dominated by conifers >30 inches dbh (diameter at breast height) and understory of shade-tolerant conifers or hardwoods;
- A 60 to 80 percent canopy closure;
- Decadence (i.e., live trees with features such as cavities, broken tops, or dwarf mistletoe infections);

- Many large snags (standing dead trees); and
- Ground cover of logs and wood debris.

Some of these structural characteristics have been found both in old-growth (>200 years old) Douglas-fir forests and in relatively young (<80 years old) second-growth coastal redwood forests.

Thomas et al. (1990) attributes owl presence in younger forests to ideal growing conditions that allow forests in the coastal redwood zone to develop old-growth structure in less than one-half the time that interior Douglas-fir stands require (60-80 years versus 150-200 years). These conditions include rapid development of redwood sprouts from stumps, early intrusion of conifer and hardwood species in the understory, relatively high rainfall, and long growing season (Thomas et al. 1990).

b) Habitat Selection

Most studies show that spotted owls select habitat with the structure of old growth for nesting (LaHaye 1988; Blakesley et al. 1991), roosting (Solis 1983; Sisco and Gutierrez 1984; Blakesley et al. 1991), and foraging (Solis 1983; Sisco and Gutierrez 1984; Carey et al. 1990; Forsman 1988; Thomas et al. 1990; USDI 1989b, 1990a). Some attributes of this structure (e.g., dense canopy closure) may be more important for roosting habitat in summer than winter (Barrows 1981; Sisco and Gutierrez 1984), and evidence indicates that structure and physiography may influence roosting (Solis 1983) and nesting to a greater degree than foraging. Sisco and Gutierrez (1984) also reported stem densities and basal areas of Douglas-firs and all hardwoods to be greater in roosting than foraging habitats.

Although it is clear that northern spotted owls often select habitats with old-growth structure, it is not clear why they choose such areas. Owls may use old-growth structure because:

- It provides a gradient of perches in which the owls, adapted to cold winters, can behaviorally thermoregulate (Barrows 1981);
- It contains large, decadent trees suitable for nests (Gould 1977; Forsman et al. 1984; Carey 1985; LaHaye 1988);
- It serves as escape cover (Sisco and Gutierrez 1984; Kerns 1989b) to avoid great horned owls (Carey 1985);

- Owls are adapted to it (Carey 1985; Gutierrez 1985); and/or
- It provides plentiful prey populations (Forsman et al. 1984) and foraging areas.

Gutierrez (1985) argued that the interplay of prey abundance, availability, and distribution probably explains the owl's historical use of large tracts of old growth.

3) Distribution of Species and Habitat

USFWS (USDI 1990a) and Thomas et al. (1990) estimated that approximately 2,000 pairs of northern spotted owls are known to exist. Thomas et al. (1990) further noted that, given the limitations of data available at the time, 3,000 to 4,000 pairs may be a more realistic estimate. Thomas et al. (1990) also estimated that 7.1 million acres of what traditionally has been considered suitable habitat exist within the owl's range. This habitat estimate, however, does not include private lands; and USFWS (USDI 1990b) noted that a significant amount of habitat may occur on private lands in California.

a) Rangewide Distribution

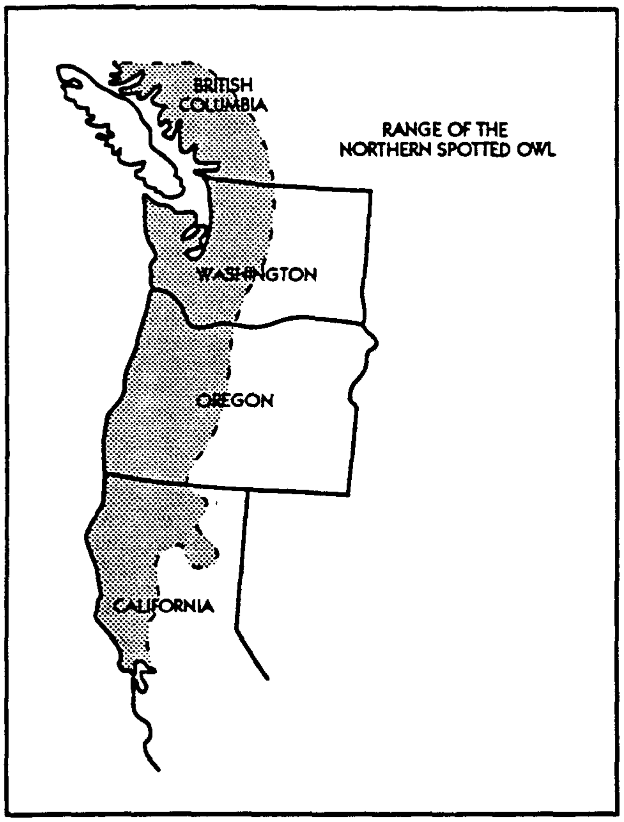
As noted by USFWS (USDI 1989), accepted estimates of the historical population size and distribution of northern spotted owls do not exist; but the owls are still found within their historical range in most areas where suitable habitat exists (Figure 6). According to Thomas et al. (1990), most of the current owl population is found from the southern portion of the Cascades in Washington southward, through the Cascades and Klamath provinces in Oregon into the Klamath and Coast Range provinces in northwestern California.

Population densities and numbers are estimated to be lowest in the northern extent of the range, in northern Washington and southern British Columbia. Densities also are believed to decrease from Mendocino National Forest south to Point Reyes, California, and from the Klamath province east to where the owl's range intersects with that of the California subspecies (Thomas et al. 1990).

b) Distribution by State and Land Ownership

Based on data obtained primarily from studies on federal lands (Table 5), Thomas et al. (1990) estimated that:

- Oregon contains nearly 56 percent of the known owl pairs and nearly 54 percent of the suitable habitat;



Source: Thomas et al., 1990

Figure 6. Current Range of the Northern Spotted Owl

TABLE 5
ESTIMATED NUMBER AND PERCENT OF OWL PAIRS AND OWL HABITAT BY STATE

State	Owl Pairs	Percent of Total	Acres of Owl Habitat*	Percent of Total
Washington	360	17.8	2,196,200	32.3
Oregon	1,129	55.8	3,643,100	53.6
California	533	26.4	956,100	14.1
TOTAL	2,022	100.0	6,795,400	100.0

SOURCE: Thomas et al. 1990.

*Does not include habitat on private lands.

- Washington contains nearly 18 percent of the pairs and about 32 percent of the habitat;

- California contains about 26 percent of the pairs and about 14 percent of the habitat.

Based on land ownership, Thomas et al. (1990) estimated that nearly 92 percent of the owl pairs and 90 percent of the habitat occur on 6.5 million acres of federal land. It should be emphasized that estimates in the Thomas report are based primarily on surveys of federal lands and do not reflect recent surveys of private lands. In particular, pair and habitat estimates for California, where federal lands comprise a much smaller portion of the owl's range than in Oregon and Washington, are considered low.

4) Decline Factors

In its proposed and final rule regarding the spotted owl, USFWS concluded that spotted owl populations are declining throughout much or all of the species' range (USDI 1990b). USFWS further concluded that, even if all existing habitat were conserved, owl populations would continue to decline until a new equilibrium with the environment could be reached (USDI 1990b). Other decline factors cited by USFWS include forest fragmentation, predation and competition, disease and parasitism, and natural occurrences.

a) Habitat Loss

USFWS noted that the most rapid reduction of habitat is occurring at low elevations and that, if current trends and practices continued, owl habitat and numbers would disappear from unprotected federal lands in 20 to 30 years (USDI 1990a). Franklin et al. (1990b) stated ". . . current management plans for spotted owls proposed a 60 to 82.5 percent reduction in current populations, assuming habitat surrounding SOHAs [spotted owl habitat areas] becomes suitable for occupancy under planned timber management plans over the next 50 years."

Studies cited by Thomas et al. (1990) and USFWS (USDI 1990b) noted 5 percent annual losses of resident territorial birds in California (Willow Creek) and 14 percent annual losses in Oregon (Roseburg). Although survey results indicated the populations were stable, the authors believed that a decline in both areas was masked by territorial vacancies filled by birds from outside the study areas and by "floaters." (Floaters are nonbreeding subadults and adults; they are a component of the population that cannot be measured directly because the birds do not respond to calls during surveys [Franklin et al. 1990a]). Thus, they hypothesized that population numbers were maintained but did not signify a "healthy" population. Because of high adult survival and apparent longevity of northern spotted owls, effects of habitat loss may not be reflected in population numbers until several years in the future (Franklin et al. 1989).

b) Forest Fragmentation

USFWS theorized that the effects of absolute habitat loss on the spotted owl are exacerbated by forest fragmentation and that, when decreased stand size and increased edge effects are taken into account, less than 50 percent of the remaining habitat may actually be suitable for owls (USDI 1990b).

Forest fragmentation has the potential to reduce habitat quality by:

- Increasing competition (e.g., with barred owls [*Strix varia*]) or predation (e.g., by great horned owls);
- Increasing negative stand edge effects such as vulnerability to windthrow or severe weather;
- Reducing survival rates for dispersing owls; and
- Reducing population densities and thus interaction between individuals.

On a small scale, fragmentation may cause individual pairs to increase their home range to include greater areas of suitable habitat to meet nutritional requirements (Forsman et al. 1984). Together with habitat loss, it also may prevent displaced pairs from finding suitable nesting habitat (Forsman et al. 1984).

Conversely, forest fragmentation may cause the "packing" of displaced owls into remaining suitable habitats. The packing results in high population densities that may be maintained over several years but do not indicate "healthy" populations. Artificially high densities of packed populations may lower reproductive success (USDI 1990a) and juvenile survival rates. On a large scale, fragmentation may isolate pairs and populations and thus affect population viability (Thomas et al. 1990).

Studies of forest fragmentation, however, reveal ambiguous results. In some studies summarized by Thomas et al. (1990), no significant differences were found between the amount of fragmentation within and outside home ranges or between nest and random locations. In other studies, owls in areas with clumped distributions of old growth had smaller ranges on average than owls in areas where old growth was fragmented; owls also were observed selecting habitats that were less cut over or had small indices of fragmentation (Thomas et al. 1990). Thomas et al. (1990) also noted that woodrat densities are positively associated with forest fragmentation and may temporarily benefit owls by increasing prey diversity and abundance.

In Oregon, Forsman et al. (1984) observed that when older tracts of forest were spaced close together, owl densities were high. Meyer et al. (1990) found randomly selected owl sites contained larger old-growth patches than randomly selected landscape sites, but the owl sites in the Coast Range province contained more clear-cut habitat than the landscape sites. The authors concluded that owl site selection was not influenced by recent timber harvest and that owls may tolerate a small percentage of clear-cut areas. Fragmentation did not seem to affect juvenile dispersal, but lack of nonfragmented areas may have biased the results (Miller 1989).

In northern California, Sisco and Gutierrez (1984) reported that summer studies in Six Rivers National Forest revealed that owls using more extensive cutover habitat had larger home ranges; winter studies revealed that owls using more cutover habitat had smaller home ranges. Restricted winter access was identified as a possible source of bias.

c) Predation and Competition

Predation by great horned owls has been identified as a major source of juvenile mortality (Forsman et al. 1984; USDI 1990b). Recent studies cited by USFWS (USDI 1990b) suggest that spotted owls avoid areas intensively used by great horned owls, but others (Marcot and Gardetto 1980; Solis 1983; Sisco and Gutierrez 1984; Gutierrez 1985) have found spotted and great horned owls to apparently coexist in close proximity. Barred owls, which recently have expanded their range (USDI 1989), may compete or hybridize (Verner, pers. comm. 1991) with spotted owls. However, impacts of great horned owls, barred owls, and other predators and competitors on the overall spotted owl population are unknown (USDI 1990b).

d) Disease and Parasitism

Little is known of the occurrence, distribution, and etiology of diseases and parasites in spotted owls (Gutierrez 1989). In a study of all three subspecies of spotted owls, all birds were found to be infected with at least one hematozoa (blood parasite) and many had multiple infections (Gutierrez 1989). External parasites may cause spotted owl young to fledge before they can fly (Forsman et al. 1984), but the effects of internal or external parasites on spotted owls have not been determined.

e) Natural Occurrences

Natural occurrences such as volcanos, storms, and fires may be catastrophic or subtle and cumulative in killing owls or destroying their habitat (Ruediger 1985).

C. 1989 Survey

1) Methods

The following techniques and protocols were used in Simpson's 1989 studies to collect and analyze data regarding spotted owls on Simpson's property.

a) Night Survey Technique

The night survey technique was designed to follow USFWS guidelines/protocol (Forsman 1983). It involved travelling along logging road transects after dark, stopping at 0.3-mile intervals to play a recording of spotted owl vocalizations broadcast from a 15-watt speaker for 10 minutes, and listening for responding vocalizations from an owl. Transects were run sequentially, beginning with the Korbel area and followed by Fortuna/Carlotta, Smith River, and Klamath.

When a response was heard, the azimuth was determined and the distance to the responding owl was estimated. The sex of the owl was determined by differences in its vocalizations (e.g., pitch and type of call). If the owl remained stationary, the surveyor triangulated on its position by moving 0.1 mile along the transect and taking another azimuth to the owl. Frequently, it was necessary to skip one scheduled calling station to prevent a responding owl from following the surveyor.

To reduce the possibility of double counting individual owls during the survey effort, surveyors did not count responses when they doubted the origin of a vocalization (see Appendix A for other methods used to reduce double counting). Locations of an owl were recorded as "auditory" if the owl was only heard vocalizing and as "visual" if it was seen in natural or artificial light or if it was repeatedly calling at close range (less than 50 yards) but darkness prevented the surveyor from actually seeing the bird. Responses of other owl species heard on the survey also were recorded.

b) Follow-Up Visits

Follow-up visits were conducted in areas where night responses were heard, with the surveyor searching the area while calling with recorded vocalizations or by voice. If a response was heard, the owl could be located and moused. Mousing involved presenting a laboratory mouse to the owl and observing the owl's behavior. If the owl was mated and nesting, it was assumed that, after taking one or more mice, it would return to its mate or owlets with a mouse. If the owl repeatedly ate or cached four mice, it was assumed that the owl was probably not mated or nesting.

c) Spot Calling

To gather additional data on the habitat affinities and reproduction of spotted owls in managed forests in 1989, areas were selected for spot calling in late July and August. Spot calling was conducted by calling with recorded owl vocalizations or by voice at key points in areas that had not been included in night surveys. This calling was done in morning and evening hours when surveyors had the greatest efficiency of locating owls and their roost or nest sites. Calling points were selected on the basis of good acoustical coverage of a large area. Calling continued for at least 15 to 20 minutes at each point, and a variety of spotted owl vocalizations were used to better elicit a response from both sexes in the area.

d) Density Index

An index of spotted owl density was calculated from the number of responses per mile surveyed. Actual survey miles that included highly circuitous logging roads were converted to relatively straight line distances by tracing the route on a map and eliminating sharp bends in the road. Only male responses were included in the density calculation because most responding spotted owls were males. Also, home ranges of males are essentially non-overlapping and males that respond to calls are usually mated (Forsman et al. 1984). Thus, male responses per mile can be used as a crude index of density of pairs of spotted owls.

For additional information on methods used in the 1989 owl survey, see Appendix A.

2) Results

The 1989 surveys covered approximately 75,000 acres and recorded 125 spotted owls on or adjacent to Simpson property.

a) Survey Period and Area

The 1989 studies began with an owl survey that was conducted from May 31 to July 27. Follow-up work on survey responses began June 18 and continued through the end of August.

- Twenty-four transects totalling 129 linear miles were selected by Simpson's foresters to provide representative sampling of second-growth stands 30 years and older (Table 6). Approximately 53,357 acres were

TABLE 6
MILES SURVEYED, NUMBER OF MALE OWL RESPONSES PER MILE, AND DOMINANT VEGETATION OF TRANSECTS SURVEYED FOR OWLS ON SIMPSON TIMBERLANDS IN 1989 BY SUBAREA

Subarea/ Transect	Miles Surveyed	Male Responses	Responses Per Mile	Dominant Vegetation
Smith River				
Winchuck	6.0	0	0	RW/DF
Ravine Creek	4.5	1	0.22	RW/DF/TO
Dominie Creek	3.4	1	0.29	RW/DF/AL
Rowdy Creek	5.7	2	0.35	RW/DF/AL
Kings Valley	3.0	0	0	RW/DF
TOTAL:	22.6	4	0.18 (AVG)	
Klamath				
McGarvey Creek	5.0	2	0.40	RW/DF
NF AhPah Creek	5.5	1	0.18	RW/AL
SF AhPah Creek	6.3	0	0	RW/AL
B-1000	6.5	0	0	DF/TO
Pecwan	7.0	1	0.14	DF/TO
Tectah Creek	5.5	0	0	RW/DF/TO
Johnson Road	9.0	2	0.22	DF/TO/P
Hancorne/J100	7.0	0	0	DF/TO/P
Roach Creek	5.0	0	0	RW/DF/P
Williams Ridge	8.0	1	0.12	TO/DF/P
TOTAL:	64.8	7	0.11 (AVG)	
Korbel				
Ribar	2.2	2	0.91	RW/DF/AL
NF1000	4.5	4	0.89	RW/DF/TO
Cal Barrel	9.8	3	0.31	DF/TO
Bald Mountain	5.0	2	0.40	DF/TO
Wiregrass	2.5	3	1.20	DF/TO
Dolly Varden	4.5	2	0.44	RW/DF/TO
Roddiscraft/Powerline	4.0	2	0.50	DF/TO
Fortuna/Carlotta				
Gas Wells	5.4	2	0.37	RW/DF
Carlotta	3.8	2	0.53	RW/DF
TOTAL:	41.7	22	0.53 (AVG)	

TABLE 6
MILES SURVEYED, NUMBER OF MALE OWL RESPONSES PER MILE, AND DOMINANT VEGETATION OF TRANSECTS SURVEYED FOR OWLS ON SIMPSON TIMBERLANDS IN 1989 BY SUBAREA
(continued)

Subarea/ Transect	Miles Surveyed	Male Responses	Responses Per Mile	Dominant Vegetation
Upper Mad River*				
Boulder Creek	8.7	2	0.23	H
Graham Creek	9.0	1	0.11	H/DF
County Road	8.1	4	0.49	H/DF
Powerline	3.9	1	0.26	H/DF
E. County Road	18.9	2	0.11	H/DF
Wilson Creek	2.1	0	0	H/DF
Gravelly	4.2	0	0	H/DF
Coyote Creek	6.3	2	0.32	DF/H
Deer Creek	1.5	1	0.67	H/DF
TOTAL:	62.7	13	0.21 (AVG)	
University Hill*				
8-mile Loop	4.5	1	0.22	RF/DF/H
Pelletreau Loop	6.0	1	0.17	DF/H
TOTAL:	10.5	2	0.19 (AVG)	
STUDY TOTALS:	202.3	48	0.24 (AVG)	

*Areas not surveyed by Simpson biologists

RW = redwood
DF = Douglas-fir
AL = red alder
TO = tanoak
P = prairies
H = hardwood

sampled in four areas: Smith River, Klamath, Korbel/Mad River, and Fortuna.

- An additional 62.7 miles in Upper Mad River and 10.5 miles in University Hill were surveyed by biologists other than those hired by Simpson.

- Spot calling by Simpson biologists covered approximately 19,400 acres.

b) Night Survey Results

In the 1989 transect survey, 48 individual male owls responded in 202.3 miles surveyed, indicating an average rate of 0.24 responses per mile surveyed (see Table 6). Only 3 new individuals were found in the second run of transects.

Most responses were obtained in transects located around Korbel and Fortuna (0.53 responses/mile), followed by those in Upper Mad River (0.21 responses/mile), Smith River (0.18 responses/mile), University Hill (0.19 responses/mile), and Klamath (0.11 responses/mile). Although differences in the number of responses per mile existed among study areas, they were not statistically tested due to potential sampling biases resulting from differences in vegetation, topography, weather, season, auditory survey technique, and surveyor ability.

c) Combined Survey Results

The night surveys, follow-up site visits, and spot calling in the Smith River, Mad River, Klamath, Korbel, and Fortuna/Carlotta study areas recorded 125 individual northern spotted owls seen or heard on and adjacent to Simpson land (Table 7).

- Of the 125 owls found by Simpson biologists, 46 were individual males, 58 were mated (29 pairs), and 21 were owlets. In addition, two owlets were fledged from the Upper Mad River (area not surveyed by Simpson biologists), bringing the total number of owlets to 23.

- Ninety-three individual owls were located visually, and an additional 28 were located by auditory responses only. All mated pairs were visually located, with the male and female interacting or vocalizing within 100 yards of each other.

- The locations of 75 (72 percent) of the 104 adults (46 males and 29 pairs) were revisited in daytime surveys. Owls were found in 59 (79 percent) of the revisited locations.

- Twenty-one of 23 fledged owlets were actually seen, and two others were added as minimum reproductive output of two mated pairs located in August. Concentrations of whitewash (owl feces), regurgitated casts, and molted

TABLE 7
OWL SURVEY FOLLOW-UP AND REPRODUCTIVE STATUS OF ADULT AND SUBADULT OWLS AND NUMBER OF OWLETS FLEDGED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1989 BY SUBAREA

Subarea	No Follow-ups Males	No Follow-ups Pairs	Unsuccessful Follow-ups Males	Unsuccessful Follow-ups Pairs	Status Undetermined[1] Males	Status Undetermined[1] Pairs	Reproductive Pairs Pairs	Reproductive Pairs Owlets
Smith River	0	0	2	0	0	0	2	3
Klamath	6	1	4	0	2	0	2	4
Korbel	3	1	8	0	6	4	5	6
Mad River	5	4	1	0	5	2	4	4
Fortuna/ Carlotta	3	0	1	0	0	2	2	4
TOTAL[2]	17	6	16	0	13	8	15	21[3]

[1]Follow-up was successful in locating owl but reproductive status could not be determined.

[2]125 individual owls: 46 individual males
29 mated pairs (58 individuals)
21 owlets

[3]In addition, 2 owlets fledged from 2 pairs in the Upper Mad River (the area not surveyed by Simpson biologists), bringing the total number of owlets to 23.

juvenile plumage in areas where the two pairs were found indicated that each pair had successfully fledged at least one owlet.

d) Estimated Reproductive Success

Reproductive success of all known spotted owl pairs could not be estimated in 1989 because surveys were not initiated until May 31 and most follow-ups were done too late in the breeding season to be certain of the reproductive status of a pair.

However, 13 pairs were identified before August and moused at least once in follow-up visits; consequently, their reproductive status could be estimated. Of these, 11 (85 percent) fledged a minimum of 16 owlets, for a fledging success of 1.2 owlets per pair. This estimate, however, is probably biased because unsuccessful pairs tends to be less responsive to surveys and do not exhibit high site fidelity.

D. 1990 Survey and Nest Monitoring

1) Methods

The following methods were used in Simpson's 1990 owl survey and nest monitoring study to collect and analyze data regarding spotted owls on Simpson's property.

a) Spot Calling Survey

Throughout the spring and summer of 1990, selected areas of Simpson's property were surveyed by Simpson biologists for spotted owls using spot calling techniques. In addition to these surveys, individual THP areas throughout Simpson's ownership were surveyed for owls. The spot calling technique was selected over the transect protocol because it proved to be more effective and is now the recommended method endorsed by USFWS (USDI 1991).

b) Banding

To obtain better estimates of owl density, demographic information, and data on owl movements, spotted owls on or adjacent to Simpson property were banded under the auspices of federal and state permits (see Appendix A for additional information about the permits). When an owl was located, bait animals (laboratory rats or mice) were used to attract it within range to be captured with a noose pole or dip net. Once captured, the owl was banded with a USFWS band on one leg and a bicolored auxiliary leg band on the other. After body measurements were taken, the owl was immediately released. (See Appendix A for additional information about the procedures used.)

c) Density Estimate

Minimum absolute density was estimated by surveying large tracts and attempting to locate and band all owls within the areas. Spotted owls that responded to the survey probably had portions of their territories outside the survey area. Thus, density estimates calculated using only the area actually surveyed would potentially overestimate density. To compensate for this, one-half the mean nearest neighbor distance between known owl sites (activity center or nest site) was added to the periphery of the area surveyed. The areas surveyed to obtain absolute density estimates were selected to represent the entire range of cover types and stand conditions within Simpson's ownership.

d) Paired Status

Paired status was determined by observing a male and female in close proximity (<0.25 mile) in any of the following contexts: roosting, vocalizing, nesting, delivering prey, or tending young. An owl was judged to be single if it was observed on three or more occasions in the same general area without detecting an owl of the opposite sex.

e) Nest Locations

Most spotted owl nests were located by finding and mousing a roosting male or female. If a male began a series of directional flights, he was followed through the woods until he was seen giving the mouse to the female. The nest was located when the female returned to it to incubate.

f) Nest Success

Nest success was determined from owl pairs visited repeatedly from April 1 to May 18. Pairs were judged to be nesting if the female was observed incubating eggs or brooding young. A pair was considered successful if it fledged at least one owlet. Owls located after the nesting season were not used in evaluations of nesting success because pairs that did not nest could not be differentiated from pairs that attempted to nest but failed.

For additional information on the methods used in the 1990 owl survey and nest monitoring study, see Appendix A.

2) Results

The 1990 owl survey covered approximately 104,000 acres and recorded 218 spotted owls.

a) Survey Period and Area

The 1990 owl survey was conducted throughout the spring and summer within the six study areas, beginning in March and concluding in October. Over 104,000 acres of Simpson's ownership were surveyed, including portions of the areas not surveyed in 1989.

b) Spot Calling Results

The 1990 survey located a total of 218 owls on or adjacent to Simpson's land (Table 8). Of the total number of responding owls, 172 were adults and subadults and 154 were paired. Thirty-eight nesting pairs and 46 fledged owlets were identified. In addition, 24 non-nesting pairs and 15 pairs of unknown

TABLE 8
REPRODUCTIVE STATUS AND NUMBER OF ADULT AND SUBADULT OWLS AND NUMBER OF OWLETS FLEDGED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1990 BY SUBAREA

Subarea	Nesting Pairs	Non-nesting or Status Unknown Pairs	Status Unknown Males	Fledged Owlets
Klamath/Smith River	6	5	0	6
Korbel	12	14	10	16
Mad River	10	10	2	10
Upper Mad River	6	2	2	8
Fortuna/Carlotta	4	6	2	6
University Hill	0	2	2	0
TOTAL[1]	38	39[2]	18[3]	46

[1]218 individual owls
[2]24 non-nesting, 15 unknown status pairs
[3]2 single, 16 unknown status males

status were recorded. Two unpaired males and 16 males of unknown status also were identified.

c) Nesting Success

Between April 1 and May 18, 1990, 50 pairs were monitored and of these 32 (64 percent) attempted nesting (Table 9). Some of the 18 remaining pairs may have attempted nesting and experienced early failure but were not observed doing so; none of those 18 reached later stages of incubation.

- A minimum of 23 of the 32 known nesting pairs fledged a minimum of 36 owlets, resulting in 0.72 fledged owlets per total number of monitored pairs.
- After the nesting season, 6 more pairs with fledged owlets were located, and the total number of owlets observed increased to 46.
- In addition, 13 pairs were located after the breeding season but their reproductive status could not be determined.

d) Banding

As part of the 1990 study, 166 spotted owls were captured and banded, including 128 adults and subadults and 38 juveniles (Table 10). Of the adults and subadults, 68 were male and 60 were female; sex of the juveniles could not be determined. Sixty pairs were banded, including 16 pairs with at least one subadult owl. Of these 16 pairs, four attempted to nest and two successfully fledged at least one owlet.

e) Population Density Estimate

Results for only one thoroughly surveyed area (Mad River) were adequate to calculate a population density estimate. The area had 16 confirmed owl sites (7 nesting pairs, 8 non-nesting pairs, and 1 single male) on 18,476 acres (including a buffer strip of 0.38 mile--one-half the mean nearest neighbor distance). This converts to a crude minimum density of 1.1 territorial owls per square mile. This estimated density is notable because more than 50 percent of the Mad River area has been clear-cut since 1979.

In a larger area (60,000 acres) that includes Mad River and Korbel, 54 owl sites were found (17 nesting pairs, 22 non-nesting/status unknown pairs, and 15 single/status unknown males). This converts to a density estimate of 0.99 territorial owl per square mile. This estimate is based on surveys that covered only 75 percent of the area.

TABLE 9
REPRODUCTIVE SUCCESS OF 50 OWL PAIRS MONITORED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1990

Number of pairs monitored:	50
Number of pairs observed nesting:	32
Number of successful nesting pairs:*	23
Number of fledged owlets:	36
Number of owlets per pairs monitored:	0.72

*Fledged at least one owlet.

TABLE 10
NUMBER, AGE, AND SEX OF OWLS BANDED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1990

Sex	Adults	Subadults	Juveniles	Total
Males	58	10	0	68
Females	49	11	0	60
Unknown	0	0	38	38
TOTAL	107	21	38	166

f) Comparison with 1989 Survey Results

Although not all methods used and areas surveyed in 1990 were comparable to those in 1989, some comparisons of survey results are possible.

- A comparison of 7 sites surveyed in Korbel/Mad River in both 1989 and 1990 suggests a population increase in the area, with a net gain of 9 birds (Table 11).

- Of 10 "new" birds entering Korbel/Mad River area, 4 were subadults.

- A comparison of 19 nest sites monitored in both 1989 and 1990 indicates a decline in fledging success (Table 12). Nine pairs showed a net decrease in the number of fledged owlets, 3 showed a net increase, and 7 showed no change. Overall, the 19 pairs fledged 8 fewer owlets in 1990 than in 1989.

TABLE 11
COMPARISON OF 1989 AND 1990 OWL OCCUPANCY
IN SITES ON SIMPSON TIMBERLANDS
BY SUBAREA

Subarea/Owl Site	1989 Occupancy	1990 Occupancy	Change
Korbel			
Mule Creek	0	2	+2
SF Bald Mt Creek	1	2	+1
Jiggs Creek	2	1	-1
Old 299 #1	1	2	+1
Old 299 #2	0	2	+2
Mad River			
4851	0	2	+2
Upper Mad River			
Little Deer Creek	0	2	+2
TOTAL	4	13	+9

TABLE 12
COMPARISON OF FLEDGING SUCCESS OF OWL SITES MONITORED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1989 AND 1990 BY SUBAREA

Subarea/Owl Site	Number Fledged 1989	Number Fledged 1990	Change
Smith River			
Dominie Creek	2	0	-2
Klamath			
Klamath Mill	2	0	-2
Williams Ridge	2	0	-2
Korbel			
Redwood Creek	1	0	-1
NF 1300	1	1	0
Jiggs Creek	1	0	-1
Cal Barrel	0	2	+2
Roddiscraft/Powerline	1	0	-1
Ribar Rock Pit	0	0	0
Upper Ribar	0	0	0
Mad River			
Simpson Creek	1	0	-1
Canyon Creek	2	1	-1
Devil's Creek	1	2	+1
4230 #2	1	0	-1
Upper Mad River			
Humbug Creek	1	2	+1
Bug Creek	1	1	0
Coyote Creek	0	0	0
Fortuna/Carlotta			
Walsh	2	2	0
Carlotta	2	2	0
TOTAL	21	13	-8

E. 1989-1990 Food Habit Study

1) Methods

In both 1989 and 1990, regurgitated owl pellets were collected at known spotted owl roost or nest sites to obtain data on prey taken by owls. A total of 196 collections were made, 33 in 1989 and 163 in 1990. Laboratory and statistical analyses of the collections were then conducted.

The pooled collections were analyzed in the laboratory for skeletal and other remains such as scales, feathers, and invertebrate exoskeletons. Because owls may pick at large prey (e.g., brush rabbits) and not swallow them whole, bones of large prey may not appear in pellets. To preclude under-representation of such prey in the study, owl casts also were analyzed for hairs and other remains. All remains found in the casts were identified to the closest taxon possible.

Statistical analyses were conducted to determine whether regional differences existed among prey species taken by spotted owls (see Appendix A for a description of the analysis of food habit data).

For additional information on the methods used in the 1990 food habit study, see Appendix A.

2) Results

Dietary analysis of the 196 pellet collections indicates that woodrats comprise the largest share of owl diets in terms of both frequency (46.5 percent) and biomass (69.8 percent) (Table 13).

Within the study areas, woodrats constituted 36 to 51 percent of the prey species frequency and 56 to 74 percent of the biomass (Table 14). Significant statistical differences in the distribution of prey species taken were found to exist among study areas.

- Woodrats and one other primary prey species accounted for approximately 80 percent of owl diet biomass in all areas.
- Woodrats and brush rabbits accounted for most of the biomass in the Korbel, Mad River, and Fortuna/Carlotta study areas and for all areas combined.

TABLE 13
NUMBER AND PERCENT FREQUENCY AND BIOMASS
OF PREY SPECIES FOUND IN 196 COLLECTIONS
OF REGURGITATED OWL PELLETS IN 1989 AND 1990

Prey Species	Frequency #	Frequency %	Biomass[1] grams	Biomass[1] %
Neotoma fuscipes (dusky-footed woodrat)	332	46.5	89,308	69.8
Sylvilagus bachmani (brush rabbit)	34	4.8	17,000	13.3
Glaucomys sabrinus (northern flying squirrel)	72	10.1	7,848	6.1
Arborimus longicaudus (red tree vole)	72	10.1	1,656	1.3
Sciurus griseus (western grey squirrel)	2	0.3	1,360	1.1
Thomomys bottae (valley pocket gopher)	21	2.9	1,155	0.9
Microtus spp. (vole species)	29	4.1	1,087	0.9
Peromyscus spp. (mouse species)	41	5.7	820	0.6
Columba fasciata (band-tailed pigeon)	8	1.1	2,720	2.1
Cyanositta stelleri (Steller's jay)	8	1.1	592	0.5
Misc. mammals[2]	38	5.3	1,347	1.1
Misc. birds[3]	32	4.5	2,576	2.0
Misc. species[4]	25	3.5	439	0.3
TOTAL	714	100.0	127,908	100.0

[1]Biomass data obtained from unpublished data, U.S. Forest Service Redwood Sciences Laboratory, Arcata, CA.
[2]Includes California red-backed voles, shrews, shrew moles, moles, long-tailed weasel, and unknown species.
[3]Includes hairy woodpecker, western pygmy owl, red-breasted sapsucker, varied thrush, and unidentified species.
[4]Includes unidentified snakes, amphibians, chub, insects, spiders, beetles, moth or butterfly larva, grasshoppers, and crickets.

TABLE 14
PERCENT FREQUENCY AND BIOMASS OF PRIMARY PREY SPECIES FOUND IN 196 COLLECTIONS OF REGURGITATED SPOTTED OWL PELLETS IN 1989 AND 1990

Subarea/ Number of Pellet Collections	Woodrat		Brush Rabbit		Flying Squirrel		Tree Vole	
	F	B*	F	B*	F	B*	F	B*
Smith River N=7	36	60	0	0	57	39	7	1
Klamath N=14	45	71	2	6	15	10	15	2
Korbel N=53	51	73	4	10	11	6	10	1
Mad River N=65	45	71	5	16	10	6	10	1
Upper Mad River N=24	41	74	2	5	7	5	11	2
Fortuna/Carlotta N=22	45	56	12	28	5	2	5	<1
ALL AREAS N=196**	46	70	5	13	10	6	10	1

F = Frequency
B = Biomass

*Biomass data obtained from unpublished data, U.S. Forest Service Redwood Sciences Laboratory, Arcata, CA.
**In addition to the collections from study areas, 11 collections were made in outlying areas.

- In Fortuna/Carlotta, brush rabbits were relatively more important and woodrats relatively less important in owl diets than in other subareas.

- Woodrats and flying squirrels accounted for most of the biomass in Klamath. 1989/1990 trends suggest the same is true for Smith River; however, the sample size for Smith River is too small to be included in a statistical analysis.

- Flying squirrels and brush rabbits were equally represented in terms of biomass in owl diets in Upper Mad River.

F. 1990 Nest Site Study

1) Objectives

The 1990 nest site study was designed to achieve the following objectives:

a. Describe the habitat characteristics of nest sites and stands;

b. Describe the mosaic of habitat surrounding owl nest sites to assess the importance of landscape features to nesting locations; and

c. Determine the reproductive success of pairs and relate success to habitat characteristics.

2) Methods

Methods used in the nest site study are as follows.

a) Nest Structures

After the young fledged, nest trees were climbed by tree spurring or using mechanical ascenders on a climbing rope to ascertain the type of nest used and take various measurements. The origin of old mammal nests was determined by examining nest material or old feces found in the original nest material. Broken top, cavity, and platform nests were differentiated, and broken top nests were categorized by the relative degree of protection provided. These included broken top platforms that were at the top of trees and were exposed on all sides and from above, lateral platforms that were exposed on one side and from above, and broken top chimneys that were exposed only from above and had a slit-like opening on one side.

b) Nest Trees

Percent canopy coverage directly above the nest, diameter of the tree at nest height, and the distance from the center of the nest to the bole were measured. If the nest was a broken top, secondary crowns extending at least 1.7 feet above the nest were counted. Nest trees were identified to species and were measured for height, nest height, and diameter at breast height.

c) Nest Sites

Twenty-two habitat variables were measured within each nest site (see Appendix A). The nest site was defined by a 0.18-acre circular plot (radius equals 50 feet) centered on the nest tree and represented the nesting micro-habitat within the nest stand. Nest sites were plotted on aerial photographs (1 inch equals 1000 feet) to determine closest distance to edge (transition from one cover type to another), water, forest opening ≥1.25 acres, and known pair of spotted owls. Characteristics of nest sites were statistically compared to those of random, non-nest sites within nest stands.

d) Nest Stands

Nest sites on aerial photographs also were used to define the forest stands in which pairs of owls nested. From the photos, nest stands were defined as the extent of the homogeneous cover type up to a 0.5-mile radius from the nest site.

Within the defined nest stands, four to five randomly located sampling points were established to measure habitat variables to statistically compare to those of nest sites. Sampling consisted of fixed and variable radius plots, the centers of which were the randomly located points. Variable radius plots were used to maximize sampling efficiency and were applied to trees and snags. Fixed radius plots were 0.05-acre circular plots (radius = 26.4 feet) used to measure small trees, shrubs, logs, and ground cover. As an index of relative prey density, all woodrat middens in the plot were counted.

e) Habitat Mosaic Analysis

In addition to the general stand characteristics, the mosaic of habitat around the 30 nest sites was analyzed. The nest sites were plotted on aerial photos and used as centers for 0.5-mile radius (502 acres) circles drawn on photographs. The 500-acre circle size was chosen on the basis of work done by Meyer et al. (1990), who tested circles of various sizes in western Oregon and suggested that site selection by spotted owls is most strongly affected by habitat within an inner core of ≤500 acres.

Acreage of circles covered by different age-classes or cover types was determined by using a dot grid. A map wheel was used to determine linear measurements such as edge.

Stand ages were grouped in terms of their potential use by owls as suggested by preliminary data. Stands 0 to 7 years were considered to have no direct value as owl habitat (a preliminary survey indicated that woodrats were consistently present only in clear-cuts over seven years). Stands 8 to 31 years included woodrats and thus were potential foraging areas. Ages of nest stands were used to define the two oldest age-class categories. Age-class 31 to 45 encompassed potential foraging, roosting, and occasional nesting habitat. The 46+ category represented prime nesting, roosting, and also foraging habitat; based on the nest study results, stands at least 46 years old were suitable nesting habitat regardless of their silvicultural history. Other physical features and any known silvicultural history of the stands also were noted.

Thirty non-nest sites were randomly chosen to compare with nest sites. Some random sites included areas where non-nesting owls had been located.

f) Statistical Analyses

Statistical analyses were conducted to determine whether nest types influence reproductive success and whether significant differences existed between (1) nest site microhabitat and random site microhabitat in the same stand; (2) nest sites of reproductively successful and unsuccessful pairs; and (3) stand mosaics that contained owl nests and those that did not.

For additional information on the methods used in the 1990 nest site study, see Appendix A.

3) Results

Selected nest site statistics were collected and analyzed for 30 nests found between April 1 and May 18, 1990. Five of the nests were in the Klamath study area, nine in Korbel, eight in Mad River, five in Upper Mad River, and three in Fortuna/Carlotta.

a) Nest Structures

The 30 nests were categorized into 7 structure types and grouped as "exposed" or "protected" based on the amount of relative protection they provided (Table 15). Thirteen (43 percent) of the 30 sites were old mammal nests; two were old raptor nests; and one was simply classified as a debris platform formed from twigs and leaves that collected in a deformity in the nest tree.

Statistical analysis of the type of nest used indicated no significant difference in the reproductive success of pairs using exposed or protected nests.

b) Nest Trees and Sites

Data collected for the 30 nests show that 87 percent of the nest trees were conifers and 13 percent were hardwoods; two-thirds of the nest trees were either redwood or Douglas-fir (Table 16). Four of the nests were located in snags.

TABLE 15
SPOTTED OWL NEST TYPES

Category/Type	Number	Percent	Successful Pairs* Number	Successful Pairs* Percent
Exposed				
Small mammal nest	13	43.3	8	67*
Raptor nest	2	6.7	2	100
Debris platform	1	3.3	0	0
Broken top platform	2	6.7	2	100
Total	18	60.0	12	71**
Protected				
Lateral platform	4	13.3	4	100
Broken top chimney	4	13.3	4	100
Cavity	4	13.3	1	25
Total	12	39.9	9	75
TOTAL NESTS	30	100.0	21	72**

*Fledged at least one owlet.
**Reproductive status of one pair unknown.

TABLE 16
SPECIES OF SPOTTED OWL NEST TREES

Category/Type	Number	Percent	Successful Pairs* Number	Successful Pairs* Percent
Redwood *(Sequoia sempervirens)*	10	33.3	7	70
Douglas-fir *(Pseudotsuga menziesii)*	10	33.3	8	80
Grand fir *(Abies grandis)*	3	10.0	2	67
Western red cedar *(Thuja plicata)*	3	10.0	2	67
Hardwoods**	4	13.3	2	67***
TOTAL	30	100.0	21	72***

*Fledged at least one owlet.
**Includes tanoak, madrone, and California bay.
***Reproductive status of one pair unknown.

Characteristics of nest trees were variable (Table 17). Diameters ranged from 21 to 109 inches dbh, and height ranged from 36 to 219 feet. Average percent canopy cover at nest sites ranged between 52 and 99 percent but on average was high (91.5 percent).

c) Nest Stands

The 30 nests were located in four forest cover types, each of which included a hardwood component: redwood with a hardwood component (RW/HW), Douglas-fir with a hardwood component (DF/HW), predominantly hardwoods with conifers present (HW/CON), and a mixture of redwood, Douglas-fir and hardwoods (RW/DF/HW). Common hardwood species included tanoak, red alder, madrone, and California bay. Some of the DF/HW cover types contained a significant amount of other conifers such as grand fir, western hemlock, and western red cedar. The respective number of nests in each cover type were: 5 in RW/HW, 9 in DF/HW, 7 in HW/CON, and 9 in RW/DF/HW.

Nest stand sizes varied widely, ranging from 12 to 296 acres and with a mean of 75.8 acres. Twelve of the nests occurred in even-aged second-growth stands (Table 18). Fifteen of the nests occurred in second-growth stands with a residual of older trees that were left from previous harvests and in many cases were hardwoods. Four of these 15 stands are in areas that were selectively logged to varying degrees between the late 1950s and early 1970s. Most of these stands contain a significant and in some cases dominant hardwood component; densities of residual large old-growth Douglas-fir vary from one per acre to approximately five per acre. The remaining three nests were in small patches (25 to 56 acres) of old growth surrounded by younger forest.

With respect to the nest stands with remnant older trees, it should be emphasized that these stands are not necessarily equivalent to the stands with residual old growth" discussed in Section 1.D of this HCP. The category used in Section 1.D is taken from Simpson's forest inventory and refers to stands in which 10 to 30 percent of the timber is old growth and which often are characterized as a mixture of brush and residual trees. Only about 3 percent (less than 10,000 acres) of Simpson's ownership fits the forest inventory category. The characterization of stands in the nest site study is part of a biological evaluation of habitat.

Statistical analysis of the results of the nest and habitat studies indicates that the nest sites of 21 successful and 8 unsuccessful pairs differed in six variables regarding the hardwood component. Nest sites of successful pairs had higher densities and basal areas of hardwood trees 5 inches to 20 inches dbh than unsuccessful pairs (Table 19). Total hardwood density and basal area at nest sites also were higher for successful pairs. Corresponding basal area and density variables were highly correlated.

TABLE 17
SELECTED SPOTTED OWL NEST TREE AND NEST SITE VARIABLES

Variable	Mean	Standard Deviation	Median	Range
Nest tree dbh (")	47.1	19.5	45.1	21-109
Nest tree height (ft)	122.1	45.3	121.5	36-219
Average canopy cover (%)	91.5	8.5	93.5	52-99
Nest height (ft)	64.2	24.9	58.5	36-126
Diameter at nest (") (N=29)	28.1	12.4	29.1	7-64

TABLE 18
DISTRIBUTION OF 30 SPOTTED OWL NEST STANDS BY AGE-CLASS AND SILVICULTURAL HISTORY

Age-Class (years)	Nests Stands in Second Growth	Nest Stands in Old Growth	Total
31-45	7	0	7
46-60	9	0	9
61-80	7	0	7
81-200	4*	0	4
>200	0	3	3
TOTAL	27	3	30

*These nest sites are located in areas that were selectively logged, to varying degrees, between the late 1950s and early 1970s. Densities of residual large old-growth Douglas-fir vary from one per acre to approximately five per acre. Most of these stands contain a significant, and in some cases dominant, hardwood component.

TABLE 19
NEST SITE VARIABLES THAT DIFFERED SIGNIFICANTLY BETWEEN SUCCESSFUL AND UNSUCCESSFUL PAIRS OF SPOTTED OWLS

Variable	21 Successful Pairs		8 Unsuccessful Pairs		P
	Mean	(SD)	Mean	(SD)	
Basal area (ft^2/ac) hardwoods 5.2-10.9"	20.7	(16.7)	6.3	(6.3)	0.019
Basal area (ft^2/ac) hardwoods 11-20.9"	35.1	(27.0)	14.4	(31.0)	0.022
Total basal area (ft^2/ac) hardwoods	68.4	(46.8)	41.4	(85.5)	0.028
Number of hardwoods 5.2-10.9"	57.6	(48.2)	20.8	(20.5)	0.038
Number of hardwoods 11-20.9"	29.4	(25.4)	10.0	(21.8)	0.021
Total number of hardwoods	90.3	(67.4)	33.7	(43.9)	0.019

SD = Standard Deviation
P = Probability of rejecting the null hypothesis when it is true.

A preliminary comparison with 143 random sites within nest stands also indicates that the 30 nest sites differ significantly in 3 of 12 habitat variables (Table 20). Mean basal area of large conifers was greater while mean basal area of small hardwoods and mean canopy closure were less at nest sites. Means of all other tree size classes were not significantly different. Preliminary analysis of the 12 variables using principal component analysis (PCA) revealed that nest sites were situated within a smaller subset of available habitat structure of the forest stand containing the nest.

d) Nesting Mosaic Analysis

Because of small sample sizes, habitat mosaic variables by study area (Table 21) were not statistically analyzed for differences among subareas. Four variables were significantly different between random-site and nest-based circles (Table 22). The mosaic within nest-based circles had more edge area, more habitat patches, smaller maximum patch sizes, and more types of habitat than that in random-site circles.

TABLE 20
HABITAT VARIABLES
OF 143 RANDOM SITES AND 30 SPOTTED OWL NEST SITES

Variable	Nest Site	(SD)	Random Site	(SD)	P
Conifer basal area 5.2-10.9" dbh (ft^2/ac)	10.7	(11.1)	11.0	(26.7)	0.952
Conifer basal area 11-20.9" dbh (ft^2/ac)	34.9	(49.3)	46.1	(56.0)	0.310
Conifer basal area 21-36" dbh (ft^2/ac)	77.0	(82.4)	62.3	(69.5)	0.308
Conifer basal area >36" dbh (ft^2/ac)	**98.2**	**(114.0)**	**25.7**	**(37.3)**	**0.002**
Density of conifer saplings (#/ac)	83.6	(87.6)	85.5	(171.3)	0.930
Hardwood basal area 5.2-10.9" dbh (ft^2/ac)	**17.7**	**(16.6)**	**30.9**	**(41.1)**	**0.005**
Hardwood basal area 11-20.9" dbh (ft^2/ac)	31.5	(31.0)	25.4	(34.0)	0.372
Hardwood basal area >21.6" dbh (ft^2/ac)	21.5	(45.6)	12.6	(29.4)	0.177
Density of hardwood saplings (#/ac)	205.3	(225.2)	152.5	(215.8)	0.228
Percent canopy closure*	**74.2**	**(6.9)**	**78.1**	**(6.6)**	**0.004**
Percent slope	42.4	(19.4)	44.3	(23.2)	0.683
Log volume (ft^3/ac)	3181.0	(3622.1)	2358.6	(4054.3)	0.305

SD = Standard Deviation
P = Probability of rejecting the null hypothesis when it is true.
* = Percent canopy closure was subjected to arcsine transformation.

NOTE: Bold type indicates variables showing significant difference between nest sites and random sites.

TABLE 21
MEAN AREA COVERED BY SELECTED AGE-CLASS, COVER TYPE, AND OTHER MOSAIC VARIABLES WITHIN 502-ACRE CIRCLES CENTERED ON 30 SPOTTED OWL NEST SITES

	Fortuna (N=3)	Klamath (N=5)	Korbel (N=9)	Mad River (N=8)	Upper Mad River (N=5)
Age-Class					
0-7 years (ac)	37.7	34.2	46.0	149.0	0
8-30 years (ac)	1.3	173.4	60.0	23.0	41.2
31-45 years (ac)	154.0	117.2	96.7	51.4	96.4
> 46 years (ac)	306.0	118.6	280.3	215.4	259.0
Total Habitat*(ac)	461.3	409.2	437.0	289.8	396.6
Cover Types					
Open (ac)	3.0	58.6	19.0	63.2	105.4
New regrowth (ac)	37.7	34.2	46.0	149.0	0
DF/HW (ac)	0	146.4	126.0	87.1	253.8
HW/CON (ac)	11.0	118.0	163.8	42.8	142.8
RW/DF/HW (ac)	69.0	144.8	115.1	126.3	0
RW/HW (ac)	381.3	0	32.1	33.6	0
Other Variables					
# of cover types	3.7	3.4	3.9	4.6	2.6
# of patches	8.0	9.8	11.0	13.3	10.6
Min. patch size (ac)	3.7	4.8	6.0	3.0	4.8
Max. patch size (ac)	313.7	238.4	1923.0	148.9	260.2
Edge (ft)	19200.0	25080.0	30610.0	34850.0	31420.0
Sharp edge (ft)	5500.0	8751.0	11980.0	23960.0	23300.0
Roads (ft)	13430.0	15400.0	11740.0	20610.0	7900.0

*Total habitat is defined as stands age 8 or older; it excludes open, non-forested areas and trees under 8 years.

DF/HW = Douglas-fir with a hardwood component
HW/CON = Predominantly hardwoods with conifers present
RW/DF/HW = Mix of redwood, Douglas-fir, and hardwoods
RW/HW = Redwood with a hardwood component

TABLE 22
MEANS AND STANDARD DEVIATIONS
OF AGE-CLASS, COVER TYPE, AND OTHER MOSAIC VARIABLES
WITHIN 502-ACRE CIRCLES CENTERED ON
30 SPOTTED OWL NEST SITES AND 30 RANDOM PLOTS

Variable	Nest Mosaics Mean	Nest Mosaics (SD)	Random Mosaics Mean	Random Mosaics (SD)	P
Edge (mi)	**5.68**	**(1.75)**	**4.24**	**(1.59)**	**0.001***
Patches (#)	**11.00**	**(4.00)**	**6.87**	**(2.89)**	**0.000***
Min. patch size (ac)	4.57	(2.84)	21.17	(41.73)**	0.104
Max. patch size (ac)	**214.43**	**(99.43)**	**270.17**	**(87.91)**	**0.025***
Habitat types (#)	**3.77**	**(1.10)**	**2.87**	**(1.01)**	**0.002***
0-7 years (ac)	63.00	(77.45)	54.13	(90.82)	0.686
8-30 years (ac)	60.03	(81.89)	103.0	(145.96)**	0.849
31-45 years (ac)	93.7	(138.3)	67.10	(112.24)	0.417
46-60 years (ac)	105.67	(143.74)	118.13	(162.77)	0.754
61-80 years (ac)	68.80	(92.18)	50.33	(93.38)	0.444
81-200 years (ac)	47.27	(90.81)	46.2	(100.53)	0.966
>200 years (ac)	13.33	(32.54)	5.03	(15.89)**	0.293
Total 46+ years (ac)	235.07	(135.56)	219.70	(178.34)	0.278
RW/HW (ac)	56.73	(124.37)	27.57	(96.53)**	0.156
RW/DF/HW (ac)	99.23	(133.45)	167.23	(196.12)**	0.466
DF/HW (ac)	127.73	(149.75)	98.13	(138.29)	0.430
HW/CON (ac)	105.10	(127.43)	96.87	(141.29)	0.813
Total habitat (ac)***	388.80	(82.52)	389.80	(126.55)**	0.277
Clear-cut (ac)	63.00	(77.45)	54.13	(90.82)	0.686
Open (ac)	50.20	(46.77)	58.07	(83.77)**	0.497
Sharp edge (mi)	3.11	(1.90)	2.43	(1.83)	0.165
Road (mi)	2.69	(1.43)	2.89	(1.82)	0.683

SD = Standard Deviation
* $P \leq 0.05$
** Nonparametric (Mann-Whitney U) test
*** Total habitat is defined as stands age 8 or older and excludes open, non-forested areas and trees under 8 years.

DF/HW = Douglas-fir with a hardwood component
HW/CON = Predominantly hardwoods with conifers present
RW/DF/HW = Mix of redwood, Douglas-fir, and hardwoods
RW/HW = Redwood with a hardwood component

NOTE: Bold type indicates variables showing significant difference between nest mosaics and random mosaics.

G. 1991 Surveys and Studies

In the spring of 1991, Simpson continued and expanded its spot calling surveys, banding program, and nest site study. Methods and protocols used in the 1991 effort were identical to those used in 1990 (see Chapter 2.D and Appendix A). Survey results reported here reflect data collected as of June 30, 1991. Banding totals, data analysis, and nest site study results reflect information collected in the plan area as of October 24, 1991.

1) Preliminary Results of 1991 Survey

As of June 30, 1991, the spot calling survey identified 261 adult and subadult spotted owls on or adjacent to Simpson's property (Table 23). These owls include 50 nesting pairs, 44 non-nesting pairs, 21 pairs of unknown status, 27 males of unknown status, and 4 females of unknown status. A comparison of 12 owl pairs observed nesting on Simpson's property in both 1990 and 1991 revealed that only 5 (40 percent) used the same nest tree in both years.

It should be noted that the 1991 survey covered areas in the northern portion of the property previously not covered by spot calling surveys. Records to date indicate that there are at least 51 owl sites (78 individual owls) in the Klamath area, which is approximately 30 percent of the total number observed in the plan area. Twenty-three of the 51 sites are "unconfirmed," which means that an owl was recorded at the site but the status of the location as a nesting or primary activity site had not yet been confirmed.

2) Total Area Surveyed to Date

Since 1989, over 200,000 acres on or adjacent to Simpson's ownership have been surveyed for spotted owls (Figure 7 and Table 24). Survey areas for different years overlap, with that in 1991 covering the most acreage. The 1991 survey also is significant because it covered areas in the northern portion of Simpson's property that previously had not been surveyed. It should be noted, however, that the northern property has not been surveyed as extensively as the southern property. The THP surveys conducted in 1990 and 1991 covered about 90,000 acres. This total is significant because the surveys cover areas where harvesting is being planned for the near future.

TABLE 23
REPRODUCTIVE STATUS OF SPOTTED OWLS FOUND ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1991 BY SUBAREA

Subarea	Total Number of Pairs	Number of Nesting Pairs	Number of Non-Nesting Pairs	Number of Unknown Status Pairs	Number of Unknown Status Males	Number of Unknown Status Females
Smith River/ Klamath	27	6	6	15	20	4
Korbel	33	15	17	1	3	0
Mad River	23	7	13	3	2	0
Upper Mad River	17	13	2	2	2	0
Fortuna/ Carlotta	15	9	6	0	0	0
TOTAL*	115	50	44	21	27	4

*261 adult and subadult spotted owls

TABLE 24
ACRES COVERED BY SIMPSON'S 1989, 1990, AND 1991
SPOTTED OWL SURVEYS BY TYPE OF SURVEY

	Acres
1989 Transect Protocol Survey	53,357
1989 Spot Call Survey	19,357
1990 Spot Call Survey	104,079
1991 Spot Call Survey	116,694
1990-91 THP Surveys by Simpson Redwood	45,039
1990-91 THP Surveys by Arcata Redwood	45,397

THP = Timber Harvesting Plan

Figure 7

color oversize

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3) Location and Status of Owl Sites

Based on the best available information as of June 30, 1991, Simpson estimates that there are at least 146 owl sites on or within less than one mile of its property (Figure 8 and Table 25). Of the 146, 112 (or 75 percent) were known to be on Simpson property in 1991.

To ensure that the HCP considers the presence of other spotted owls adjacent to but not in the plan area, Simpson also requested information about the location and status of owls from federal agencies, state agencies, and neighboring private landowners. To date, detailed information has been provided by CDFG on owl occurrence in Del Norte and Humboldt counties and by the Forest Service for Siskiyou National Forest.

- CDFG records for Del Norte and northern Humboldt counties indicate that 377 owl sites were reported as of April 1991, including 73 on Simpson property (Appendix B). Numbers reported per individual township range from 0 to 20. Recent discussions with CDFG staff indicate that many additional owl sites have been reported since April, and a revised total will be included in this document when it becomes available.

- Forest Service records for Siskiyou National Forest, including lands in Oregon, indicate the presence of 30 owl sites in areas adjacent to or near Simpson's property (see Appendix B). All but one are in townships in Oregon.

- Simpson's own surveys indicate at least 34 owl sites within less than one mile of Simpson's property (see Table 25). These sites may or may not be included in the CDFG records.

4) Owl Density and Landscape Analysis

The distribution of spotted owls on a landscape level was estimated by plotting the owl sites located in 1991 on or adjacent to Simpson property on a map that also outlined thoroughly surveyed areas and then drawing a one-mile radius circle around each site to represent the area likely to be used by owls (Figure 9). Although a one-mile radius (approximately 2,000 acres) is less than most home range estimates for spotted owl pairs (see Section 2.B.1.f), the overlap of the plotted circles indicates that it is not an unreasonable measure of owl use in the plan area. Many of the plotted circles overlap five or more other circles, and some individual circles contain five to six owl sites (see Figure 9). Larger circles based on accepted home range estimates would encompass virtually all of the thoroughly surveyed area without adequately distinguishing areas used by owls from those not used by owls.

Based on the number of owl sites detected within the thoroughly surveyed area (approximately 220,000 acres), two regions were defined and owl density estimates were calculated for each: a northern area of low owl density (0.32 owl/mi^2) and a southern area of high owl density (1.2 owls/mi^2). Overall owl density within the surveyed area was calculated as 0.65 owl/mi^2. Within the two regions, blocks (not linear segments) of forested areas greater than 2,000 acres and not intersecting with an owl site were identified as areas not likely used by owls. In this way, three distinct categories were identified for additional analysis: (1) areas with a high density of owl use, (2) areas with a low density of owls, and (3) areas with no owls (Figure 10).

For each of the three categories, age-class and cover type data were then compiled for areas on Simpson's ownership (Table 26). (Approximately 188,000 or 85 percent of the 220,000 acres surveyed are on Simpson property.) These data indicate that areas of high owl density have over twice the amount of stands in age-class 46+ than areas of low owl density. The bulk (70 percent) of non-owl areas are stands in the 8-30 age-class that have been harvested in the past 30 years. The data also indicate that, within the 188,000-acre area, only 7.4 percent of the acreage in age-class 46+ is not within one mile of an owl site and consequently considered not used by owls.

5) Data Collection and Analysis

As of October 24, 1991, 358 spotted owls have been banded on or adjacent to Simpson property: 204 adults, 52 subadults, and 102 juveniles (Table 27). Of 256 adult and subadult birds banded, 204 (80 percent) were adults and 52 (20 percent) were subadults.

All owl sites confirmed in 1990 were checked again in 1991 to determine site occupancy. A site was considered occupied if the same owl(s) were present or new owl(s) were occupying the same roost and/or nest site. Seventy-seven of 79 sites (97.5 percent) located in 1990 were occupied in 1991, but the total number of owl sites actually increased because four new sites were located in 1991 that did not exist in 1990 (Table 28). (Many other new sites were located in 1991, but were in areas not surveyed in 1990.)

Eight newly occupied sites have been identified in the plan area since 1989. ("Newly occupied" refers to sites found in thoroughly surveyed areas never known to be occupied but found to be occupied in a subsequent survey year.) Four of the sites were established between 1989 and 1990, and four were established between 1990 and 1991. Six of the eight sites were occupied by a pair that included at least one subadult. Also, six of eight of the sites were in some of

Figure 8

oversize

(count as 2 pages)

TABLE 25
LOCATION STATUS OF CONFIRMED AND UNCONFIRMED SPOTTED OWL SITES ON OR ADJACENT TO SIMPSON TIMBERLANDS AS OF JUNE 30, 1991

Subarea Spotted Owl Site	Location Status	Adjacent Ownership
Smith River (N=1)		
Dominie Creek	ON	
Klamath (N=27*)		
B-10	ON	
B922	ON	
H131	ON	
T300	ON	
Arrow Mills		
Blue Creek Cabin	ON	
Cappell Creek	ON	
Goose Creek 1	ON	
Hunter Creek	ON	
Klamath Mill	ON	
Williams Ridge	ON	
Wilson Creek	ON	
Upper Tully Creek	ON	
Arco Male 1	UNC	
Arco Male 2	UNC	
Arco Male 3	UNC	
Arco Male 4	UNC	
Arco Male 5	UNC	
Arco Male 6	UNC	
Arco Male 7	UNC	
Arco Pair 1	UNC	
Arco Pair 2	UNC	
Goose Creek 2	UNC	
Goose Creek 3	UNC	
Klamath Bar	UNC	
NF Ah Pah Creek	UNC	
Pecwan Ridge	ADJ	Bureau of Indian Affairs

TABLE 25
LOCATION STATUS OF CONFIRMED AND UNCONFIRMED SPOTTED OWL SITES ON OR ADJACENT TO SIMPSON TIMBERLANDS AS OF JUNE 30, 1991
(continued)

Subarea Spotted Owl Site	Location Status	Adjacent Ownership
Korbel (N=36)		
L-2000	ON	
NF 1300	ON	
Bald Mt. Creek	ON	
Cal Barrel	ON	
Camp Bauer	ON	
Canyon Creek #1	ON	
Denman Creek	ON	
Fernwood	ON	
Jiggs Creek	ON	
Liscom Hill	ON	
Lupton Creek #1	ON	
Lupton Creek #3	ON	
Mule Creek	ON	
Old 299 #1	ON	
Old 229 #2	ON	
Old 299-Pine Creek	ON	
Pollock Creek	ON	
Pollock Creek #2	ON	
Ribar Rock Pit	ON	
SF Bald Mt. Creek	ON	
Upper Poverty Creek	ON	
Upper Ribar #1	ON	
Aldo Dusi	ADJ	small private
Canyon Creek #2	ADJ	small private
Kermit	ADJ	Sierra Pacific
Lake Prairie #1	ADJ	Sierra Pacific
Lake Prairie/Franklin	ADJ	Sierra Pacific
Lupton Creek #2	ADJ	small private
Negro Joe Creek	ADJ	small private
Pardee	ADJ	Sierra Pacific
Redwood Creek	ADJ	Barnum Timber
Rice/Windy Creek	ADJ	small private
Roddiscraft/Powerline	ADJ	Sierra Pacific
Tilley Slide	ADJ	small private
Tilley/Windy Creek	ADJ	small private
M-1150	UNC	

TABLE 25
LOCATION STATUS OF CONFIRMED AND UNCONFIRMED SPOTTED OWL SITES ON OR ADJACENT TO SIMPSON TIMBERLANDS AS OF JUNE 30, 1991
(continued)

Subarea Spotted Owl Site	Location Status	Adjacent Ownership
Mad River (N=25)		
4076	ON	
4107	ON	
4128	ON	
4230 #1	ON	
4300	ON	
4850	ON	
4851	ON	
5700	ON	
6007	ON	
6400	ON	
6600	ON	
7000	ON	
Bear Creek-MR	ON	
Boundary Creek	ON	
Dry Creek	ON	
Maple Creek	ON	
Noname Creek	ON	
Butler Ridge	ADJ	small private
Freeman	ADJ	small private
Jacoby Creek #1	ADJ	Community Forest
Jacoby Creek #2	ADJ	Community Forest
Maple Creek Bridge	ADJ	small private
Palmer Creek	ADJ	small private
Simpson Creek	ADJ	Sierra Pacific
4230 #2	UNC	

TABLE 25
LOCATION STATUS OF CONFIRMED AND UNCONFIRMED SPOTTED OWL SITES ON OR ADJACENT TO SIMPSON TIMBERLANDS AS OF JUNE 30, 1991
(continued)

Subarea Spotted Owl Site	Location Status	Adjacent Ownership
Upper Mad River (N=19)		
Boulder Creek #1	ON	
Boulder Creek #2	ON	
Boulder Creek #3	ON	
Bug Creek	ON	
Camp Gate North	ON	
Camp Gate South	ON	
Deer Creek	ON	
Graham Creek	ON	
Humbug Creek	ON	
Little Deer Creek	ON	
N. Goodman Prairie	ON	
Blue Slide Creek	ADJ	small private
Coyote Creek	ADJ	small private
Girls Camp/BSC	ADJ	small private
S. Goodman Prairie	ADJ	small private
Substation	ADJ	small private
Tree Farm	ADJ	small private
Mt. Andy	UNC	
Pond	UNC	
Fortuna/Carlotta (N=15)		
EBF	ON	
R200 (Rio Dell)	ON	
Carlotta (C2300)	ON	
Fielder Creek	ON	
Salmon Creek #2	ON	
Salmon Creek #3	ON	
Salmon Creek #4	ON	
Walsh	ON	
Little Salmon Creek	ADJ	
F1300 (gas wells)	ADJ	Pacific Lumber
Grizzly Creek	ADJ	Pacific Lumber
Grizzly PL	ADJ	Pacific Lumber
Jones's Prairie	ADJ	small private
Railroad Gulch	ADJ	small private
West Lake Creek	ADJ	small private

*Does not include 23 additional unconfirmed sites identified in the Klamath subarea.

N = Total number of spotted owl sites
ON = Confirmed owl site located on Simpson property
ADJ = Confirmed owl site within <1 mile of Simpson property
UNC = Follow-up visit to site pending; owl recorded on site

Figure 9

oversize

(count as 2 pages)

Figure 10

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(count as 2 pages)

TABLE 26
PROPORTION OF AGE-CLASSES AND COVER TYPES BY AREAS OF OWL DENSITY

Owl Density (owls/mi^2)	Area in Acres	Percent Acreage/Covertype in Age Class: 0-7 Years	8-30 Years	31-45 Years	46 & Over Years	Nonforest
1.20 (high)	75,508	16.2	13.8	25.0	36.6	8.4
0.32 (low)	66,802	6.5	61.9	11.7	15.5	4.4
0.00 (no owls)	46,449	2.4	70.0	20.7	5.8	1.1

TABLE 27
NUMBER, AGE, AND SEX OF OWLS BANDED
ON OR ADJACENT TO SIMPSON TIMBERLANDS AS OF JUNE 30, 1991

Sex	Adults	Subadults	Juveniles	Total
Males	112	24	0	136
Female	92	28	0	120
Unknown	0	0	102	102
TOTAL	204	52	102	358

TABLE 28
OCCUPANCY OF OWL SITES LOCATED IN 1990 AND REVISITED IN 1991

	Located in 1990	Confirmed in 1991
Paired	72	74*
Single	4	6
Unknown Status	3	1
TOTAL	79	81

*2 unoccupied, 4 new

Simpson's youngest occupied stands (20-45 years) that are believed to have just reached suitability for owls.

Total turnover rates of banded territorial owls was 10 of 68 males (14.7 percent) and 12 of 60 females (20.0 percent). Three of the replaced birds were found at different sites; the others were presumed to be at unknown sites, displaced into the floater nonterritorial population, or dead (Table 29). The majority (68.4 percent) of new recruits into the population in the Simpson study (Table 30) were subadult birds.

Reproductive success of spotted owls in the plan area in 1991 was 0.63 owlet fledged per pair (Table 31). A point estimate of juvenile survival within the plan area was calculated as follows. The number of recaptures in 1991 of birds banded as juveniles in 1990 (5) was divided by the total number of juveniles banded in 1990 (38). The resulting percentage (13.2) was divided by 44 percent, which is the expected proportion of recaptured birds (banded as juveniles) to be recaptured the first year after they were banded based on studies at Willow Creek (Franklin 1992). Thus, the calculated minimum first year survival rate of spotted owls in the plan area was 30 percent.

6) Nest Site Study

In 1991, 30 additional nest sites, stands, and mosaics were studied to increase the sample size to 60 (see Section 2.F.2 and Appendix A for description of the methods used). Available data now includes average attributes for 60 nest sites (Table 32), average attributes for 60 nest stands (Table 33), descriptive statistics for age-classes and cover types for 60 nesting mosaics and 60 random plots (Table 34 and Figure 11), and additional habitat variables for 60 nest sites and nest stands (Table 35).

Analysis of the data for nest and random mosaics found several variables to be significantly ($P \leq 0.05$) different (see Table 34 and Figure 11). On average, nest mosaics differed from random mosaics by having:

1. Less acreage in the 8-30 age-class
2. More acreage in the 31-45 and 46-60 age-classes
3. More edge area
4. Greater number of cover types per mosaic

TABLE 29
TURNOVER/SURVIVAL RATES

Sex	1990 Banded	1991 Missing*	Moved**
Males	68	9 (13.2%)	1
Females	60	10 (16.7%)	2
TOTAL	128	19 (14.8%)	3

*Bird not resighted in study area
**Bird resighted at different site

TABLE 30
SEX AND AGE-CLASS OF NEW RECRUITS

Sex	Subadult	Adult	Total
Male	5	3	8
Female	8	3	11
Total	13	6	19
Percent of Total	68.4%	31.6%	

TABLE 31
REPRODUCTIVE SUCCESS OF 92 OWL PAIRS
MONITORED ON OR ADJACENT TO SIMPSON TIMBERLANDS IN 1991

Pairs Monitored	92
Number of Pairs Nesting	47
Percent of Pairs Nesting	51%
Number of Successful Pairs	38
Percent of Successful Pairs	81%
Owlets Fledged	58
Owlets Fledged Per Pair	0.63

TABLE 32
AVERAGE ATTRIBUTES OF 60 SPOTTED OWL NEST SITES BASED ON DATA COLLECTED IN 1990 AND 1991

Attribute	Average	Standard Deviation
Canopy Cover	92.6%	7.1
Conifers/Acre		
5-10" dbh	25.7	51.0
11-20" dbh	30.2	38.6
21-36" dbh	16.4	18.3
>36" dbh	3.2	3.3
Total Number	75.5	82.2
Hardwoods/Acre		
5-10" dbh	61.2	116.5
11-20" dbh	29.8	44.1
>21" dbh	4.4	9.0
Total Number	95.4	137.2
Log Volume (ft^3/acre)	2,743.2	3,080.7

TABLE 33
AVERAGE ATTRIBUTES OF 60 SPOTTED OWL NEST STANDS BASED ON DATA COLLECTED IN 1990 AND 1991

Attribute	Average	Standard Deviation
Canopy Cover	94.9	5.9
Conifers/Acre		
5-10" dbh	37.1	85.0
11-20" dbh	33.4	44.4
21-36" dbh	14.7	18.0
>36" dbh	2.3	3.6
Total Number	87.5	113.6
Hardwoods/Acre		
5-10" dbh	115.5	160.1
11-20" dbh	25.6	36.2
>21" dbh	3.4	6.8
Total Number	144.5	168.9
Log Volume (ft^3/acre)	2,092.5	3,450.6

TABLE 34
DESCRIPTIVE STATISTICS FOR AGE-CLASS AND COVER TYPE MEASUREMENTS COLLECTED FROM 60 NEST AND RANDOM MOSAICS (502-ACRE CIRCULAR PLOTS) STUDIED IN 1990 AND 1991

Habitat Variable	Nest Mosaics		Random Mosaics	
	Mean	SD	Mean	SD
Age-Class				
0-7 (acres)	42.4	63.6	57.5	95.4
8-30 (acres)*	**59.1**	**93.8**	**131.1**	**169.5**
31-45 (acres)*	**112.5**	**148.5**	**72.3**	**122.3**
46-60 (acres)*	**136.8**	**157.3**	**83.7**	**139.4**
61-80 (acres)	59.9	85.8	69.7	108.5
81-200 (acres)	29.9	68.7	28.1	74.8
>200 (acres)	12.8	33.5	2.7	11.5
Total >46 (acres)*	**239.4**	**149.8**	**184.2**	**161.8**
Cover Types				
Redwood/hardwood (acres)	59.8	131.1	42.8	121.4
Redwood/Douglas-fir/ hardwood (acres)	100.6	144.5	142.1	191.5
Hardwood/conifer (acres)*	**166.1**	**169.1**	**114.5**	**146.3**
Non-forest (acres)	48.7	47.5	54.1	83.1
Other Variables				
Length of Edge between Cover Types (miles)*	**5.1**	**1.9**	**4.0**	**1.8**
Length of Sharp Edge between Cover Types (miles)	2.6	1.8	2.5	2.0
Distance to Nearest Forest Opening (feet)*	**1040.0**	**848.7**	**775.4**	**831.0**
Number of Cover Type Patches	9.2	4.0	6.4	2.8
Minimum Patch Size (acres)	9.8	28.5	23.9	69.9
Maximum Patch Size (acres	245.8	115.4	276.8	99.1
Number of Cover Types*	**3.5**	**1.2**	**2.8**	**0.9**
Position of Site on Slope* 0 (draw) - 1 (ridge top)	**0.35**	**0.23**	**0.52**	**0.28**
Distance to Nearest Water Source (feet)	448.6	317.2	626.3	460.9
Length of Road (miles)*	**2.3**	**1.3**	**3.0**	**1.7**

SD = Standard Deviation
* = Significant difference ($P \leq 0.05$)

NOTE: Bold type indicates habitat variable showing significant difference between nest mosaics and random mosaics.

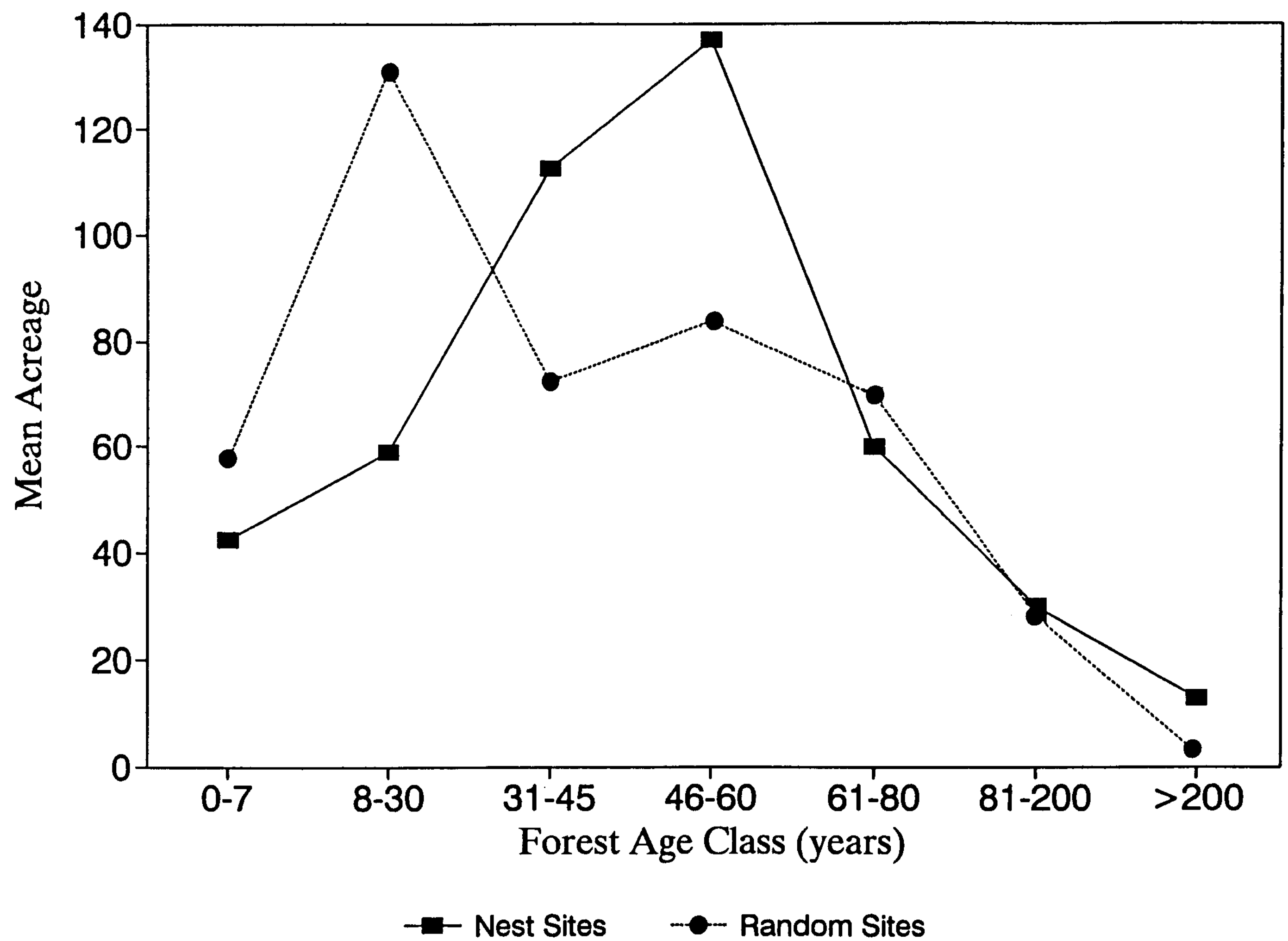

Figure 11. Forest Age-Class Profile for Mosaics (502-acre circles) Centered Around 60 Spotted Owl Nests and 60 Random Sites

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TABLE 35
ADDITIONAL HABITAT VARIABLES COLLECTED FROM 60 SPOTTED OWL NEST SITES AND STANDS IN 1990 AND 1991

Habitat Variable	Nest Site		Nest Stand	
	Mean	SD	Mean	SD
Nest tree dbh (inches)	50.9	24.3	--	--
Nest tree height (feet)	126.7	42.9	--	--
Diameter of tree at nest height (inches)	28.5	15.7	--	--
Height of nest (feet)	64.7	23.4	--	--
Canopy height (feet)	32.3	8.2	29.4	10.2
Conifer basal area 5-10" dbh (ft^2/acre)	8.9	16.2	11.7	26.0
Conifer basal area 11-20" dbh (ft^2/acre)	41.8	53.5	43.6	56.2
Conifer basal area 21-36" dbh (ft^2/acre)	66.5	76.0	57.1	69.2
Conifer basal area >36" dbh (ft^2/acre)	38.7	41.8	26.1	42.7
Total conifer basal area >5" dbh (ft^2/acre)	150.6	119.1	138.5	124.1
Density of conifer saplings 1-5" dbh (number/acre)	70.6	73.6	78.1	141.0
Hardwood basal area 5-10" dbh (ft^2/acre)	18.4	33.7	34.2	45.4
Hardwood basal area 11-20" dbh (ft^2/acre)	34.6	49.9	28.8	40.9
Hardwood basal area ≥21" dbh (ft^2/acre)	18.4	36.4	13.9	27.9
Total hardwood basal area >5" dbh (ft^2/acre)	71.5	82.3	76.9	76.4
Percent cover forbs	2.6	4.5	3.2	7.5
Percent cover ferns	22.1	19.6	17.5	19.5
Percent cover grass	0.7	2.4	1.5	6.3
Percent cover seedlings	4.3	6.7	4.3	7.7
Percent shrubs	11.2	17.8	13.2	21.9
Percent slope	42.2	18.7	41.2	21.0

SD = Standard Deviation

5. More acreage dominated by hardwoods
6. Greater distance to forest opening
7. Lower position on slope.

H. Discussion of 1989-1991 Results

1) Owl Occurrence in the Plan Area

As previously noted, little was known about the status of spotted owls on Simpson's property and other private timberlands in California prior to 1989. Most studies had been conducted on public rather than private lands and, given the logging history of the region, it was assumed by many that the forests were too young to support spotted owls. LaHaye (1988) noted that no known owl sites were on private, commercial timberlands. He concluded that this resulted from the lack of surveys and because the majority of lands had been logged and were currently occupied by early succession stage forests. Surveys conducted since 1989, however, indicate that there are many spotted owls on private timberlands in relatively young forests and that the owls are successfully reproducing.

Simpson's 1989 survey recorded 104 adult and subadult owls on or adjacent to its property. With increased survey efforts, the total grew to 172 in 1990 and 261 as of June 30, 1991.

a) Reproductive Success

The 23 owlets observed in the 1989 survey and the 102 owlets banded in 1990 and 1991 indicate that owls successfully reproduced in and around the plan area. Valid estimates of fledging success were for 1990 (0.72 fledged/pair) and 1991 (0.63 fledged/pair). Spotted owl reproduction may normally vary between years (Forsman 1988; Miller 1989; Franklin et al. 1990a).

Although spotted owl reproduction also may vary geographically or regionally (Miller 1989), the minimum estimate of fledging success in 1990 (0.72 fledged/pair) agreed with an estimate (0.69 fledged/pair) obtained by Pious (pers. comm. 1991) in privately owned and managed coastal redwoods. The 1991 reproductive success rate was consistent with that found by Franklin (pers. comm., 1991) in 1991 and a five-year (1985-1989) average success of 0.66 reported by Franklin et al. (1990a) in northern California.

The 1991 point estimate of juvenile survival was calculated from one year of data and a small sample size, but it does indicate that juvenile spotted owls successfully dispersed and subsequently survived in second-growth habitats. The calculated 30 percent survival of juveniles is regarded as a minimum because an unknown proportion of owls disperse off the property. Based on reported dispersal distances, the proportion moving off the property may be as high as 50 percent.

b) Site Occupancy and Population Turnover

Long-term studies by Franklin et al. (1990a) revealed average annual site occupancy to be 70.0 percent, with 53.2 percent of sites continuously occupied for five years between 1985 and 1989. In contrast, site occupancy in the plan area between 1990 and 1991 was 97.5 percent. Turnover rates of banded territorial owls were similar for the two studies (14.7 percent males, 20 percent females for the plan area and 15.8 percent males and 19.8 percent females for Franklin et al. [1990a]). In both studies, over 66 percent of new recruits were subadults.

As in comparing survey results, caution is warranted in comparing regional population densities because of the difficulty of obtaining accurate estimates. Owl density observed in the southern portion of Simpson's ownership was 1.2 owls/mi^2, which exceeds 0.84 owl/mi^2, the highest density previously reported for spotted owls in California (Marcot and Gardetto 1980). Overall owl density in thoroughly surveyed areas in the plan area was 0.65 owl/mi^2, which is comparable to 0.61 owl/mi^2 reported by Franklin et al. (1990b). The 1.2/mi^2 density also is approximately 20 times greater than the 1.7 pairs/township (36 square miles) discussed in the Thomas report in connection with owl conservation on private lands in northern California (Thomas et al. 1990).

Caution also has been urged in interpreting owl densities because of the "packing" phenomenon. As described by Brown (1969), the phenomenon now referred to as "packing" occurs when birds crowd into areas of suitable habitat due to the absence of other suitable areas. The number of potentially breeding birds in the area increases to a point at which the territorial behavior of the resident birds limits the number of birds actually able to breed. When this occurs, the potential negative effects on successful reproduction are two-fold: (1) a large population of non-breeding birds (floaters) is created and (2) the success of the breeders may be reduced by effects tied to overcrowding and the presence of the non-breeders, such as increased frequency of agonistic encounters or reduction of food sources. Brown (1969) also noted that the effects of floater populations may be more severe for longer lived species.

Studies summarized by USFWS (USDI 1990b) have hypothesized that spotted owl populations can be maintained over several years by the "rescue effect" of floaters and immigrants. The studies contend that owl population numbers may appear to be stable while the number of territorial birds is actually declining and that, as more owl habitat is removed, the proportion of older, displaced birds in the floater population would increase.

Thomas et al. (1990) noted that packing seemed to be occurring in the Mad River redwood area. However, if packing were occurring in the area due to habitat loss, one would expect to find areas of low density from which birds had been displaced by recent logging and areas of high density to which displaced birds had moved. This was not observed on Simpson lands in the Mad River area in the 1989 or 1990 surveys. Instead, spotted owls were found in highly fragmented, recently harvested areas in Mad River as well as in areas in Upper Mad River where relatively little logging has occurred for many years.

Furthermore, in a packed population, displaced adult birds would be expected to fill most territorial vacancies due to the large proportion of displaced older birds in the floater population (USDI 1990b). This too was not observed. Six of eight newly occupied sites identified since 1989 were occupied by pairs that included at least one subadult. The proportion (27 percent) of banded pairs in 1990 that included at least one subadult bird and the high proportion (over two-thirds) of subadults among new recruits also discount the likelihood of packing and suggest that recruitment into adult populations is occurring. In Oregon, new recruits into a population were subadults, and this was interpreted as recruitment from within the population (Thomas et al. 1990). Subadult owls found in a survey of other privately owned and managed timberlands also suggested juvenile recruitment into adult populations (Irwin et al. 1989).

Relatively more subadults have been banded in the plan area (20 percent) than in areas studied by Franklin et al. (1990a) (13.5 percent), but turnover rates are comparable. This, the fact that six of the eight newly occupied sites had pairs including one subadult, and the fact that six of the new sites were in Simpson's youngest occupied stands (20-45 years) suggest that marginal, new sites tend to be occupied by subadult birds.

2) Prey Species and Habitat Mosaics

Consistent with findings by Solis (1983), Kerns (1989a), and Ward (1990), woodrats were found to be the primary prey species in the plan area.

The high densities of owls in the area also appear to be linked to the abundance of woodrats and, in some cases, brush rabbits, which are relatively rare in other parts of the owl's range (Thomas et al. 1990). In northern California, Sakai (pers. comm. 1991) found that dusky-footed woodrat abundance was greatest in sapling/early brush timber.

Although owls may avoid foraging in open clear-cut habitats to avoid predators or because dense brush makes prey inaccessible (Forsman et al. 1984), such areas can serve as reservoirs of prey such as woodrats (Sakai, pers. comm. 1991). When the prey disperse into adjoining habitats, they become vulnerable to foraging owls (Gutierrez et al. 1983). Thus, wooded/brushy edges may be favorable foraging habitats (Sakai, pers. comm. 1991) as observed by Solis (1983), Sisco and Gutierrez (1984), and Ward (1990).

Although foraging behavior was not directly observed in Simpson's studies, data indicate that woodrats and brush rabbits constitute over 80 percent of owl diet biomass. This suggests that brushy clear-cuts may be important to the biology of owls in the redwood region. Other studies of coastal redwoods support this conclusion. Pious (1989) observed that in the daytime, owls were often found roosting near clear-cuts. Kerns (1989a) found woodrats and brush rabbits predominated owl diets and noted that, although they seemed to prefer foraging under broken canopy, owls foraged in 29 different habitat types, including a 10-year-old redwood plantation, gravel bars, and stream courses. He concluded that owls may be flexible in their use of foraging habitat, and what is suitable foraging habitat may not be suitable roosting or nesting habitat. His conclusion, however, is considered premature (USDI 1990b) because availability of foraging habitat was not measured.

Reproductive success of owls in the plan area also may be related to woodrat abundance. Nest stands of successful reproductive pairs had higher densities and basal areas of hardwoods 5-20 inches dbh than the stands of unsuccessful pairs, possibly because such areas were linked to woodrat abundance. Barrows (1985) and Ward (1990) suggested that reproductive success of owls may be linked to availability of prey, particularly large prey such as woodrats. Miller (1989) noted that reproductive success is higher in areas where woodrats predominate in owl diets than where flying squirrels predominate. Franklin et al. (1990a) documented high consistent reproductive rates for spotted owls in California, where woodrats are the major prey.

Gutierrez (1985) suggested that the interplay of food abundance, availability, and distribution may explain the owl's historical dependence on large tracts of forest. The interplay also may help to explain regional differences in the effects of forest fragmentation on home ranges and population densities. For example, when habitats of owls that live in areas where flying squirrels are the primary prey are fragmented, the owls increase their home range size to encompass more area in which to forage (Forsman et al. 1984), and owl density decreases. Woodrats, the primary prey in the plan area, are positively associated with forest fragmentation (Thomas et al. 1990), which suggests that a mosaic of wooded and clear-cut areas may have the opposite effect of increasing owl density. Work by Paton et al. (1989) showed that in areas where woodrats predominated as prey items, spotted owl home ranges were smaller than those where flying squirrels predominated. Sisco and Gutierrez (1984) also found owls in some cases using extensively cutover areas to have smaller home ranges.

Thomas et al. (1990) noted that forest fragmentation may be beneficial in the short term due to increased prey availability but also may have negative impacts such as exposing spotted owls to predation by great horned owls. Within the plan area, the full impact of great horned owls on spotted owls is not known. However, adults of the two species appear to co-exist as competitors rather than as predator and prey. In the highly fragmented Mad River area, spotted and great horned owls were heard calling simultaneously from the same general location on several occasions. On one occasion, observers saw a great horned owl pair fly towards a calling spotted owl male and commence agitated calling. The female spotted owl then flew off her nest to participate in the apparent territorial dispute. The pairs continued to call to each other across an unseen boundary until the great horned owl pair moved away. The female spotted owl then returned to the nest, and the male continued to call. Marcot and Gardetto (1980) and Solis (1983) also observed encounters between great horned and spotted owls in northwestern California.

Since impacts of predators or competitors on spotted owls are largely unknown (Thomas et al. 1990), the relationship of great horned and spotted owls in the plan area warrants further study.

3) Nest Sites and Nesting Mosaics

In a study in northwestern California, LaHaye (1988) found that 80 percent of spotted owls nest in broken-top trees or cavities. He also noted that, in an area that had been logged within the past 100 years, all of the nests observed were platforms, suggesting that use reflects availability of nest structures. Mammal nests were the type of nests most often used by owls observed on Simpson's timberlands (all but two percent of which have been logged since 1890).

Although availability of nest structures was not measured in Simpson's studies, many of the nest stands were produced by even-aged management and lack the high degree of decadence that provides broken tree top and cavity nest sites. Pious (1989) also found platforms to be used most often as nesting structures by spotted owls in managed coastal redwoods. Within the area covered by Simpson's studies, 50 percent of the nests in even-aged stands were old flying squirrel nests (woven masses of redwood bark and sticks). This suggests the indirect importance of flying squirrels to spotted owls in the plan area.

Measurements of nest trees (i.e., height, height of nest, and dbh of nest trees) in the plan area fall within the range of those measured by Forsman et al. (1984), LaHaye (1988), and Pious (1989).

Nest sites were distributed among a wide range of habitat types, often reflecting the historical and current management of the area. Principal component analysis of nest and random sites revealed that in most instances nest sites are a reduced subset of the available habitat in the stand. This suggests that the required nesting microhabitat may be more restricted than overall available habitat.

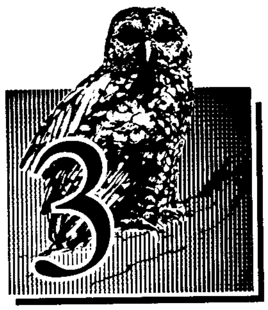
Although nest site characteristics were variable, some were consistent with those of old-growth structure. This suggests that nesting and roosting habitat may be more dependent on structural attributes of old growth than foraging habitat. Random sites had significantly more canopy coverage than nest sites, but mean closure at nest sites was high (92 percent). (The higher closure at random sites is probably explained by the presence of dense, young trees and large shrubs.) Pious (1989) also found high (>73 percent) total canopy coverage at nest sites. Kerns (1988) found nesting habitat in second-growth coastal redwood stands characterized by an overstory of trees >20 inches dbh. Results of Simpson's studies agree with this finding and with the nesting habitat work by Blakesley et al. (1991) in northwestern California.

Other data from Simpson's studies suggest an affinity with relatively large trees. Nest sites had a significantly higher mean basal area (i.e., higher density) of large (>35-inch dbh) conifers than did random sites. Sometimes the nest site was located in a small cluster of trees larger than those of the surrounding stands. Principal component analysis (DCA) agreed with the difference in basal area of large conifers between nest and random sites, but PCA also showed many nest site scores within the polygon of random site scores. This indicates that although nest sites may contain larger residual trees, they are not essential for nest sites. Also, analysis of nest and random mosaics suggests that on a landscape level, mosaics with nesting spotted owls contain more of the youngest age-classes of potential nesting habitat (31-45 years and 46-60 years) than the older age-classes (61-80, 81-200, and >200). Older age-classes appeared to occur approximately in the same proportion for nest and random mosaics.

Results of other studies in managed coastal redwoods also suggest that owls in this area may depend on old-growth structure for nesting and roosting habitat more than for foraging habitat. Kerns (1989b) noted the importance of vertical structure of roosting habitat as he observed owls to roost high up in overstory trees on cool mornings and low in the shade of understory trees on hot afternoons. Roost and nest sites were characterized by Kerns (1988) and Pious (1989) as being multilayered; dominated by conifer overstory trees >16-inch dbh and smaller understory hardwoods (5- to 16-inch dbh) (Pious 1989); and having ground cover consisting of logs and woody debris. Pious (1989) found canopy closure at roost sites to be >85 percent, but Kerns (1988, 1989a) found canopy cover to vary.

Thomas et al. (1990) noted that suitable owl habitat may exist in stands 50 to 60 years old in coastal redwoods. Kerns (1988) observed that owls were found in relatively young (60- to 80-year) second-growth stands that had resulted from clear-cut or selective management. Simpson's 1989, 1990, and 1991 studies confirmed the presence of owl nesting areas in stands aged 31 to 45 years and 46 to 60 years. The landscape analysis of the distribution of owls throughout

Simpson's ownership also supports the premise that virtually all stands in age-class 46+ are used by spotted owls. That analysis indicates that of 188,000 acres thoroughly surveyed for spotted owls, only 7.4 percent of the acreage in age-class 46+ is beyond one mile of an owl site and considered not likely used by owls.



Supplemental Planning and Analysis

A. Introduction

As previously noted, the information resulting from Simpson's 1989-1991 spotted owl surveys and studies provides the basis for planning a conservation strategy that would meet the requirements of both federal and state laws protecting the species. However, documentation of current conditions is only one part of the planning process. Simpson's goal is to reconcile long-term and large-scale timber management with the protection of spotted owls, and meeting that goal requires a long-term and large-scale conservation strategy.

This section of the HCP identifies four additional steps that Simpson has taken in planning its spotted owl conservation strategy. These steps are:

1. Preparation of a 30-year forecast to help determine how much habitat would be available for spotted owls on the property over time;

2. Development of a computer model by which potential habitat for spotted owls could be identified throughout the property;

3. Identification of other species of concern in the plan area and a preliminary analysis of their habitat needs and sensitivity to impacts; and

4. Consideration of alternative approaches and conservation strategies.

B. Age-Class Forecast

To identify how conditions within the plan would change over time, Simpson has prepared a 30-year forecast that simulates the harvest, regeneration, and growth of stands over time. As discussed in Section 1.D, this type of forecast is possible because of the computer programs that Simpson uses to maintain inventories of its timber stands and to plan future harvests. The programs link cover types to specific geographical locations, which allow the results of the simulation to be mapped at any point in the forecast period.

1) Forecast Period and Assumptions

The 30-year forecast prepared for this plan covers January 1, 1991, through January 1, 2021, and groups the results into age-classes. Totals for each of the age-classes were tabulated and mapped for the base year (1991) and three points in the forecast period: 1996, 2011, and 2021. The age-classes are the same as those in the 1990 nest site study (see Section 2.F) and reflect the potential biological value of the stands as habitat for spotted owls:

- 0-7 years (recently regenerated stands that have no direct value to owls)
- 8-30 years (potential foraging and "prey reservoir" habitat)
- 31-45 years (foraging, roosting, and occasional nesting habitat)
- 46+ years (prime nesting and roosting and also foraging habitat).

Hardwoods and brush cover types with a minor component of residual old-growth and remnant old-growth cover types were separated from other components of the 46+ age-class and included in the forecast. Non-forested lands (i.e., grass-lands, rock pits, and waterways) were quantified as of 1991 and treated as having no direct value as habitat for owls.

In the harvesting model, the 46+ age-class includes second-growth cover types, hardwood and brush cover types with a minor old-growth residual component, and remnant old-growth cover types. Acres of stands in each category were calculated separately in the 30-year forecast.

Harvest levels were set at 145 million board feet (MMBF) in 1991, 175 MMBF between 1992 and 1997, 101 MMBF between 1998 and 2001, 131 MMBF between 2002 and 2010, and 200 MMBF between 2011 and 2020. These levels are based on Simpson's current long-term operating assumptions, which Simpson reserves the right to modify in response to changes in ownership configuration, Forest Practice Rules, economic conditions, and forest-product markets. At the selected levels, 3,000 to 6,000 acres would be harvested annually over the forecast period.

2) Forecast Results

Results of the 30-year forecast indicate that second-growth stands in 46+ age-class will more than double over the period, increasing from 67,214 acres in 1991 to 140,907 acres in 2021 (Table 36 and Figures 12-16). The 31-45 age-class increases by nearly 50,000 acres in the first ten years but returns to 1991 levels (about 77,000 acres) by 2021. The 8-30 age-class decreases by about 40 percent over the period but remains above 115,000 acres through 2001. Combined, age-classes 31-45 and 46+ show a net increase of about 55,000 acres (38 percent) between 1991 and 2021. The proportion of Simpson's ownership represented by these two age-classes also increases over the period and remains above 50 percent from 1996 through 2021.

The north-south distribution of the age-classes also shows notable trends. The 46+ age-class increases four-fold in the north over the period, from under 16,000 acres in 1991 to over 83,000 acres in 2021; in the south, the age-class remains at a relatively constant level of 50,000 acres over the period. The 31-45 age-class more than doubles between 1991 and 2001 in the north and remains relatively constant in the south over the same interval; it decreases somewhat in both the north and south between 2001 and 2021. The 8-30 age-class decreases in the north from about 114,000 acres in 1991 to about 39,000 acres in 2021; in the south, it remains above 40,000+ acres and shows a net increase at the end of the period. Combined, age-classes 31-45 and 46+ more than double over the period in the north, increasing from about 54,000 to over 135,000 acres; in the south, the two increase slightly over the first ten years and remain above 85,000 acres over the entire forecast period. In addition, in 1996 and 2001, there is roughly the same amount of acreage in the two age-classes in the north as in the south; following 2001, the amount in the north is significantly higher than in the south.

TABLE 36
DISTRIBUTION IN ACRES OF SIMPSON TIMBERLAND STANDS IN OWL HABITAT AGE-CLASSES FROM 1991-2021

	1991	1996	2001	2011	2021
0-7					
North	22,741	17,056	13,564	13,956	25,410
South	18,009	17,804	21,615	19,550	17,362
Total	40,750	34,860	35,179	33,506	42,772
8-30					
North	114,093	95,209	75,574	40,502	38,781
South	43,466	45,571	40,911	44,610	51,151
Total	157,559	140,780	116,485	85,112	89,932
31-45					
North	38,247	66,354	85,079	79,282	51,741
South	39,204	37,598	41,635	33,675	27,405
Total	77,451	103,952	126,714	112,957	79,146
46+					
North	15,960	16,462	23,945	65,053	83,297
South	51,254	51,634	49,121	55,464	57,610
Total	67,214	68,096	73,066	120,517	140,907
ROG/MIX					
North	14,966	10,926	7,845	7,214	6,778
South	2,802	2,128	1,453	1,436	1,207
Total	17,768	13,054	9,298	8,650	7,985
NF					
North	8,706	8,706	8,706	8,706	8,706
South	13,658	13,658	13,658	13,658	13,658
Total	22,364	22,364	22,364	22,364	22,364
OWNERSHIP					
North	214,713	214,713	214,713	214,713	214,713
South	168,393	168,393	168,393	168,393	168,393
TOTAL	383,106	383,106	383,106	383,106	383,106

ROG/MIX = hardwood and brush cover types with a minor old-growth residual component and remnant old-growth cover types

NF = non-forested land

Figure 12

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Figure 13

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Figure 14

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Figure 15

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Figure 16

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C. Nesting Mosaic Model

Since age-class alone does not determine suitable owl habitat, Simpson is developing a forecasting model that takes into account the mix of age-classes, cover types, and other variables (i.e., the nesting mosaic) around spotted owl nest sites in the plan area. This "nesting mosaic" model is still in a developmental phase and will be refined over time as part of the implementation of the HCP. Its primary purpose is to estimate the current and future distribution of potential owl nesting habitat on Simpson's property, thereby facilitating both owl conservation and timber harvest planning.

1) Development of the Model

The nesting mosaic model was developed using discriminant analysis, data from the 1990 nest site study, and Simpson's GIS data base. It should be noted that data from the 1991 nest site study (see Section 2.G) were not available when the model was first being developed but will be used to refine it.

Using the GIS, a 0.5-mile radius circle (502.7 acres) was placed around the 30 spotted owl nest sites and 30 random sites studied in 1990 (see Chapter 2.F). Each circle was intersected with the GIS cover type layer to determine the age-class of all stands within the circle. One of the nest site circles did not intersect Simpson property and consequently could not be assessed using the GIS, which does not contain cover type information for areas outside the ownership. Likewise, only those acres on Simpson's property could be assessed in circles that fell near the border of the ownership.

Five variables identified in the 1990 habitat mosaic analysis were determined for each circle:

a. Proportion of land area in the non-forest and 0-7 year age-class;

b. Proportion of land area in the 8-30 year age-class;

c. Proportion of land area in the 31-45 year age-class;

d. Proportion of land area in the 46+ year age-class; and

e. Total number of cover types divided by total acreage of Simpson timber land within the circle.

Discriminant analysis was then used to develop a function to classify the data on the nest and random-site circles. An arcsine transformation was applied to the first four variables and a square root transformation was applied to the fifth. The resulting discriminant function was statistically significant ($P \leq 0.05$) and classified 17 of 29 (59 percent) nest sites as nest sites and 20 of 30 random sites as random sites. Several other variables and transformations were tested during the development of the model, but none were found to produce a more significant discriminant function.

The behavior of the discriminant function was investigated by systematically varying the function's inputs. Results of this testing indicated that at least three of the age-class variables, including the 8-30 age-class variable, must be non-zero for a site to be classified as having the nesting mosaic. In addition, sites are more likely to be classified as having the mosaic if they contain a large number of cover types.

The discriminant function was then applied to all of Simpson's ownership by partitioning the land base into one-square-mile (640 acres) sections. As with the GIS analysis of the nest and random-site circles, only acres in Simpson's ownership within each section could be evaluated.

2) Nesting Mosaic Forecast

When applied to 1991 cover types and age-classes, the model indicates that 158,477 acres of Simpson's property currently fit the nesting mosaic profile (Table 37 and Figure 17). While subject to further refinement, this estimate is consistent with the number of owl sites on Simpson's property. When applied to the results of the 30-year age-class forecast, the model indicates that the number of acres with the nesting mosaic will be roughly the same in 2021 as in 1991, with a 16 percent decrease noted between 2001 and 2011. The model also indicates that an average of 100,000 acres of nesting habitat will be available in the north over the 30-year period, and an average of 55,000 acres will be available in the south.

While subject to further refinement, these projections are consistent with the age-class forecast. The decrease in nesting mosaic between 2001 and 2011, for example, is projected to occur over the same period that the 8-30 age-class is at its lowest due to the natural aging of stands. In addition, the total amount of nesting mosaic remains relatively stable over a 30-year period during which the decrease in potential foraging and "prey reservoir" habitat (8-30 age-class) is offset by an increase in prime nesting and roosting and also foraging habitat (46+ age-class).

TABLE 37
ACREAGE OF SIMPSON TIMBERLANDS IDENTIFIED BY COMPUTER HARVEST SIMULATION MODEL AS POTENTIAL SPOTTED OWL NESTING MOSAIC FROM 1991-2021

Year	North	South	Total
1991	113,129	45,348	158,477
1996	112,892	50,405	163,297
2001	104,850	59,602	164,452
2011	85,054	53,294	138,348
2021	98,513	60,904	159,417

D. Other Species of Concern

To ensure that conservation measures for spotted owls would not be in conflict with the needs of other listed species and to identify opportunities to benefit multiple species, Simpson has compiled data on 39 species associated with the habitat in the plan area, excluding insects. These species include 9 plants, 5 fish, 6 amphibians and reptiles, 15 birds, and 4 mammals (Table 38). The data compiled include information on the range, habitat requirements, status, sensitivity to timber harvests, occurrence in the plan area, and potential effects of the HCP on these other species of concern (Appendix C).

Of the 39 species identified here, 7 are listed as threatened or endangered by USFWS or CDFG, 1 is proposed for federal listing, 9 are candidates for federal listing, 7 are designated as sensitive bird species by the California Board of Forestry, and 23 are "species of special concern" in California (see Table 38). Nineteen of the 39 species have been observed on Simpson's property, and 4 fish of special concern are assumed to occur in streams on Simpson's ownership based on observations of adult and juvenile salmonids (see Appendix C).

1) Rare, Threatened, or Endangered Species

Three of the 39 other species are federally and state listed as endangered. These three species are the American peregrine falcon (*Falco peregrinus anatum*), bald eagle (*Haliaeetus leucocephalus*), and Macdonald's rock cress (*Arabis macdonaldiana*). Two plants (Humboldt milk vetch [*Astragalus agnicidus*] and western lily [*Lilium occidentale*]) have endangered status in California and occur in Humboldt County, and one bird (bank swallow [*Riparia riparia*]) is state listed as threatened. The marbled murrelet (*Brachyramphus marmoratus*) has been state listed as threatened and also is proposed for federal listing. Two plants are listed as rare in California: leafy reed grass (*Calamagrostis foliosa*) and bensoniella (*Bensoniella oregona*).

2) Candidates for State or Federal Listing

Four plants, two amphibians, one reptile, and two mammals are candidates for federal listing. Category 2 candidates for federal listing include the yellow-tubered toothwort (*Cardamine gemmata*), Mendocino gentian (*Gentiana setigera*), Tracy's sanicle (*Saniculaa tracyi*), Del Norte salamander (*Plethodon elongatus*), California red-legged frog (*Rana aurora draytoni*), Western pond turtle (*Clemmys marmorata marmorata*), Townsend's big-eared bat (*Plecotus townsendii*), and white-footed vole (*Arborimus albipes*). The

Figure 17

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TABLE 38
STATUS OF FEDERAL AND STATE SPECIES OF CONCERN IN THE PLAN AREA

	Scientific/Common Name	Status
	Arabis macdonaldiana (Macdonald's rock cress)	FE,SE
	Calamagrostis foliosa (leafy reed grass)	SR
	Astragalus agnicidus (Humboldt milk vetch)	SE
	Bensoniella oregona (bensoniella)	SR
	Lilium occidentale (western lily)	SE
	Cardamine gemmata (yellow-tubered toothwort)	F2
	Gentiana setigera (Mendocino gentian)	F2
	Sanicula tracyi (Tracy's sanicle)	F2
	Thlapsi montanum var. *californica* (Kneeland prairie penny cress)	F1
a	*Oncorhynchus clarki clarki* (coastal cutthroat trout)	CSC
	Oncorhynchus gorbuscha (pink salmon)	CSC
a	*Oncorhynchus kisutch* (Coho salmon)	CSC
a	*Oncorhynchus mykiss gairdneri* (summer steelhead)	CSC
a	*Oncorhynchus tshawytscha* (spring chinook salmon)	CSC
o	*Rana aurora draytoni* (California red-legged frog)	CSC,F2
o	*Rana boylei* (foothill yellow-legged frog)	CSC
o	*Ascaphus truei* (tailed frog)	CSC
o	*Rhyacotriton olympicus* (Olympic salamander)	CSC
o	*Plethodon elongatus* (Del Norte salamander)	CSC,F2
o	*Clemmys marmorata marmorata* (western pond turtle)	F2*
o	*Strix occidentalis caurina* (northern spotted owl)	FT,CSC,S
o	*Ardea herodias* (great blue heron)	S
o	*Casmerodius albus* (great egret)	S
o	*Accipiter cooperii* (Cooper's hawk)	CSC
	Accipiter gentilis (northern goshawk)	CSC,FSS*
o	*Accipiter striatus* (sharp-shinned hawk)	CSC
o	*Aquila chrysaetos* (golden eagle)	CSC,S
o	*Haliaeetus leucocephalus* (bald eagle)	FE,SE,S
o	*Pandion haliaetus* (osprey)	CSC,S
o	*Falco peregrinus anatum* (American peregrine falcon)	FE,SE,S
o	*Bonasa umbellus* (ruffed grouse)	CSC
o	*Brachyramphus marmoratus* (marbled murrelet)	ST,FP,S
	Riparia riparia (bank swallow)	ST
	Progne subis (purple martin)	CSC
o	*Parus atricapillus* (black-capped chickadee)	CSC
	Icteria virens (yellow-breasted chat)	CSC

TABLE 38
STATUS OF FEDERAL AND STATE SPECIES OF CONCERN
IN THE PLAN AREA
(continued)

	Scientific/Common Name	Status
	Plecotus townsendii (Townsend's big-eared bat)	CSC,F2
	Arborimus albipes (white-footed vole)	CSC,F2
o	*Arborimus (= Phenacomys) longicaudus* (red tree vole)	CSC
o	*Martes pennanti pacifica* (Pacific fisher)	CSC,FSS

a = Assumed to occur in the permit area
o = One or more specimens observed in the permit area

FE = Listed as Endangered by USFWS
FT = Listed as Threatened by USFWS
F1 = Category 1 Candidate for federal listing
F2 = Category 2 Candidate for federal listing
FSS = Federal Sensitive Species
FP = Proposed for federal listing
SE = Listed as Endangered in California
ST = Listed as Threatened in California
SR = Listed as Rare in California
CSC = Species of Special Concern in California
S = Listed as Sensitive Bird Species by CDF

*Petition has been filed with USFWS to list these species.

Kneeland prairie penny cress (*Thlapsi montanum* var. *californicum*) is a Category 1 candidate.

3) Sensitive Bird Species

The 39 species include eight of the eleven sensitive bird species on the Board of Forestry's list. These are the great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), golden eagle (*Aquila chrysaetos*), bald eagle, osprey (*Pandion haliaetus*), American peregrine falcon, spotted owl, and marbled murrelet.

4) Species of Special Concern

Twenty-three of the 39 species are species of special concern in California, as is the northern spotted owl.

- Fish species of special concern include the coastal cutthroat trout (*Oncorhynchus clarki clarki*), pink salmon (*Oncorhynchus gorbuscha*), Coho salmon (*Oncorhynchus kisutch*), summer steelhead (*Oncorhynchus mykiss gairderni*), and spring chinook salmon (*Oncorhynchus tshawytscha*).

- Amphibian and reptile species of special concern include the Olympic salamander (*Rhyacotriton olympicus*), Del Norte salamander, tailed frog (*Ascaphus truei*), California red-legged frog, foothill yellow-legged frog (*Rana boylei*), and western pond turtle.

- Bird species of special concern include the spotted owl, Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), sharp-shinned hawk (*Accipiter striatus*), golden eagle, osprey, ruffed grouse (*Bonasa umbellus*), purple martin (*Progne subis*), black-capped chickadee (*Parus atricapillus*), and yellow-breasted chat (*Icteria virens*).

- Mammal species of special concern are the Townsend's big-eared bat, white-footed vole, red tree vole (*Phenacomys [Arborimus] longicaudus*), and Pacific fisher (*Martes pennanti pacifica*).

The northern goshawk is also considered a sensitive species by USFWS, and a petition has been filed to federally list the species. The Pacific fisher also is a federal sensitive species.

E. Alternatives Considered

As discussed in USFWS's guidelines for HCPs, appropriate conservation and mitigation measures under Section 10(a) of the federal ESA can take many forms, including habitat preservation, enhancement, restoration, and creation; buffers around and land use restrictions within areas with extant habitat; habitat management; and public education. In shaping its conservation strategy, Simpson weighed its ability to implement such measures on its property and evaluated different approaches to habitat conservation. Simpson also considered alternative ways to comply with the federal ESA, including avoidance of take.

1) Alternative Conservation Strategies

To determine the best course of action, Simpson considered the advantages and disadvantages of three different approaches to habitat conservation: one based on maximum protection of existing spotted owl sites, one based on recommendations in the Thomas report, and one based on timber resource management. Each of these approaches was evaluated in terms of Simpson's two primary goals: compliance with the federal ESA and continuation of timber harvest operations.

Under the maximum protection approach, emphasis would be placed on avoidance of take and preservation of areas currently used by owls. Protection of occupied habitat could occur through a combination of seasonal and permanent restrictions on timber harvest operations and/or the establishment of permanent reserves in areas with the best quality habitat or largest number of owls. Timber harvesting would continue in areas not used by owls and/or in areas outside of permanent preserves. This approach would maximize protection based on current conditions; but as conditions changed over time, so would the efficacy of the conservation measures and so would Simpson's ability to avoid take. In addition, given the current distribution of spotted owls on the property, timber harvest operations would likely be severely constrained, making implementation of the conservation measures economically infeasible for Simpson.

Under the Thomas report approach, emphasis would be placed on preservation of blocks of habitat capable of supporting 15 to 20 owl pairs and/or maintenance of habitat used by dispersing owls. As discussed in Section 1.B of this HCP, the Thomas report outlines a two-part conservation strategy by which a network of conserved areas would be established and habitat between the areas would be maintained in a condition that would permit owl dispersal. Timber harvesting would continue outside of conserved blocks and would be planned to help maintain the corridors. This approach potentially would link conserved blocks on Simpson's property to a network of other conserved areas and/or permanently maintain dispersal corridors across the property. However, if applied strictly as proposed in the Thomas report, the approach would potentially maximize rather than minimize potential take of spotted owls on Simpson property. Based on data available at the time, the Thomas report assumed that owl densities on private timberlands were low and could be maintained at a level of 1.7 pairs/township (36 mi^2). The lowest density recorded on Simpson's property (0.32 owl/mi^2) is more than five times higher than that suggested in the Thomas report, and the highest density (1.2 owls/mi^2) is more than twenty times higher (see Section 2.G).

Under the timber resource management approach, emphasis would be placed on the protection of owl habitat as a regulated resource on the property. Preservation of habitat and protection of nest sites would occur in the context of timber harvest regulations and related laws that apply to the property as a whole and to individual harvest areas. Impacts to the existing owl population on the property could be minimized and mitigated, but the degree to which future stands would be able to support spotted owls could not be guaranteed.

After weighing these approaches, Simpson concluded that the best way to meet its goals would be to combine aspects of all three. Specifically, the strategy proposed in this HCP emphasizes habitat management in concert with nest site protection and designation of areas where no timber harvesting will be allowed. Ongoing research also is proposed, both for its use in planning habitat management over time and for its value in planning the recovery of the species. These and other components of the conservation plan are described in detail in Section 4.C of this HCP.

2) Alternatives to this HCP

Four alternatives to the preparation of this HCP also were considered: no project (i.e., no HCP would be prepared), compliance with CDF's existing spotted owl rules, completion of the California HCP, and preparation of a multiple species conservation plan.

a) No Project

Under the no project alternative, spotted owls on Simpson's property would be protected by Section 9 of the federal ESA. Timber harvesting technically could still occur under this scenario, provided no owls were killed, injured, or affected in a way that would constitute harm or harassment under the ESA. However, given the current distribution of spotted owls on the property, it is not likely that Simpson could continue commercial timber harvest operations on its properties under this alternative. Moreover, the no project alternative would not promote the regeneration of owl habitat, establish set-asides where no harvesting would occur, or provide additional owl research that would benefit the species.

b) Compliance with Existing CDF Rules

Under this alternative, Simpson would plan harvests in one or more areas to prevent harm or harassment of spotted owls as specifically defined in CDF's spotted owl rules and as required under federal ESA. No incidental take would occur, and no permit would be necessary. As with the no project alternative, this approach avoids take but does not otherwise directly benefit the owl population on Simpson's property. While the alternative provides a way to demonstrate compliance with prohibitions on take, it does not reconcile long-term and large-scale timber management with the conservation of a federally listed species. Moreover, the pattern of timber removal and regrowth under a no take scenario could have detrimental effects on spotted owls over time. It is the consensus of the scientific committee for the California HCP that the no take rules will lead to fragmentation and degradation of habitat over time and do not represent a long-term viable alternative for the northern spotted owl. The committee ranked six alternatives for coastal mesic and mixed evergreen subregion. In both subregions, the current no take rules were ranked next to last in terms of maintaining long-term viability for spotted owls (CDF 1991).

c) Completion of the California HCP

Under this alternative, Simpson would wait until the statewide spotted owl HCP initiated by CDF is completed and a regional incidental take permit has been approved. Incidental take on Simpson's property would then be authorized through the permit secured and administered by CDF. This option would postpone incidental take on Simpson's land until CDF's plan is approved but also would delay implementation of the conservation measures proposed by Simpson. This delay would not benefit the existing owl population on or adjacent to Simpson's property.

d) Preparation of a Multiple Species Plan

Under this alternative, Simpson would prepare an HCP for all threatened, endangered, and candidate species on its California properties. Since some of the species are state as well as federally listed, such a plan could involve processing of a state Section 2081 permit/agreement. While this approach would cover a broader range of species than Simpson's spotted owl HCP, the multiple species HCP would require data on each of the other species equivalent to the level collected on the owl. Collection of the additional data and processing of the state and federal permits would postpone implementation of the conservation measures proposed for the owl for several years and thereby also delay the anticipated benefits of those measures to owls in and adjacent to the permit area. This alternative was rejected because although other species of concern occur on Simpson's property, Simpson does not propose to take any such species and is not seeking a permit for such take. Moreover, Simpson's spotted owl HCP is designed to avoid activities which are inconsistent with conservation efforts for other species (see Appendix C).

Simpson's Spotted Owl Conservation Plan

A. Introduction

As discussed in Section 3.E, Simpson's spotted owl conservation plan has been designed to meet two primary goals: compliance with the federal ESA and continuation of timber harvest operations on the property. Moreover, the underlying philosophy of the plan is that these two goals are not mutually exclusive and that, in fact, silviculture can and will be used to sustain spotted owl habitat on Simpson's property.

This section of the HCP presents the details of the conservation plan in a sequence that corresponds to its use as part of Simpson's application for an incidental take permit from USFWS. Section 4.B identifies the proposed scope of the federal permit and the level of take that will occur. Section 4.C presents the measures by which the impacts of take will be minimized and mitigated to the maximum extent practicable, and Section 4.D identifies how the plan will be implemented and monitored.

B. Scope of the 10(a) Permit

As discussed in Sections 1.D and 2.H, existing owl habitat in the plan area is literally the by-product of past timber harvesting. Likewise, future harvesting and timber growth are expected to play major roles in replicating habitat conditions that support spotted owls. However, future harvesting also will displace some resident owls and remove a portion of the existing habitat. Although no direct harm to individual spotted owls is intended and suitable habitat will be available to some displaced owls, the action involves a federally listed threatened species and is subject to the provisions of the federal ESA. Consequently, Simpson is seeking an incidental take permit from USFWS for impacts of its ongoing timber harvest operation on spotted owls.

1) Permit Period and Area

Simpson is seeking a 30-year permit, with a comprehensive review of permit conditions at the end of ten years (see Section 4.D). (The comprehensive review is in addition to annual reporting requirements.)

The permit would authorize incidental take of spotted owls in connection with timber harvest operations on the commercial timberlands of its California subsidiaries, Arcata Redwood Company and Simpson Redwood Company. These properties are located in Del Norte, Humboldt, Mendocino, and Trinity counties, California.

Should Simpson in the future acquire new timber lands in California, they would automatically be covered by the permit. Simpson would survey and report on those new lands as soon as practicable and would impose the conservation and mitigation measures described in Section 4.C to those acres. Simpson currently does not contemplate the sale of any lands that would be covered by the permit. However, should that occur, the lands would be sold free of coverage by the permit, that is, unrestricted.

2) Type of Take

The permit would cover incidental take of spotted owls in connection with otherwise lawful timber harvest operations in the permit area. As discussed in Section 1.B, the federal ESA defines "take" as "to harass, harm, pursue, shoot, wound, kill, trap, capture, or attempt to engage in any such conduct." Federal regulations further define "harass" and "harm" as follows. "Harass" means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). "Harm" means an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

The primary form of incidental take for which Simpson seeks this permit is displacement of owls due to modification of owl habitat, particularly areas with nest sites and primary activity centers (owl sites). No direct killing or injuring of spotted owls is anticipated, and Simpson will take all reasonable precautions to avoid such impacts; instances of unintentional or inadvertent harm, however, would be covered by the permit. Some foraging, roosting, and nesting habitat would be removed annually, but no net loss of habitat in the age-classes and with the characteristics of areas currently used by owls is expected because harvested habitat would be replaced through maturing of younger timber stands.

The following is an estimate of the level of take which will result from habitat modification and owl displacement. Whether such activities will actually impair essential behavioral patterns and result in death or injury, constituting "harm," will depend on the circumstances involved in each case. In addition, the conservation measures identified in the HCP (e.g., protection of nest sites during the nesting and fledging season) are designed to avoid the likelihood of injury to owls which would constitute harassment. Nevertheless, Simpson seeks a permit covering any activity which could result in a take and has, therefore, made very conservative assumptions in its analysis, both as to the type and level of take. In effect, this analysis reflects a "worst case" scenario.

Accordingly, for purposes of the incidental take permit and this HCP, it is assumed that a take will occur when owl sites are harvested, displacing owls that occupied those sites during the nesting and fledging season (direct displacement). Simpson has also assumed that displacement, and therefore take, will occur where owl sites themselves are not harvested but harvesting within stands near those sites reduces habitat to threshold levels discussed below (indirect displacement). Simpson believes that the actual take caused by its operations will be much lower than the estimates that follow.

3) Estimated Level of Take

The calculations of take from direct and indirect displacement are expressed as annual rates and are based on the number of owl sites potentially affected by Simpson's timber harvest operations over the next 10 years. Both calculations assume steps to avoid and minimize the impacts of take, including the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed. Simpson also has assessed the possibility that additional owls in currently unknown locations might be displaced.

a) Direct Displacement

Simpson estimates that approximately 3 owl pairs per year would be displaced by the harvest of stands with known owl sites. This estimate is based on the number of owl sites in areas planned for harvest over the next 10 years and was calculated as follows.

First, the locations of 72 owl sites known to be on Simpson property were plotted on sourcing maps used to plan timber harvests. This mapping indicated that 19 (26.4 percent) of the 72 sites were in stands that would be entered for harvest by 2001. Owls in the 19 sites were assumed to be taken as soon as the stand was entered for harvest. Then, to ensure that displacement was not underestimated, it was assumed that 40 unconfirmed sites would be affected by timber harvesting in the same proportion (26.4 percent) as the confirmed sites. By this calculation, owls in an additional 10.6 sites would be displaced. The two estimates were combined, yielding a total of 29.6 sites over the 10-year period or approximately 3 displaced pairs per year.

This estimate of owl displacement (3 pairs per year) is considered high because of the following assumptions that were built into the calculation: (1) owls were considered taken as soon as the stand was entered for harvest even though some owls would likely move to an adjacent stand with minimal disruption of their behavior (also see Section 4.C); (2) unconfirmed sites were included in the calculation even though most of the sites are in the areas not scheduled for harvest in the next ten years; and (3) each site was assumed to be occupied by a pair even if currently occupied by only one owl.

As noted above, steps will be taken to avoid direct displacement and to minimize and mitigate its impacts when it occurs. These steps include the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed (see Section 4.C).

b) Indirect Displacement

Regarding potential displacement of owls due to habitat removal in adjacent stands, Simpson estimates that approximately 2 owl pairs per year might be affected by such activities. This estimate is an extension of the detailed 1990-91 study of habitat variables within 502-acre circles around 60 nest sites (see Section 2.G). A summary of how the estimate was calculated follows, and a more detailed description of the steps taken is presented in Appendix D.

First, the 60 circles were plotted on the sourcing maps referenced above. This mapping revealed that 34 of the 60 circles overlapped areas planned for harvest. Of these 34, 9 were among the sites already identified as taken when the stand was entered for harvest. The remaining 25 circles were then analyzed in terms of how the stands would change and how much harvesting would occur within each over the next 10 years. This analysis was based on the data collected in 1990-91 on age-classes and cover types within each circle, which made it possible to project the amount of habitat within two age-classes within each circle in 2001. The two age-classes of concern are (1) stands 46 years or older (46+), which are considered the best potential nesting habitat on the property; and (2) stands 31 years and older (31+), which would include the best potential nesting habitat, marginal nesting habitat, and foraging habitat. The mean minus one standard deviation for each of the two age-classes in all 60 circles as of 1990-91 was then used as a threshold for determining potential displacement. If the amount of 31+ was below 233 acres or the amount of 46+ was below 89 acres, owls in that circle were considered displaced and therefore taken. This analysis indicates that owls in 9 (15 percent) of the 60 sites would be displaced. This proportion (15 percent) was then applied to all 146 owl sites identified on and adjacent to Simpson's property, yielding a total of 22 sites during the decade, or approximately 2 owl pairs per year, potentially displaced by adjacent harvests.

This estimate of owls potentially displaced by indirect impacts (2 pairs per year) is considered high because of the following assumptions that were built into the calculation: (1) the thresholds used to determine take are higher than those indicated by a landscape analysis of spotted owl sites on the property (see Section 2.G and Appendix D); (2) sites adjacent to the applicant's property were included in the calculation even though it is not likely they would be affected to the same degree as sites on the property; and (3) sites were assumed to be occupied by a pair even if currently occupied by only one owl.

It also should be noted an attempt was made to calculate take due to habitat removal using a discriminant function analysis of multiple habitat variables identified in the 1990-91 nest site study (see Appendix E). This analysis did not yield a reliable measure of take but does represent an additional attempt by the applicant to identify and quantify potential impacts to spotted owls.

As noted above, steps will be taken to avoid indirect displacement of owls and to minimize and mitigate its impacts when it occurs. These steps include the protection of nest sites during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed (see Section 4.C).

c) Total Estimated Take

To complete its worst case calculation of take Simpson combined the estimates of direct and indirect take. Under this scenario, displacement would range from 3 to 5 pairs per year, with 5 representing the worst case.

As a share of the rangewide population, five pairs represent approximately 0.25 percent of the minimum number of pairs (2,000) thought to exist in the species' range when the owl was listed (USDI 1990a, 1990b). If, under the worst-case scenario, 50 pairs were displaced over 10 years, approximately 2.5 percent of the minimum number of pairs would be affected by the applicant's operations. It also should be noted that 3,000 to 4,000 pairs was considered to be a more reasonable estimate at the time of the listing, as cited by Thomas et al. (1990). Under this estimate, the number of pairs affected by Simpson's operations would likely be an even smaller percentage of the actual number in the species' range.

Within the permit area, 3 to 5 pairs represent 2.5 to 4.5 percent of 112 owl sites known to be on Simpson's property as of June 30, 1991, and 0.8 to 1.3 percent of the 377 owl sites reported in Del Norte and Humboldt counties to CDFG as of April 1991. It should be noted that the two-county total does not include the results of the applicant's 1991 surveys or those of other property owners in the area. Consequently, the number of owls and owl sites affected on Simpson's property would likely be an even smaller portion of the total number in the immediate region.

As under the other scenarios, steps will be taken to avoid direct and indirect displacement of owls and to minimize and mitigate its impacts when it occurs (see Section 4.C). These steps include nest site protection during the nesting and fledging season and establishment of set-asides where no harvesting will be allowed.

d) Risk to Unknown Sites

Regarding the possibility that unknown owls might be taken through timber harvest, the three years of surveys conducted for the preparation of this HCP and those required for individual THPs minimize the likelihood that such instances would occur. In addition, currently unknown owl sites are not likely to occur in areas that would affect the estimated annual rate of displacement. Simpson's surveys over the past three years have been concentrated in areas where merchantable timber (the "best" owl habitat) occurs and harvests are being planned. Unknown owl sites would likely be found in unmerchantable stands that are not being planned for harvest in the near future and have not been surveyed for owls because the areas did not meet even the most minimum standards of owl habitat. Some owls already have been found roosting and nesting in such areas.

Additional owls found in such stands would increase the total number of owl sites in the plan area but would not be directly affected by timber harvests in the near future. Moreover, the increase in owl sites would further reduce the proportion of owls displaced.

4) Other Potential Impacts

In addition to estimating take of owls, Simpson also has calculated habitat loss and assessed other potential impacts.

a) Habitat Loss

Regarding habitat loss, it was assumed that all stands in age-class 46+ represent potentially suitable habitat. This assumption is further supported by the landscape analysis of spotted owl sites on Simpson's property as of June 30, 1991 (see Sections 2.G and 2.H). Under this assumption, 3,000 to 6,000 acres of potential habitat would be harvested annually. This loss, however, would be offset by the maturing of younger stands into the 46+ age-class. At the end of the first decade, there will be 8 percent more 46+ than at present. At the end of the second decade, there will be 80 percent more than at present; and at the end of the third decade, 109 percent more than at present (see Section 3.C). Both the amount and long-term availability of potential habitat would benefit spotted owls in the plan area, including those displaced by timber harvesting.

However, most of the 46+ stands that will exist at the end of the 30-year permit period will have resulted from silviculture practiced before the HCP was implemented. How these stands will compare to those that are currently 46+ is largely unknown due to a number of differences between the way current and future stands of this age were produced. Some stands currently in the 8-30 age-class may have fewer snags and residual trees and less dead and down woody materials than current 46+ stands used by owls. However, since 1976, Class I and II streams have been protected with stream protection zones, which means that future 46+ stands will likely have more structure in the lower parts of the drainages--the areas most used by spotted owls. Future 46+ stands also will likely develop structural features faster than those in the past due to enhanced growth from intensive forest management (e.g., stocking requirements, brush management, precommercial thinning, and fertilization).

Simpson believes, but cannot guarantee, that most stands 46+ will be used by owls in the future as they are now. Therefore, monitoring measures will be implemented to track the ages of stands in relation to their use by spotted owls so that appropriate mid-course changes to the conservation strategy can be made if necessary (see Sections 4.C and 4.D). Habitat management measures also will be implemented to minimize and mitigate the impacts of habitat loss (see Sections 4.C and 4.D).

b) Other Impacts

Other potential impacts of concern are those cited by USFWS when the spotted owl was listed. These include the potential effects of forest fragmentation, the loss of management options, possible increases in predation and competition, possible increases in disease and parasitism, and added risk of harm due to natural occurrences. Potential impacts to other species of concern also have been identified.

- **Forest Fragmentation.** Future harvesting in the plan area is expected to produce stands of different ages that would provide suitable habitat for spotted owls. Fragmentation would affect individual spotted owls but would not isolate populations. In addition, much of the permit area is flanked by state and federal parks and forests, making isolation of populations unlikely. Moreover, existing harvesting practices such as streamside management zones would result in much of the harvested lands being suitable for passage by dispersing owls (Thomas et al. 1990) as found by Sisco and Gutierrez (1984). Effects on individual owls will be minimized and mitigated as described in Section 4.C.

- **Loss of Management Options.** When the spotted owl was listed, USFWS's comments regarding loss of management options concerned the quantity and quality of habitat preserved in reserve networks, the effects of even-aged management on habitat replacement, and the inadequacy of current regulatory mechanisms. Since suitable habitat would be maintained in the permit area over time at existing or higher levels, the expected level of owl displacement is not expected to have a negative effect on the carrying capacity or quality of habitat of adjacent federal and state lands. Moreover, given the number of owl sites in and adjacent to the permit area, five of the subareas identified on Simpson's property have the potential to sustain 15 to 20 pairs, which would make them the functional equivalents of the optimal HCAs recommended in the Thomas report. In addition, habitat management that will be implemented as mitigation for incidental take includes measures to accelerate the development of replacement habitat (see Section 4.C). Finally, the activities that will result in incidental take are now and will continue to be subject to state Forest Practice Rules.

- **Predation and Competition.** Predation and competition have not been observed in the permit area as factors causing a decline in the local owl population. Given that the amount of suitable habitat in the permit area is projected to remain at or exceed present levels, increased predation and competition are not anticipated as a result of owl displacement. It is possible, however, that the availability of habitat may attract other owls and other species to the area and consequently increase the number of predators and competitors. The potential for such impacts would be monitored as part of the implementation of the HCP (see Sections 4.C and 4.D).

- **Disease and Parasitism.** Disease and parasitism have not been observed as factors causing a decline in the local owl population. The monitoring program, however, would allow for early detection of such problems in the plan. In addition, the distribution of owls in different parts of the property reduces the potential that disease or parasitism in one area would jeopardize the overall population.

- **Natural Occurrences.** Wildfires have occurred on the property in the recent past, but their effect on the resident owl population is not known. Given the size of the permit area, the distribution of owls on the property, and the management of the land for timber harvesting, the anticipated level of owl displacement would not increase the likelihood that natural occurrences would jeopardize the local population.

- **Other Species of Concern.** As discussed in Section 3.E, Simpson does not propose to take any other federally listed species in the permit area. However, 39 other sensitive plants and animals are associated with habitat in the permit area and, where they occur in the same location as spotted owls, have been indirectly protected by Section 9 of the federal ESA. Resumption of timber harvests in these areas would remove the indirect protection of Section 9 but would not change other requirements under state and federal law that apply to those species. As discussed in Appendix C, the impacts of Simpson's spotted owl HCP on most of the other species is expected to be neutral, that is, neither adverse nor beneficial. Based on a preliminary analysis, however, at least 18 of the 39 species may benefit from the proposed conservation measures.

C. Mitigation Measures

To ensure protection of spotted owls as per federal and state laws and to mitigate and minimize, to the maximum extent practicable, the potential effects of timber harvesting on the resident owl population, Simpson proposes to implement a four-point conservation program. The program includes:

1. Habitat management and nest site protection;

2. Ongoing spotted owl surveys and studies;

3. Set-asides in selected habitat areas; and

4. Employee/contractor training.

The program will be integrated with Simpson's long-term operating plan for the next 30 years (1991-2021). As with all long-term plans, the conservation program will require updating and modification over time. Specific measures proposed here are focused on the first 10 years of the program. Mechanisms for adjusting the measures as necessary are included in the program, including a comprehensive review and update at the 10-year mark.

1) Habitat Management and Nest Site Protection

Habitat management measures include timber harvest planning, owl habitat planning, and overall environmental resource management. The measures will be implemented primarily through the THP process, which requires site-specific actions. This HCP will be used to guide the development of individual THPs and to establish long-term planning objectives.

As part of the development and approval of this HCP, the proposed conservation measures are being evaluated to prevent inconsistency with conservation measures for other listed species, species of special concern identified by the Board of Forestry, and species proposed for listing. In addition, the THP process, which includes "no take" and habitat protection regulations as well the environmental review of individual THPs, will be used to avoid, minimize, and mitigate impacts on such species.

a) Timber Harvest Planning

Timber harvests will be planned and implemented in a way that will:

- Protect owl nest sites during the nesting and fledging season;
- Maintain suitable foraging, roosting, and nesting habitat on Simpson property;
- Estimate the amount of residual trees and snags before and after harvest; and
- Accelerate the development of replacement habitat following harvesting.

Stands scheduled to be cut between March 1 and August 31 will be surveyed for spotted owls prior to entering the area for harvest. A 1,000-foot buffer around each stand also will be surveyed to include adjacent areas potentially affected by timber harvest.

During the layout of each harvest area, foresters will look for evidence of spotted owls (e.g., whitewash and pellets) and spot call at strategic locations to ensure coverage of the area. Immediately prior to entry, the area will be surveyed again for owls. If no owls respond, the area will be revisited a maximum of three times. If an owl responds, it will be moused to determine its reproductive status and, if paired, its nest site.

If a nest is found, the nest tree will be marked and no timber falling or yarding will be allowed within a 0.25-mile radius of it until it has been determined that the young have fledged or that the nest has failed. After the young have fledged, the radius of protection will be 500 feet from the nest tree and connectivity to continuous habitat will be maintained. When the young have dispersed, or it has been determined that the nest has failed, falling and yarding will be allowed within the 500-foot radius.

b) Owl Habitat Planning

When planning timber harvests, Simpson also will identify ways to retain resource values that would provide a core for future owl habitat. Such resource values include:

- Patches of hardwoods and conifers;
- Habitat structure along watercourses;

- Hard and soft snags;
- Standing "live culls;" and
- Small areas of undisturbed brush.

Not all areas will have owl habitat values that can be retained; and in those that do, existing natural conditions, other wildlife considerations, and worker safety issues will vary. Site-specific measures will be identified in the THP for the area, and the amount of snags and residual trees before and after harvest will be estimated and reported.

c) Overall Resource Management

In addition to addressing the specific needs of the spotted owl, Simpson's THPs will be designed to:

- Retain 50 to 70 percent canopy and 50 percent ground cover along Class I and large Class II streams;
- Retain 30 to 50 percent canopy and 50 percent ground cover along small Class II streams;
- Retain a variety of tree sizes (height and diameter) and species within Watercourse and Lake Protection Zones (WLPZs), with priority given to wildlife habitat trees and down woody material;
- Where appropriate, widen WLPZs to take advantage of existing natural conditions;
- Maintain cooperative arrangements with appropriate agencies to implement projects for the enhancement and rehabilitation of watercourses;
- Protect ponds, swamps, bogs, and seeps as separate riparian areas and identify them in the THP as habitat retention areas;
- Identify and protect non-riparian areas that will have value to wildlife following harvest (minimum size of 0.5 acre, no maximum) and, where possible, use such areas to connect WLPZs;
- Protect resource values during site preparation through measures such as limitations on burning, exclusion of heavy equipment from retention areas, and construction of additional firelines (where appropriate) around retention areas;

- Design, construct, and maintain roads to minimize impacts and the number of stream crossings through riparian areas;
- Use directional falling techniques to protect designated retention areas; and
- Modify silvicultural systems as appropriate to ensure compatibility with the habitat requirements of other species found within Simpson's ownership that are considered sensitive by state and federal regulatory agencies.

These measures will benefit other species of concern as well as the owl and meet or exceed current state Forest Practice Rules.

2) Spotted Owl Research Program

To gather additional data on owl behavior and habitat needs and to help guide the implementation of conservation measures, Simpson proposes to continue its spotted owl research program.

a) Owl Surveys and Banding

Owl surveys will be conducted annually on Simpson's property as part of THP preparation and ongoing owl research projects. Banding of spotted owls on Simpson property also will continue where appropriate to facilitate population estimates and to gather additional demographic information. As of October 24, 1991, Simpson has banded 358 spotted owls.

b) Nest Monitoring

Each year a minimum of 50 spotted owl pairs (selected at random but in proportion to the distribution of known pairs) will be monitored to determine reproductive success of the spotted owl population on Simpson's property. Reproductive success of the pairs in the monitored nests will be compared with the regional average, as determined by the ongoing Willow Creek project or other pertinent regional studies.

c) Nesting Habitat Model

Nest site characteristics will be further studied to quantify the vegetative and habitat mosaic characteristics of spotted owl habitat. The results will be used to refine the nesting mosaic model and to help document the extent to which second-growth forests in the coastal redwood zone are able to sustain a breeding population of spotted owls.

d) Prey-Base Study

The abundance and distribution of key prey species will be quantified among stands of different ages and cover types. This study was initiated on a preliminary basis in 1991 and will be expanded in future years.

Other research projects will be considered as time and funding allow.

3) Set-Asides

To protect existing owl sites in select areas (thereby avoiding take) and to promote development of suitable owl habitat following harvesting in other areas, Simpson will establish 39 set-asides in which timber harvesting will not be allowed: 8 in Klamath, 14 in Korbel, 9 in Mad River, 4 in Upper Mad River, and 4 in Fortuna/Carlotta (Table 39 and Figure 18). Combined, the 39 contain 13,242.5 acres and, as of June 30, 1991, 39 owl sites.

a) Set-Aside Selection Criteria

The set-asides were selected based on their current and potential function as nesting and roosting habitat, their size, their location in relation to known owl sites immediately adjacent to Simpson property, and their location in relation to planned timber harvests on Simpson property. Where possible, large contiguous blocks of habitat were selected. In the highly fragmented Mad River area, set-asides were chosen to accelerate the development of future habitat and to protect known owl pairs in the few remaining patches of suitable habitat in the area.

b) Distribution of Proposed Set-Asides

Thirty-one set-asides are in the southern one-half of Simpson's property, where the majority of known owl sites are located and two-thirds of the timber harvesting planned over the next 10 years is likely to occur. These sites range in size from under 100 to over 2000 acres and contain 10,331.7 acres.

Eight set-asides are in the northern portion of Simpson's property, which is flanked by state and federal parks and wildlife reserves. Compared with the southern portion of Simpson's property, the northern portion currently has younger age-classes and consequently will have less timber harvesting over the next 10 years. The proposed set-asides in this area range in size from under 100 to over 900 acres and contain 2,910.8 acres.

TABLE 39
NUMBER OF OWL SITES IN (AS OF JUNE 30, 1991)
AND ACREAGE OF PROPOSED SET-ASIDES ON SIMPSON
TIMBERLANDS BY SUBAREA

Subarea/Set-Aside	Owl Sites	Acres
Klamath (N=8)		
H131	1	167.1
Upper Tully Creek	1	239.7
T300	1	71.9
Williams Ridge	1	262.0
Metah Creek*	0	176.4
Blue Creek Cabin	1	637.3
Bear Creek	0	431.6
Starwein Ridge*	0	924.8
Subtotal	5	2,910.8
Korbel (N=14)		
Roddiscraft/Powerline	**	303.9
Mule Creek	1	405.4
Poverty Creek	1	811.9
Camp Bauer	2	241.2
Bald Mt. Creek	1	61.3
SF Bald Mt.	1	130.0
Cal Barrel	1	192.7
Old 299	1	172.2
Lupton Creek	1/**	248.5
Wiregrass*	0	229.3
Redwood Creek	**	181.2
Fawn Prairie*	0	242.4
Dolly Varden*	0	374.5
Canyon Creek	1	193.2
Subtotal	10	3,787.7
Mad River (N=9)		
6007	1	193.8
Puter Creek	0	127.8
4230	1	77.1
4076	3	294.7
5700	1	76.3
Black Dog Creek*	0	167.7
Devil's Creek	0	113.3
4850	5	876.4
No Name Creek	2	747.6
Subtotal	13	2,674.7

TABLE 39
NUMBER OF OWL SITES IN (AS OF JUNE 30, 1991) AND ACREAGE OF PROPOSED SET-ASIDES ON SIMPSON TIMBERLANDS BY SUBAREA
(continued)

Subarea/Set-Aside	Owl Sites	Acres
Upper Mad River (N=4)		
Humbug Creek	1	168.4
Bug Creek	1	371.7
Little Deer Creek	2	681.2
Boulder Creek	5	2,002.5
Subtotal	9	3,223.8
Fortuna/Carlotta (N=4)		
Salmon Creek	1	218.1
EBF	1	111.7
Walsh	0	140.7
McCloud Creek*	0	175.0
Subtotal	2	645.5
TOTAL SET-ASIDES (N=39)	39	13,242.5

*Potential owl habitat; area not currently occupied.
**Owl site located immediately adjacent to Simpson property.

Figure 18
color oversize
(count as 2 pages)

Legal descriptions of the locations of each set-aside will be included in the implementation agreement for this HCP.

c) Land Use Constraints

No timber harvesting will be allowed in the set-asides. Construction and maintenance of access roads in set-asides will be allowed, provided that such activities are not within 500 feet of nest stands during the nesting and fledging season and are planned and conducted in accordance with state and federal requirements. If a nest is found in a set-aside near a stand to be entered for harvest, no timber falling or yarding will be allowed within a 0.25-mile radius of it until it has been determined that the young have fledged or that the nest has failed. After the young have fledged, the radius of protection will be 500 feet from the nest tree and connectivity to continuous habitat will be maintained. When the young have dispersed, or it has been determined that the nest has failed, falling and yarding will be allowed within the 500-foot radius.

Simpson believes that these restrictions on activities during the nesting season will avoid the disruption of nesting owls' essential behavioral patterns.

d) Annual Monitoring

Set-asides will be monitored annually. To determine occupancy by spotted owls, monitoring will include site visits during the March 1 to May 15 nesting season. Spot calling will be done at strategic locations to ensure complete coverage of each set-aside. If no responses are elicited, the area will be revisited and spot calling repeated up to a maximum of three times. If an owl responds, it will be moused to determine if it is banded, paired, or nesting, and if nesting, to locate the nest. Pairs found nesting will be revisited later in the season to determine reproductive success.

A comprehensive review of the purpose and function of the set-asides will be conducted at the end of 10 years.

4) Employee/Contractor Training

To facilitate implementation of the HCP, Simpson will institute a training program for its registered professional foresters, engineers, and timber falling contractors. The program will train the employees and contractors in survey and monitoring protocols, familiarize them with the details of the HCP, and encourage their involvement in data collection and plan implementation.

D. Plan Implementation

1) Implementation Agreement

Implementation of the conservation and mitigation measures will be governed by an agreement between Simpson and USFWS and funded by Simpson as part of the company's ongoing operations. The agreement will identify the conditions of the incidental take permit, including reporting requirements, thresholds that would trigger corrective actions, and the scope of the comprehensive 10-year review.

a) Annual Reports

At the end of each year, Simpson will prepare an annual report and submit it to USFWS for review. Copies of the report also will be made available to CDF and CDFG. The report will:

- Specify actual instances of owl displacement over the preceding year, including the number of spotted owl sites removed, the number of spotted owls displaced, and any inadvertent harm or injury to individual owls that may have occurred;
- Determine the proportion of habitat lost with owl sites for several areas of influence (e.g., 1,000-foot, 0.5-mile, and 0.7-mile radii);
- Compare actual and estimated levels of owl displacement for the past year;
- Estimate levels of owl displacement for the upcoming year;
- Estimate the current number of owl sites and amount of owl habitat on Simpson property and note any significant changes from the previous year;
- Report pre- and post-harvest estimates of snags and residual trees in timber harvest plans;
- Report the results of the nest and set-aside monitoring efforts; and
- Assess the efficacy of the conservation measures to date based on thresholds specified in the implementation agreement.

The report also will identify any corrective measures or other changes that may be necessary to improve the efficacy of the plan.

b) Thresholds

Simpson proposes that the primary threshold for triggering corrective action be the reproductive success rate of a sample of the spotted owl population on Simpson property measured against regional averages. If an annual report indicates that the rate has fallen significantly ($P \leq 0.05$) below the rate of the Willow Creek study area for three consecutive years, Simpson will propose corrective measures for review and approval by USFWS. The Willow Creek study area was chosen for comparison because it is the only study in the region with long-term data on the reproductive success of northern spotted owls. Lambda (the finite rate of population change) also will be calculated annually to monitor for long-term population declines.

c) 10-Year Comprehensive Review

To further ensure the ultimate efficacy of the conservation measures, Simpson proposes that a comprehensive review of the HCP and permit conditions be conducted at the end of the first 10 years. The review will include:

- A comparison of actual and estimated levels of owl displacement;
- A comparison of actual and estimated distribution of owl habitat;
- A reevaluation of the biological basis for the conservation strategy based on the data collected through the research program and other sources;
- A detailed analysis of efficacy of and continued need for the set-asides and of the long-term viability of the owl population on Simpson's property; and
- An estimate of annual owl displacement for the remainder of the permit period.

As part of the 10-year review, the timing and need for future comprehensive reviews will be determined.

d) Funding

Simpson will fund implementation of the HCP and will identify budgets for monitoring and research in the annual reports submitted to USFWS. The implementation agreement will specify Simpson's financial responsibility for specific measures.

2) Monitoring Measures

To provide accurate records of actual levels of take, monitor potential impacts of take on the owl, and track the efficacy of conservation measures, Simpson will institute the following record-keeping process. Simpson also will develop a contingency plan to ensure prompt response to unforeseen events.

a) Field Records

Pre-harvest owl surveys and actual instances of take will be reported on standardized forms that Simpson will maintain for the duration of the permit period. Simpson will designate a resource manager or wildlife biologist to review the forms, compile reports, and maintain the files. The information recorded on the forms will be summarized in annual reports to USFWS, and the forms will be made available to USFWS, CDF, and CDFG on request.

b) Data Base Update

Simpson will update its GIS data base regularly to include the most current information on the location of owl sites and owl habitat on Simpson property. In addition, the habitat forecasting model will be refined as additional data on owl habitat characteristics become available.

c) Unforeseen Events

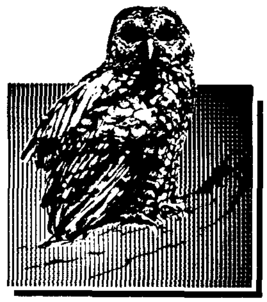
In addition to providing the above records and reports, Simpson will notify USFWS of any direct harm to an owl on Simpson property, any catastrophic event that destroys owl sites or owl habitat, and any unexpected shift in the number or distribution of known owl sites on Simpson property. Such notice will be made in writing within reasonable time limits.

d) Contingency Plan

Simpson will work directly with USFWS staff to develop a contingency plan that identifies specific actions that Simpson will take if thresholds are exceeded or unforeseen events occur. The contingency plan will be prepared and submitted with the first annual report and revised as appropriate over the permit period at the direction of the USFWS.

3) Plan Amendments

Corrective measures and other necessary changes will be developed in coordination with USFWS. Significant changes will be submitted to USFWS as proposed amendments to the permit. Such amendments will be subject to assessment under the ESA and to appropriate environmental documentation.



References

Barrows, C. W.

1980 Feeding ecology of the spotted owl in California. *Journal of Raptor Research* 14:73-78.

1981 Roost selection by spotted owls: an adaptation to heat stress. *Condor* 83:302-309.

1985 Breeding success relative to fluctuations in diet for spotted owls in California. Pages 50-54 *in* R. J. Gutierrez and B. Carey, editors. Ecology and management of the spotted owl in the Pacific Northwest. General Technical Report PNW-185, USDA Forest Service, Portland, Oregon.

Barrows, C. W., and K. Barrows

1978 Roost characteristics and behavioral thermoregulation in the spotted owl. *Western Birds* 9:1-8.

Blakesley, J. A., A. B. Franklin, and R. J. Gutierrez

1991 Spotted owl roost and nest site selection in northwest California. Unpublished manuscript, Humboldt State University, Arcata, California.

Brown, J. L.

1969 Territorial behavior and population regulation in birds: a review and reevaluation. *Wilson Bulletin* 81:293-329.

California Department of Forestry and Fire Protection

1991 Notes on the Northern Spotted Owl Habitat Conservation Plan Scientific Committee Meeting Held December 18-19, 1991.

Carey, A. B.

1985 A summary of the scientific basis for spotted owl management. Pages 100-114 *in* R. J. Gutierrez and B. Carey, editors. Ecology and management of the spotted owl in the Pacific Northwest. General Technical Report PNW-185, USDA Forest Service, Portland, Oregon.

Carey, A. B., J. A. Reid, and S. P. Horton
1990 Spotted owl home range and habitat use in southern Oregon Coast Ranges. *Journal of Wildlife Management* 54:11-17.

Forsman, E. D.
1981 Molt of the spotted owl. *Auk* 98:735-742.

1983 Methods and materials for locating and studying spotted owls. General Technical Report PNW-162. USDA Forest Service, Portland, Oregon. 7pp.

1988 The spotted owl: literature review. Pages C1-C35 *in* Final supplement to the environmental impact statement for an amendment to the Pacific Northwest regional guide. Spotted owl guidelines. 2 vols. USDA Forest Service, Pacific Northwest Region, Portland, Oregon.

Forsman, E. D., E. C. Meslow, and H. M. Wight
1984 Distribution and biology of the spotted owl in Oregon. *Wildlife Monographs* 87:1-64.

Franklin, A. B.
1991 Personal communication. Humboldt County, California.

1992 Population regulation in northern spotted owls: theoretical implications for management *in* D. McCullough and R. Barrett, eds. Wildlife 2001: populations. In press.

Franklin, A. B., J. A. Blakesley, and R. J. Gutierrez
1989 Population ecology of the northern spotted owl (*Strix occidentalis caurina*) in northwest California: preliminary results, 1988. Unpublished report.

1990a Population ecology of the northern spotted owl (*Strix occidentalis caurina*) in northwest California: preliminary results, 1989. Unpublished report. 35pp.

Franklin, A. B., J. P. Ward, R. J. Gutierrez, and G. I. Gould
1990b Density of northern spotted owls in northwest California. *Journal of Wildlife Management* 54:1-10.

Gould, G. I., Jr.
1977 Distribution of the spotted owl in California. *Western Birds* 8:131-146.

Gutierrez, R. J.
1985 An overview of recent research on the spotted owl. Pages 39-49 *in* R. J. Gutierrez and B. Carey, editors. Ecology and management of the spotted owl in the Pacific Northwest. General Technical Report PNW-185, USDA Forest Service, Portland, Oregon.

1989 Hematozoa from the spotted owl. *Journal of Wildlife Diseases* 25:614-618.

Gutierrez, R. J., A. B. Franklin, W. LaHaye, V. J. Meretsky, and J. P. Ward
1985 Juvenile spotted owl dispersal *in* northwestern California: preliminary results. Pages 60-65 in R. J. Gutierrez and B. Carey, editors. Ecology and management of the spotted owl in the Pacific Northwest. General Technical Report PNW-185, USDA Forest Service, Portland, Oregon.

Gutierrez, R. J., D. M. Solis, and C. Sisco
1983 Habitat ecology of the spotted owl in northwestern California: implications for management. Pages 363-373 in New forest for a changing world, proceedings of the 1983 Society of American Foresters convention, Portland, Oregon.

Irwin, L. L., S. Self, and L. Smith
1989 Status of the northern spotted owl on managed forestlands in northern California. Unpublished report, Timber Association of California, Sacramento, California.

Johnsgard, P. A.
1988 North American owls: biology and natural history. Smithsonian Institution.

Kerns, S. J.
1988 Preliminary report: observations of wildlife diversity on lands of the Pacific Lumber Company. Unpublished report, Wildland Resource Managers and Pacific Lumber Company, Scotia, California.

1989a Occurrence of spotted owls in managed timber stands on lands of the Pacific Lumber Company. Unpublished progress report, 31 July 1989, Wildland Resource Managers and Pacific Lumber Company, Scotia, California.

1989b Occurrence of spotted owls in managed timber stands on lands of the Pacific Lumber Company. Unpublished progress report update, 15 December 1989, Wildland Resource Managers and Pacific Lumber Company, Scotia, California.

LaHaye, W. S.
1988 Nest site selection and nesting habitat of the northern spotted owl (*Strix occidentalis caurina*) in northwestern California. Unpublished M.S. thesis, Humboldt State University, Arcata, California.

Marcot, B. G., and J. Gardetto
1980 Status of the spotted owl in Six Rivers National Forest, California. *Western Birds* 11:79-87.

Meyer, J. S., L. L. Irwin, and M. S. Boyce
1990 Influence of habitat fragmentation on spotted owl site selection, site occupancy, and reproductive status in western Oregon. Unpublished progress report, 6 April 1990, McKinleyville, California.

Miller, G. S.
1989 Dispersal of juvenile northern spotted owls in western Oregon. Unpublished M.S. thesis, Oregon State University, Corvallis, Oregon.

Paton, P. W. C., N. G. Tilghman, and C. J. Zabel
1989 Examination of home range size and habitat use of the spotted owl in the Klamath Province: progress report covering the period from spring 1987-December 1989. Unpublished report, Pacific Southwest Forest and Range Experimental Station, Arcata, California.

Pious, M.
1989 The northern spotted owl in managed, second-growth coastal redwood forest, Mendocino County, California: preliminary results. Unpublished report, Louisiana Pacific Corporation, Calpella, California.

1991 Personal communication. Calpella, California.

Ruediger, W. C.
1985 Implementing a spotted owl management plan: the Gifford Pinchot National Forest experience. Pages 10-13 in R. J. Gutierrez and B. Carey, editors. Ecology and management of the spotted owl in the Pacific Northwest. General Technical Report PNW-185, USDA Forest Service, Portland, Oregon.

Sakai, H. F.
1991 Personal communication. USDA Forest Service, Pacific Southwest Forest and Range Experimental Station, Arcata, California.

Sisco, C., and R. J. Gutierrez
1984 Winter ecology of radio-tagged spotted owls on Six Rivers National Forest, Humboldt Co., CA. Unpublished report, Six Rivers National Forest, Eureka, California.

Solis, D. M.
1983 Summer habitat ecology of spotted owls in northwestern California. Unpublished M.S. thesis, Humboldt State University, Arcata, California.

Thomas, J. W., E. D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, & J. Verner
1990 A conservation strategy for the northern spotted owl. Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl, U.S. Department of Agriculture, Forest Service, and U.S. Department of the Interior, Bureau of Land Management, Fish and Wildlife Service, National Park Service, Portland, Oregon. 427pp.

Timber Association of California (TAC) and VESTRA Resources, Inc.
1989 California Timberland Wildlife Habitat Study.

U.S. Department of the Interior (USDI)
1989 The northern spotted owl--a status review supplement. U.S. Fish and Wildlife Service, Portland, Oregon.

1990a Final rule, endangered and threatened wildlife and plants, determination of threatened status for the northern spotted owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon.

1990b 1990 status review, northern spotted owl *Strix occidentalis caurina*. U.S. Fish and Wildlife Service, Portland, Oregon.

1991 Guidelines for surveying proposed management activities that may impact northern spotted owls. U.S. Fish and Wildlife Service, Portland, Oregon.

Verner, J.
1991 Personal communication. USDA Forest Service, Pacific Southwest Forest and Range Station, Fresno, California.

Ward, J. P.
1990 Spotted owl reproduction, diet and prey abundance in northwest California. Unpublished M.S. thesis, Humboldt State University, Arcata, California.

Glossary

A. Abbreviations and Acronyms

BIA: (United States) Bureau of Indian Affairs

BLM: (United States) Bureau of Land Management

CDF: California Department of Forestry and Fire Protection

CDFG: California Department of Fish and Game

CEQA: California Environmental Quality Act

CESA: California Endangered Species Act

dbh: diameter at breast height

ESA: Endangered Species Act

EA: environmental assessment

EIR: environmental impact report

EIS: environmental impact statement

FRRAP: Forest and Rangelands Resources Assessment Program

GIS: geographic information system

HCA: habitat conservation area

HCP: habitat conservation plan

MMBF: million board feet

NCCP: Natural Community Conservation Plan

NEPA: National Environmental Policy Act

PCA: Principal Components Analysis

RPF: Registered Professional Forester

TAC: Timber Association of California (now, California Forestry Association)

THP: timber harvesting plan

SORP: spotted owl resource plan

USFWS: United States Fish and Wildlife Service

USDI: United States Department of the Interior

WLPZ: Watercourse and Lake Protection Zone

B. Common and Scientific Names

1) Trees

California-bay	*Umbellularia californica*
California black oak	*Quercus kelloggii*
Chinkapin	*Castanopsis chrysophylla*
Coast redwood	*Sequoia sempervirens*
Douglas-fir	*Pseudotsuga menziesii*
Grand fir	*Abies grandis*
Incense-cedar	*Libocedrus decurrens*
Pacific madrone	*Arbutus menziesii*
Ponderosa pine	*Pinus ponderosa*
Oregon white oak	*Quercus garryana*
Red alder	*Alnus rubra*
Red fir	*Abies magnifica*
Sugar pine	*Pinus lambertiana*
Tanoak	*Lithocarpus densiflorus*

2) Herbaceous Plants

Bensoniella	*Bensoniella oregona*
Dwarf mistletoe	*Arceuthobium* spp.
Humboldt milk vetch	*Astragalus agnicidus*
Kneeland Prairie penny cress	*Thlapsi montanum* var. *californicum*
Leafy reed grass	*Calamagrostis foliosa*
MacDonald's rock cress	*Arabis macdonaldiana*
Mendocino gentian	*Gentiana setigera*
Tracy's sanicle	*Sanicula tracyi*
Western lily	*Lilium occidentale*
Yellow-tubered toothwort	*Cardamine gemmata*

3) Spiders and Insects

Beetles	Cerambycidae
Crickets	*Stenopelmatus* spp.
Grasshoppers	Acrididae
Moths and butterflies	Lepidoptera
Spiders	*Araneus* spp.

4) Fish

Coastal cutthroat trout	*Oncorhynchus clarki clarki*
Coho salmon	*Oncorhycnhus kisutch*
Pink salmon	*Oncorhynchus gorbuscha*
Spring chinook salmon	*Oncorhynchus tshawytscha*
Summer steelhead	*Oncorhynchus mykiss gairdneri*

5) Amphibians and Reptiles

California red-legged frog	*Rana aurora draytoni*
Del Notre salamander	*Plethodon elongatus*
Foothill yellow-legged frog	*Rana boylei*
Olympic salamander	*Rhyacotriton olympicus*
Tailed frog	*Ascaphus truei*
Western pond turtle	*Clemmys marmorata marmorata*

6) Birds

American peregrine falcon	*Falco peregrinus anatum*
Bald eagle	*Haliaeetus leucocephalus*
Band-tailed pigeon	*Columba fasciata*
Bank swallow	*Riparia riparia*
Barred owl	*Strix varia*
Black-capped chickadee	*Parus atricapillus*
California spotted owl	*Strix occidentalis occidentalis*
Cooper's hawk	*Accipiter cooperii*
Golden eagle	*Aquila chyrsaetos*
Great blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Great horned owl	*Bubo virginianus*
Hairy woodpecker	*Picoides villosus*
Marbled murrelet	*Brachyramphus marmoratus*
Mexican spotted owl	*Strix occidentalis lucida*
Northern goshawk	*Accipiter gentilis*
Northern spotted owl	*Strix occidentalis caurina*
Osprey	*Pandion haliaetus*
Purple martin	*Progne subis*
Pygmy owl	*Glaucidium gnoma*
Red-breasted sapsucker	*Sphyrapicus ruber*
Red-tailed hawk	*Buteo jamaicensis*
Ruffed grouse	*Bonasa umbellus*
Sharp-shinned hawk	*Accipter striatus*
Steller's jay	*Cyanositta stelleri*

Varied thrush	*Ixoeus naevius*
Yellow-breasted chat	*Icteria virens*

7) Mammals

Brush rabbit	*Sylvilagus bachmani*
California red-backed vole	*Clethrionomys californicus*
Deer mice	*Peromyscus* spp.
Dusky-footed woodrat	*Neotoma fuscipes*
Long-tailed weasel	*Mustela frenata*
Mole species	*Scapanus* spp.
Northern flying squirrel	*Glaucomys sabrinus*
Pacific fisher	*Martes pennanti pacifica*
Pocket gophers	*Thomomys* spp.
Red tree vole	*Arborimus longicaudus*
Shrew mole	*Neurotrichus gibbsii*
Shrew species	*Sorex* spp.
Townsend's big-eared bat	*Plecotus townsendii*
Vole species	*Microtus* spp.
Western gray squirrel	*Sciurus griseus*
White-footed vole	*Arborimus albipes*

C. Definitions

Activity Center: A nest site or primary roost area; here, synonymous with "owl site."

Azimuth: Angular distance of an object determined by a magnetic compass and expressed in degrees from 0 to 360.

Basal Area: The area of the cross section of a tree stem near its base, generally at breast height and inclusive of bark.

Biomass: the total quantity (at any given time) of living organisms of one or more species per unit of space or of all species in a biotic community.

Cable Yarding: The system of skidding (transporting) logs by means of cable (wire rope) to the yarding machine (yarder) or a landing while the yarder remains stationary.

California Habitat Conservation Plan: A conservation plan for the northern spotted owl currently being developed by the California Resources Agency.

Canopy Closure: The degree to which the crowns of trees are nearing general contact with one another.

Carrying Capacity: The maximum number of animals that can be sustained over the long-term on a specified land area.

Clinometer: An instrument for measuring the degree of a slope.

Commercial Forest Land: Forest land tentatively suitable for the production of crops of timber.

Commercial Species: Those tree species found in group A and those in group B that are found on lands where the species in group A are now growing or have grown naturally in the recorded past.

Group A: coast redwood, Douglas-fir, grand fir, western hemlock, western red cedar, bishop pine, Monterey pine, Sitka spruce, incense-cedar, Port-Orford cedar, California red fir, white fir, Jeffrey pine, ponderosa pine, sugar pine, and western white pine.

Group B: tanoak, red alder, white alder, eucalyptus, Pacific mandrone, golden chinkapin, pepperwood, Oregon white oak, and California black oak.

Compensation Measures: Measures undertaken by public and private landowners to offset the adverse environmental impacts of development. The measures are implemented through agreements and may include dedication of land, provision of funds for wildlife conservation, design modification, habitat reclamation or enhancement, and/or other protective actions.

Conservation: Methods and procedures necessary to recover an endangered or threatened species, including research, census, law enforcement, habitat acquisition, habitat protection, habitat maintenance, species propagation, and live trapping and transportation.

Corridor: A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.

Critical Habitat: Defined in the federal Endangered Species Act (1973) to include the area occupied by a species at the time it is listed, specific areas in the vicinity of the occupied habitat, and specific areas away from the occupied habitat considered essential for the conservation of the species.

Cumulative Impact: The incremental environmental impact of an action together with impacts of past, present, and reasonably foreseeable actions (regardless of the source of the other actions).

Densiometer: A mirrored disc for measuring overstory density.

Dispersal: The movement, usually one way, and on any time scale, of plants or animals from their point of origin to another location where they subsequently produce offspring.

Edge Effects: Differences in microclimate, flora, fauna, stand structure, habitat values, and stand integrity (including resistance to being blown down by high winds) that occurs in or as a result of a transition zone where two plant communities or successional stages are joined.

Endangered Species: Any plant or animal species in danger of extinction in all or a significant part of its range.

Endangered Species Act: Federal act of 1973, as amended, 16 U.S.C. Sections 1531 - 1543.

Environmental Assessment (EA): A concise public document prepared in compliance with NEPA, which briefly discusses the need for an action and alternatives to such action and provides sufficient evidence and analysis to determine whether to prepare an environmental impact statement or a finding of no significant impact.

Environmental Impact Statement (EIS): Document prepared in accordance with federal law to describe, analyze, and consider mitigation of the significant environmental effects of a project, plan, or action.

Even-Aged Forest: A forest stand composed of trees with less than a 20-year difference in age.

Extinct: Disappeared as a species due to failure to reproduce sufficient numbers to maintain succeeding generations.

Finding of No Significant Impact (FONSI): A document prepared in compliance with NEPA, usually supported by an environmental assessment, that briefly states why a federal action will not have a significant effect on the human environment and for which an environmental impact statement, therefore, will not be prepared.

Floaters: Nonbreeding adults and subadults that move within a breeding population, often replacing breeding adults that die; nonterritorial individuals.

Forest Districts: Within California, commercial forest areas have been divided into three districts--the Coast Forest District, Northern Forest District, and Southern Forest District.

Fragmentation: Process of reducing size and connectivity of stands that comprise a forest.

Functional Nesting Habitat: In California, defined as habitat with a dominant and codominant tree canopy closure of at least 40 percent and a total canopy (including dominant, codominant, and intermediates) of at least 60 percent. Usually the stand is distinctly multi-layered with an average stem diameter in dominant and codominant conifers and hardwoods of >11 inches dbh. The stand usually consists of several tree species (including hardwoods) of mixed sizes. All nests, snags, down logs, and decadent trees are considered part of the habitat. (14 CCR Section 895.1)

Functional Roosting Habitat: In California, defined as habitat that, during the territorial breeding season, consists of stands where average stem diameter is >11 inches dbh among dominant and codominant trees. Hardwood and conifers provide an average of at least 40 percent canopy closure but the stand can have a high degree of variability. Stand size and configuration must be sufficient to provide multiple perch sites suitable for protection from various environmental conditions, including wind, heat, and precipitation. (14 CCR Section 895.1)

Functional Foraging Habitat: In California, defined as habitat that is dependent on the presence and availability of prey on the forest floor or in the canopy; presence of accessible perching limbs; and adjacency to stands with canopy closures >40 percent. Average stem diameter is usually >6 inches dbh for hardwoods and >11 inches dbh for conifers among dominants and codominants, and the total overhead canopy closure, including intermediate trees, is at least 40 percent. (14 CCR Section 895.1)

Habitat: The combination of environmental conditions of a specific place occupied by a species or a population of such species.

Habitat Conservation Area (HCA): A contiguous block of habitat to be managed and conserved for breeding pairs, connectivity, and distribution of owls as recommended in *A Conservation Strategy for the Northern Spotted Owl* (Thomas Report).

Habitat Conservation Plan (HCP): An implementable program for the long-term protection and benefit of a species in a defined area; required as part of a Section 10(a) permit application under the federal Endangered Species Act.

Habitat Mosaic: The mix of habitat conditions across the landscape.

Harass: A form of take under the federal ESA; defined in federal regulations as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3).

Harm: A form of take under the federal ESA; defined in federal regulations as an act which actually kills or injures wildlife. Such acts may include significant habitat modification or degradation where it actually kills wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3).

Historic Habitat: Areas that have supported a species in the past and may or may not continue to do so.

Historic Range: The known general distribution of a species or subspecies as reported in current scientific literature.

Home Range: The area to which the activities of an animal are confined during a defined period of time.

Incidental Take: The taking of a federally listed wildlife species, if such taking is incidental to, and not the purpose of, carrying out otherwise lawful activities.

Managed Forest: Forest land that is harvested on a scheduled basis and contributes to an allowable sale quantity.

Microenvironment: The sum total of all the external conditions that may influence organisms and that come to bear in a small or restricted area.

Microhabitat: The smallest component of habitat; very localized habitat.

Mitigation: Measures undertaken to diminish or compensate for the negative impacts of a project or activity on the environment, including (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or (e) compensating for the impact by replacing or providing substitute resources or environments.

Monitoring: The process of collecting information to document implementation of mitigation measures and to evaluate whether or not the objectives of the habitat conservation plan are being realized.

Mousing: Field technique used in owl surveys in which a laboratory mouse is presented to the owl and the owl's behavior is observed. If the owl is mated, the assumption is that after taking one or more mice it will return to its mate or owlets with the mouse. If the owl repeatedly eats or caches four mice, the assumption is that it is probably not mated or currently reproductive.

Old Growth: A forest stand with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; a high incidence of large trees with large, broken tops, and other indications of decadence; numerous large snags; and heavy accumulations of logs with other woody debris on the ground.

Owl Habitat: In California, defined as Type A, B, or C owl habitat or those areas with functional foraging habitat, functional nesting habitat, or functional roosting habitat which support the owl's biological needs for breeding, sheltering, and feeding. An area of habitat could have characteristics which support all of the functional needs for nesting, roosting, and foraging or combination of those functions. Because owls are known to occasionally inhabit less than optimal forest structure, local information can be used to justify the modification of structural habitat definitions. (14 CCR Section 895.1)

Owl Site: Here, a nesting or primary roosting site; synonymous with "activity center."

Plan Area: Here, the properties of Arcata Redwood Company and Simpson Redwood Company in California.

Population: A collection of individuals that share a common gene pool.

Population Density: Number of individuals of a species per unit area.

Principal Component Analysis: A statistical analysis that reduces the number of variables to a few independent variables called principal components (PCs). The PCs are derived by linear combinations of the variables that maximize the variance in the data. The first PC explains the greatest amount of variation possible, and each subsequent PC explains the maximum amount of variance not accounted for by the other components.

Region: Here, the range of the northern spotted owl in northwestern California.

Recovery Plan: A plan to ensure the conservation and survival of endangered and threatened species. Recovery plans give priority, to the extent feasible, to those endangered or threatened species that are or may be in conflict with construction or other development projects or other forms of economic activity.

Registered Professional Forester (RPF): A person who holds a valid license as a professional forester pursuant to Article 3, Section 2, Division 1 of the California Public Resources Code.

Rotation: The planned number of years between the regeneration of an even-aged stand and its final cutting at a specified stage.

Section 7: A section of the federal Endangered Species Act that provides for consultation between federal agencies and the U.S. Fish and Wildlife Service to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species.

Section 9: A section of the federal Endangered Species Act that prohibits the "taking" of any endangered species.

Section 10(a): An amendment to the federal Endangered Species that allows for incidental takings of an endangered species if the permit for the proposed activity is accompanied a habitat conservation plan that will demonstrably benefit the species.

Silviculture: The theory and practice of controlling the establishment, composition, and growth of forests.

Species: Any distinct population of wildlife that interbreeds when mature.

Species of Special Concern: Species designated by the California Department of Fish and Game as being rare, having preternaturally small or declining populations, or whose probability for long-term survival is questioned. In the context of timber harvest plans, species of special concern are those designated by the California Board of Forestry pursuant to 14 CCR 892.2(d). Those species are the bald eagle, golden eagle, great blue heron, great egret, northern goshawk, osprey, peregrine falcon, California condor, great grey owl, northern spotted owl, and marbled murrelet.

Spotted Owl Resource Plan: A plan that demonstrates an approach to preventing a taking of the northern spotted owl while conducting timber harvest operations. Such a plan necessarily involves more than one timber harvest plan.

Suitable Habitat: Here, an area of forest vegetation with the age-class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the likely needs of the northern spotted owl.

Sustained Yield or Production: The amount of timber that a forest can produce continuously from a given intensity of management.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a species, or attempt to do so.

Territory: The area that an animal defends, usually during breeding season, against intruders of its own species.

Threatened Species: Any species or subspecies that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Timber Harvesting Plan (THP): A three-year plan for the harvesting of commercial timberlands that (1) must be prepared by a registered professional forester, (2) must be filed with and approved by the California Board of Forestry, and (3) must contain detailed information about the land to be harvested, the silviculture methods to be applied, special provisions (if any) to protect unique and sensitive resources in the area, the dates when timber operations will commence and conclude, and any other information that may be required by the State board.

Timberland: Land, other than land owned by the federal government, and land designated by the California Board of Forestry as experimental forest land, which is available for, and capable of, growing a crop of trees of any commercial species used to produce lumber and other forest products, including Christmas trees. Commercial species are determined by the State board on a district basis. (Z'berg-Nejedly Forest Practice Act of 1973)

Timber Operations: The cutting or removal of timber or other solid wood forest products, including Christmas trees, from timberlands for commercial purposes, together with all the work incidental thereto, including, but not limited to, construction and maintenance of roads, fuelbreaks, firebreaks, stream crossings, landings, skid trails, beds for the falling of trees, and fire hazard abatement, but excluding preparatory work such as treemaking, surveying, or roadflagging. (Z'berg-Nejedly Forest Practice Act of 1973)

Varimax Rotation: Procedure used to achieve an easier way of interpreting principal component (PC) analysis by producing large or small PC coefficients.

Plan Preparers

Tharon E. O'Dell, Timberlands Resource Manager, Simpson Timber Company

Tharon O'Dell has over 19 years of experience in forest management. He was hired by Simpson Timber in 1984 as Forestry Operations Manager and was promoted to Timberlands Resource Manager in 1989. He currently manages two forest nurseries, directs treatment prescriptions in harvested areas through early stand growth and development, and maintains a current forest inventory system that serves as the basis for long-term planning. O'Dell also is involved in the legislative and regulatory aspects of forestry practices in California and directs the activities of the company's wildlife biologists. He has been involved in the planning and development of the HCP since its inception and is responsible for the overall management of the planning process. O'Dell has an M.S. in forest management from Oregon State University at Corvallis, where he also completed doctoral studies in forest ecology. He received a B.S. in forestry from Southern Illinois University at Carbondale.

Lowell V. Diller, Wildlife Biologist, Simpson Timber Company

Lowell Diller has over sixteen years of experience as a wildlife biologist. He is responsible for Simpson's spotted owl research program, including the 1989, 1990, and 1991 surveys and studies that form the data base for this HCP. He has overseen the development of the biological components of the HCP and played a major role in shaping the overall conservation strategy. Diller has been Simpson Timber Company's wildlife biologist since 1989 and also is an Affiliate Associate Professor of Fish and Wildlife Resources at the University of Idaho. He has a Ph.D. in zoology from the University of Idaho at Moscow, an M.S. in zoology, and a B.S. from Oregon State University at Corvallis.

Catherine J. Hibbard, Biological Consultant, Simpson Timber Company

Catherine Hibbard has over six years of experience as wildlife biologist. She was retained as a consultant by Simpson Timber Company to assist with the preparation of the biological reports included in the HCP; she also helped with the preparation of the habitat mosaic model and forecast and the "take" calculation.

Hibbard drafted the majority of the text included in Chapter 2 of the HCP, including the summary of extant literature on the owl and the descriptions of Simpson's 1989, 1990, and 1991 studies. She also prepared Appendix C of the HCP, which summarizes conservation-related information on other species of concern in the plan area. Hibbard has an M.S. in wildlife management from the Appalachian Environmental Laboratory of the Center for Environmental and Estuarine Studies of the University of Maryland, Frostburg State University Campus, and a B.S. in natural resources from the College of Agriculture and Life Science of Cornell University.

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Lee Folliard has over five years of experience as a wildlife biologist. He was retained by Simpson Timber Company to assist Dr. Diller with the spotted owl research program. He conducted the 1990 nest site study that forms the basis for the habitat mosaic model and forecast included in the HCP. He is in the process of completing his M.S. in wildlife management from the University of Idaho at Moscow, completed graduate courses in zoology at Washington State University at Pullman, and received a B.S. in wildlife management from Frostburg State University.

Daniel Opalach, Timberlands Planning Supervisor, Simpson Timber Company

Dan Opalach has over ten years of experience in forest management planning and computer modelling. He is responsible for Simpson's geographic information system, computer-generated maps and reports, and timber harvest simulation programs. He prepared the age-class and habitat mosaic forecasts included in this HCP, together with the description of Simpson's computer capabilities. Opalach has been Simpson's Timberlands Planning Supervisor since 1989. He has a Ph.D. in forest management from the University of Washington at Seattle, an M.S. in forest management from Michigan State University at East Lansing, and a B.A. in mathematics and a B.A. in forest science from Humboldt State University at Arcata.

William R. Houston, Area Forester, Simpson Timber Company

Bill Houston has over nineteen years of experience as a forester. He has worked for Simpson Timber Company since 1972 and currently is responsible for the planning and implementation of intensive forest management activities, including reforestation, brush control, pre-commercial thinning, and fertilization. He also provides assistance with maintenance and updating of Simpson's forest inventory and with timber harvest plan preparation. He provided the description of current forest management practices and the silvicultural profile of Simpson's property that are included in the HCP. Houston is a registered professional forester in California, with a Master of Forestry from Yale University and a B.S. in forestry from the University of Missouri at Columbia.

Gary Warinner, Timberlands Information Forester, Simpson Timber Company

Gary Warinner has over eight years of experience in forest management information planning. He was retained by Simpson in 1989 and currently assists Dr. Opalach with the maintenance and use of Simpson's information system. He helped prepare the forecast and computer-generated maps included in the HCP. Warinner has an M.S. in forestry from Humboldt State University and a B.A. in zoology from the University of Texas.

Jean K. Carr, Senior Project Manager and HCP Specialist, RECON

Jean Carr has ten years of experience in plan preparation and environmental policy development. She is a senior project manager at RECON and is the primary author of four habitat conservation plans completed by RECON. She also has prepared policy statements and public information documents on regional transportation, air quality, and waste management issues. She was responsible for the preparation and revision of the overall text of the HCP. She also worked with Simpson's team to develop the proposed conservation measures. She completed her doctoral studies and M.A. in literature at the State University of New York at Stony Brook and her B.A. in literature and philosophy at the University of San Francisco.

Paul S. Fromer, Project Director and Conservation Biologist, RECON

Paul Fromer has over 16 years of experience as an ecologist and conservation planner. He directs RECON's habitat conservation planning efforts and has overseen the preparation of all HCPs prepared by RECON to date, including those for the Stephens' kangaroo rat, desert tortoise, and least Bell's vireo. Mr. Fromer served as an advisor to Simpson Timber Company when planning options were being considered and helped develop the overall conservation strategy included in the HCP. He completed his doctoral studies in zoology (advanced to Ph.D. candidacy) at the University of Montana, has an M.S. in biology from San Diego State University, and received a B.A. in zoology from the University of California at Los Angeles.

RECON Production Team

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Cover/Photo Credits

Cover design and chapter illuminations by Peter Langenfeld
Spotted owl photo by Mike McMurry
Landscape photo by Lowell Diller

APPENDIXES

APPENDIX A

APPENDIX A
METHODS AND PROTOCOLS USED IN SIMPSON'S STUDIES

I. SURVEY PROCEDURES TO REDUCE "DOUBLE COUNTING"

We did not count responses obtained from the second run of a transect as new individuals unless the responses were at least 1.5 miles from a previous response. Distant responses were not counted unless the full four-note location call of spotted owls was heard at least twice.

II. BANDING PERMITS

During 1990, our banding was authorized under three sets of permits. From May 18 to July 23, we banded under the auspices of federal and state banding permits issued by the U.S. Fish and Wildlife Service (USFWS) Bird Banding Laboratory and California Fish and Game. On July 26, 1990 a cooperative agreement was established between the USFWS and Simpson Timber Company. The purpose of the cooperative agreement was to establish an endangered/threatened species subpermit (PRT-DILLV) issued pursuant to the USFWS Regional Blanket Permit (PRT-702631). This subpermit was effective until August 16, 1990, when Simpson Timber Company obtained its own endangered/threatened species permit (PRT-751248).

We measured the following before releasing banded birds: wing cord, tarsus length, bill length, bill depth, and body mass. We also checked the birds for molt, and inspected brood patches of females.

III. NEST MEASUREMENTS

We measured all nest dimensions with a tape. For elliptical nests, we measured the short and long dimensions and for spherical nests, we measured north-south and east-west dimensions. Cavity nests were measured with a tape from the inner edge of the entrance hole to the back of the cavity and from side to side. To determine cavity depth, we measured from the lower edge of the hole to the bottom and top of the cavity. Entrance hole dimensions were measured perpendicular and parallel to the tree bole.

At the nest we also measured percent canopy coverage directly above the nest using a densiometer placed on the center of the nest. Nest aspect or orientation was determined with a compass. Height measurements were made with a clinometer.

IV. NEST SITE MEASUREMENTS

All trees (≥5 inches dbh) and snags (≥3.6 inches dbh) in the 0.18 acre nest site plot were identified to species and measured for dbh using a tape. From these measurements we calculated tree densities and basal areas for 3 dbh size classes of hardwoods and 4 size classes of conifers (see Table 1). Saplings (≤5.2 inches-1 inch dbh) were only counted by species. Four 50-foot transects were established in cardinal directions. Cover of shrubs, ferns, forbs, and seedlings were estimated using the line-intercept method (Canfield 1941). Cover of rock, litter, and coarse woody debris in the plot were visually estimated and

TABLE 1
HABITAT VARIABLES MEASURES AT SPOTTED OWL NEST SITES

	Variable	Units
1.	Elevation	ft
2.	Slope	%
3.	Slope aspect	degrees
4.	Volume of logs ≥10" on at least one diameter	inches3
5.	Canopy coverage	%
6.	Canopy height	ft
7.	Vertical structure	index
8.	Conifer saplings <5.2 - 1" dbh	#
9.	Hardwood saplings <5.2 - 1" dbh	#
10.	Conifers 5.2 - 10.9" dbh	#
11.	Conifers 11.0 -20.9" dbh	#
12.	Conifers 21.0-36.0" dbh	#
13.	Conifers >36.0" dbh	#
14.	Hardwoods 5.2 -10.9" dbh	#
15.	Hardwoods 11.0 - 20.9" dbh	#
16.	Hardwoods >21.0" dbh	#
17.	Snags ≥3.6" dbh	#
18.	Shrub cover	%
19.	Forb cover	%
20.	Fern cover	%
21.	Cover of seedlings >1.7 ft tall and <1" dbh	%
22.	Cover of rock, litter, and coarse woody debris <10" at largest diameter	% category

assigned to cover classes: 0 = absent, 1 = ≤5%, 2 = 5-15%, 3 = 15-35%, 4 = 35-75%, and 5 = >75%. An estimate of canopy closure was taken at 16.5- and 33-foot intervals on each transect using a densiometer (Strickler 1959). Logs (≥10 inches on at least one end) in the plot were measured at both end diameters and for length; volume was calculated by the formula for a cone frustum (Husch et al. 1982). A telescoping height pole (50-foot extension) was raised at the mid-point of each transect to determine a vertical structure index. Each time the tip of the pole touched any vegetation (alive or dead) the height was recorded. This procedure was also used to measure the lower extent of the canopy. Slope aspect was measured with a compass and percent slope with a clinometer. Elevations were obtained from 7.5 minute U.S.G.S. quadrangle maps.

V. MEASUREMENTS IN NEST STANDS

Within nest stands we established four to five randomly located sampling points to measure habitat variables. The stands were divided into four quadrants (by placing two perpendicular lines through them approximately along the long and short axes) to facilitate a more even distribution of sampling points (i.e., at least one sample point/quadrant). Only two small nest stands (10-17.5 acres) were sampled with four random points; all others had five points.

Variable sampling plots within nest stands were defined with a glass prism angle gauge with a 20 basal area factor (BAF). Basal area was calculated by multiplying the number of trees counted by the BAF. Trees were classified into dbh classes of 5.2-10.9 inches, 11.0-20.9 inches, 30.0-36.0 inches, and >36.0 inches.

In fixed, 0.05 acre fixed circular plots, small (1-5.2") trees, and shrubs were tallied for number of stems by species. Line transect sampling was used for smaller vegetation. Four 26.4-foot transects were positioned in cardinal directions inside the plot, and cover estimates for shrubs (by species), seedling trees (<1 inch dbh), and ground cover (<1.7 feet tall) were obtained using the line-intercept method. Canopy closure was measured at 13 feet along the transects as outlined for nest sites.

VI. NEST STAND COVERTYPE MEASUREMENTS

The two dimensional linear edge (i.e., transition zone between cover type) in the 0.5 radius nest stand plots were measured with a map wheel. The acreage of all covertypes in the circular plot was determined with a dot grid.

VII. STATISTICAL ANALYSES

A. FOOD HABITS

A 2X2 contingency table analysis was performed and a chi-square statistic (P=0.5) was calculated to determine whether regional differences existed among prey species taken by spotted owls in 1990. Data from 1990 were used to conduct the analysis because the sample size was larger than that of 1989 and data from both years were not pooled to eliminate effects due to annual variations in owl diets. The sample size in 1989 was too small to test whether significant annual variations existed. To generate a table of prey species taken by spotted owls, data from 1989 and 1990 were pooled to increase sample sizes and to gain a better understanding of overall dietary patterns.

B. NEST SITE AND STANDS

To evaluate whether nest type influenced reproductive success, a 2X2 contingency table analysis was performed on nest types (protected or exposed) versus reproductive status (success or failure). We grouped platform and broken top nests as exposed and the remaining types as protected. P was set at 0.05 and the null hypothesis was that reproductive success was independent of nest type. Other null hypotheses statistically tested included the following: no differences in vegetation structure and/or physical characteristics existed between (1) nest site microhabitat and random site microhabitat, (2) nest sites of reproductively successful and unsuccessful pairs, and (3) stand mosaics that contained owl nests and random mosaics. Univariate statistical analyses were performed with parametric tests unless the assumption of normality was severely violated in conjunction with small sample size. Normality of data was assessed using the Wilk-Shapiro test statistic. We used a Student's t-test to compare means of habitat variables. The t-test assumes equal variances and if this assumption was not met, as evident by a significant F-test, the t-value derived from unequal variances was used. If the data were not normal or sample sizes were small, the Mann-Whitney U-test was used to compare means. Each random site was treated as an observation. Statistical significance was set at $P \leq 0.05$.

To compare habitat structure of nest sites and of random sites in the surrounding forest, a principal components analysis (PCA) was conducted. All nest and random sites were combined to develop the principal components (PC). The analysis was performed on the correlation matrix with a varimax rotation using the statistical package SYSTAT (Wilkinson 1988).

APPENDIX B

STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF FISH AND GAME
P.O. BOX 944209
SACRAMENTO, CA 94244-2090
(916) 322-1263

RECEIVED
APR 29 1991

April 22, 1991

Mr. David W. Kaney
General Manager
Simpson Timber Company
PO Box 1169
Arcata, CA 95521-1169

Dear Mr Kaney:

I have enclosed the results of your data request for the number of known Northern Spotted Owl territories in Del Norte and northern Humboldt counties. As you asked, these numbers have been generated by individual townships and are provided on the form supplied with your request.

These numbers represent the number of what we believe are separate territories. By the owl's nature, not all of these represent breeding pairs or pair territories; they are at least areas where a single owl has been observed defending a territory.

Also, please be aware that this listing is not the result of a complete survey of the area. There are likely other territories which are still undiscovered. This should be considered in any comparison of the known density of owls on the relatively well-surveyed Simpson lands with those in other ownerships.

I'm sorry for the delay in getting this information to you. I hope it hasn't caused any inconvenience. If you have any questions regarding this information please call me at the number listed in the letterhead.

Sincerely,

Gordon I. Gould, Jr.
Associate Wildlife Biologist
Nongame Bird and Mammal Section

GIG:dg

Enclosure

NUMBER OF SPOTTED OWLS IN KNOWN LOCATIONS IN CALIFORNIA

Legal Description	No. Owls
T19N,R1W	0
T19N,R1E	1
T19N,R2E	1
T18N,R1W	2
T18N,R1E	2
T18N,R2E	1
T18N,R3E	3
T17N,R1W	0
T17N,R1E	6
T17N,R2E	1
T17N,R3E	4
T16N,R1W	0
T16N,R1E	3
T16N,R2E	6
T16N,R3E	6
T15N,R1W	0
T15N,R1E	1
T15N,R2E	0
T15N,R3E	2
T15N,R4E	2
T14N,R1E	3
T14N,R2E	0
T14N,R3E	5
T14N,R4E	0
T13N,R1E	1
T13N,R2E	1
T13N,R3E	1
T13N,R4E	3
T12N,R1E	0
T12N,R2E	3
T12N,R3E	4
T12N,R4E	4
T12N,R5E	7
T11N,R1E	1
T11N,R2E	0
T11N,R3E	0
T11N,R4E	7
T11N,R5E	6
T10N,R1E	4
T10N,R2E	1
T10N,R3E	2
T10N,R4E	4
T10N,R5E	6
T10N,R6E	8
T9N,R1W	0
T9N,R1E	1
T9N,R2E	4
T9N,R3E	0
T9N,R4E	0
T9N,R5E	3
T8N,R1W	0
T8N,R1E	0
T8N,R2E	3
T8N,R3E	1
T8N,R4E	1
T8N,R5E	2
T7N,R1E	1
T7N,R2E	0
T7N,R3E	2
T7N,R4E	2
T7N,R5E	9
T6N,R1W	0
T6N,R1E	2
T6N,R2E	15
T6N,R3E	8
T6N,R4E	4
T6N,R5E	8
T5N,R1W	0
T5N,R1E	1
T5N,R2E	18
T5N,R3E	13
T5N,R4E	7
T5N,R5E	20
T4N,R1W	3
T4N,R1E	4
T4N,R2E	0
T4N,T3E	0
T4N,R4E	5
T4N,R5E	13
T4N,R6E	6
T4N,R7E	8
T3N,R1W	8
T3N,R2W	0
T3N,R1E	4
T3N,R2E	1
T3N,R3E	0
T3N,R4E	6
T3N,R5E	7
T3N,R6E	6
T3N,R7E	2
T3N,R8E	2
T2N,R1W	2
T2N,R2W	1
T2N,R1E	3
T2N,R2E	3
T2N,R3E	0
T2N,R4E	0
T2N,R5E	2
T2N,R6E	5
T2N,R7E	7
T2N,R8E	2
T1N,R1W	1
T1N,R2W	2
T1N,R1E	6
T1N,R2E	4
T1N,R3E	2
T1N,R4E	2
T1N,R5E	6
T1N,R6E	8
T1N,R7E	3
T1S,R1W	0
T1S,R2W	3
T1S,R1E	0
T1S,R2E	3
T1S,R3E	0

N	Name	RD	Twm	Rng	1	2	YR
278	Skaggy Page Crk	IV	T41S	R08W		x	1990
233	Rachel	CH	T40S	R12W	x		1989
234	Pandora	CH	T40S	R12W		X	1990
256	High Praire	CH	T38S	R12W	x		1990
257	Moser Creek	CH	T41S	R12W	x		1990
264	Boulder Creek	CH	IS N	OW #20			
265	Jacks Creek	CH	T40S	R12W		x	1990

RECEIVED MAY 17 1991

Catherine;

Enclosed is the spotted owl information you requested for the Siskiyou National Forest. If I can be of further assistance please let me know

Fred Craig

N	Name	RD	Twn	Rng	1	2	YR
14	Emily	CH	T39S	R12W	x		1979
15	4th of July Cr	CH	T41S	R11W	x		1979
16	Emily Creek	CH	T39S	R12W		x	1990
17	West Coon Creek	CH	T39S	R11W		x	1990
19	Carter Creek	IV	T38S	R10W		x	1980
20	Hazel	IV	T18N	R04E		x	1990
21	Elk Valley	IV	T18N	R04E	x		1978
24	Winchuck	CH	T40S	R11W		x	1990
35	Florence Creek	GA	T37S	R10W	x		1979
40	Packers Creek	IV	T41S	R08W	x		1978
45	Trapper 1	IV	T41S	R08W		x	1978
46	Trapper Gulch	IV	T41S	R08W	x		1985
80	Trapper 2	IV	T41S	R08W		x	1990
82	Wheeler Creek	CH	T40S	R12W		x	1988
89	Mill Creek	CH	T40S	R12W	x		1990
90	Emily Creek 2	CH	T40S	R12W	x		1990
91	Acorn Creek	CH	T40S	R11W	x		1979
92	Upper Wheeler	CH	T40S	R12W		x	1990
98	Tolman	CH	T38S	R12W		x	1990
99	Levizenger Creek	IV	T41S	R08W	x		1976
100	Heather Mtn	IV	T37S	R11W	x		1981
101	Low Prarie	CH	T38s	R12W	x		1990
102	Nook Creek	CH	T39S	R12W		x	1990
103	Elk Mountain	CH	T41S	R12W	x		1990
104	Susan Creek	CH	T38S	R11W	x		1981
105	Wheeler RNA	CH	T40S	R12W		x	1990
106	Slump Creek	CH	T40S	R11W		x	1990
120	Mineral Hill 1	CH	T38S	R12W		x	1982
122	Hog Mountain	CH	T38S	R13W		x	1983
123	Bear Wallow	IV	T18N	R05E		x	1989
128	Rainbow	CH	T38S	R12W	x		1972
135	N. Fork Smith	CH	T40S	R11W	x		1990
142	Mineral Hill 2	CH	T38S	R12W	x		1990
143	Coon Creek	CH	T39S	R11W		x	1990
144	Chetco Pass	IV	T38S	R09W	x		1987
145	Lighting Gulch	IV	T39S	R09W	x		1987
150	West Emily	CH	T40S	R12W		x	1990
162	Mineral Creek	CH	T38S	R12W		X	1990
164	East Fk. Winchuck	CH	T40S	R12W	x		1990
165	Salmon Creek	CH	T41S	R12W	x		1990
170	Brushy Creek	IV	T18N	R05E		x	1986
186	Upper Winchuck	CH	T40S	R12W	x		1989
199	Bear Ridge	CH	T41S	R12W		x	1989
200	Redwood Springs	CH	T39S	R12W		x	1989
204	Pollywog Butte	CH	T39S	R11W		x	1990
205	E.Wheeler Ck. RNA	CH	T40S	R12W		x	1990
206	4th-Winch Ridge	CH	T40S	R11W		x	1990
207	Peavine Ridge	CH	T41S	R12W	x		1989
208	Packsaddle BM	CH	T41S	R11W	x		1989
209	Cedar Creek	CH	T41S	R11W		X	1990
210	Laurel Butte	IV	T18N	R04E	x		1989
211	Wood Creek	IV	T41S	R08W	x		1986
212	Trapper Center	IV	T41S	R08W		x	1989
216	Buckskin	IV	T40S	R10W	x		1989
229	Redbone	CH	T39S	R11W	x		1989

APPENDIX C

APPENDIX C
INFORMATION ON THE RANGE, HABITAT REQUIREMENTS, STATUS, SENSITIVITY TO TIMBER HARVESTS, OCCURRENCE ON SIMPSON PROPERTY, AND EXPECTED IMPACTS OF THE SPOTTED OWL HABITAT CONSERVATION PLAN (HCP) ON OTHER SPECIES OF CONCERN

I. PLANTS

Except where noted, the following information on plants was taken from the California Department of Fish and Game (CDFG) 1989 annual report on the status of state listed plants and animals (CDFG 1990).

A. MACDONALD'S ROCK CRESS (*Arabis macdonaldiana*)

1. Range

MacDonald's rock cress occurs in Curry County, Oregon and Del Norte and Mendocino Counties, California, although the U.S. Fish and Wildlife Service only recognizes populations in Red Mountain (Mendocino County) as unhybridized strains of the species. The rock cress is found at elevations of approximately 4,000 feet (Munz and Keck 1970).

2. Specific Habitat Requirements

MacDonald's rock cress inhabits serpentine soils (Munz and Keck 1970) in open, rocky areas of montane coniferous forests. They often grow in rock crevices or in sites with high soil disturbance.

3. Status

MacDonald's rock cress is known from only two occurrences in Red Mountain. Populations appear to be stable, but are threatened by mining. The species is listed as a California and federally endangered species.

4. Sensitivity to Timber Harvest and Other Impacts

Intolerance to interspecific competition is thought to be the primary factor limiting the distribution of MacDonald's rock cress, with current populations threatened by strip mining for nickel and chromium, which may have direct and indirect (e.g., acid rain, erosion) impacts on the species. We found no literature pertaining to potential impacts of timber harvesting on MacDonald's rock cress.

5. Status and Occurrence on Simpson Timberlands

Because MacDonald's rock cress is a federal and state endangered species, Simpson's registered professional foresters (RPFs) survey for it during timber harvest plan layout. No specimens of the species, however, have ever been found on Simpson's ownership.

6. Expected Impacts of HCP

We believe the impacts of the plan on MacDonald's rock cress will be neutral because RPFs will continue to search for the species for timber harvest plans. If the species is found, appropriate mitigation will be determined upon consultation with CDFG.

B. LEAFY REED GRASS (*Calamagrostis foliosa*)

1. Range

Munz and Keck (1970) regarded the range of leafy reed grass to be from Sonoma to Humboldt County, California, but CDFG (1990) also included Del Norte County in the range.

2. Specific Habitat Requirements

According to Munz and Keck (1970), leafy reed grass grows on rocky places near the coast, but CDFG (1990) also included riparian areas and steep roadcut slopes as habitat. Heidsiek (1990) studied leafy reed grass in the King Range Conservation Area and found the plant to grow in low nutrient, low moisture substrates that were actively eroding. The species seemed to prefer rugged, non-grazable sites, mostly on rock outcroppings, with new specimens found in stream banks and other areas.

3. Status

Leafy reed grass is listed as a California rare species. Populations appear to be stable, and the species seems to be more widespread than previously thought, with many occurrences in the King Range of Humboldt County (Heidsiek 1990).

4. Sensitivity to Timber Harvest and Other Impacts

Most sites where leafy reed grass occurs are inaccessible to disturbance by humans or livestock, although a few areas may be threatened by development. Heidsiek (1990) suggested that because leafy reed grass was an early successional species and disturbance oriented, that overly protective management could be detrimental to the long-term productivity of the plant. We found no literature pertaining to potential impacts of timber harvest on leafy reed grass.

5. Status and Occurrence on Simpson Timberlands

Because leafy reed grass is listed as rare in California, Simpson's RPFs survey for it during timber harvest plan layout. No specimens of the species, however, have ever been found on Simpson's ownership.

6. Expected Impacts of HCP

We believe the impacts of the plan on leafy reed grass will be neutral because RPFs will continue to search for the species for timber harvest plans. If the species is found, appropriate mitigation will be determined upon consultation with CDFG. Increased protection of riparian habitats (see "Overall Resource Management" in Section 4.C of the HCP) may actually benefit leafy reed grass.

C. HUMBOLDT MILK-VETCH (*Astragalus agnicidus*)

1. Range

Humboldt milk-vetch is found only on a private ranch south of Miranda in Humboldt County, California.

2. Specific Habitat Requirements

Humboldt milk-vetch grows in disturbed woodlands at about 2500 feet (Munz and Keck 1970).

3. Status

Humboldt milk-vetch is listed as a California endangered species and a Category 1 candidate for federal listing. It was presumed extinct for many years until a few plants were located at an historic site in 1987.

4. Sensitivity to Timber Harvest and Other Impacts

Plants discovered in 1987 apparently germinated as the result of the felling and removal of a dead tree, which caused soil disturbance and opening of the canopy. The site is now protected and the population is being researched. We found no literature pertaining to potential effects of timber harvest on Humboldt milk-vetch.

5. Status and Occurrence on Simpson Timberlands

Because Humboldt milk-vetch is listed as endangered in California, Simpson's RPFs survey for it during timber harvest plan layout. No specimens of the species, however, have ever been found on Simpson's ownership.

6. Expected Impacts of HCP

We believe the impacts of the plan on Humboldt milk-vetch will be neutral because RPFs will continue to search for the species for timber harvest plans. If the species is found, appropriate mitigation will be determined upon consultation with CDFG.

D. BENSONIELLA (*Bensoniella oregona*)

1. Range

Bensoniella is found only at elevations from 4000 to 5000 feet in the Siskiyou mountains of northwestern California and southeastern Oregon (Munz 1968).

2. Specific Habitat Requirements

Bensoniella grows in moist, grassy meadows and small openings in evergreen forests.

3. Status

Bensoniella was thought to be extinct for many years until 1977 when the species was discovered growing in Humboldt County. Since then, several additional findings have been made during surveys. None of the areas where Bensoniella occur are protected, and the species has declined in recent years. The plant is listed as a rare species in California and a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Bensoniella sites have been damaged by cattle trampling and are considered threatened by timber harvest impacts such as sedimentation and windthrow of unlogged trees. The restriction of timber harvest activities near the species' habitat has been recommended. Further information on the ecological and reproductive biology of the plant also are recommended to help formulate management plans.

5. Status and Occurrence on Simpson Timberlands

Because Bensoniella is listed as rare in California, Simpson's RPFs survey for it during timber harvest plan layout at high elevations. No specimens of the species, however, have ever been found on Simpson's ownership.

6. Expected Impacts of HCP

We believe the impacts of the plan on Bensoniella will be neutral because RPFs will continue to search for the species for timber harvest plans at high elevations. If the species is found, appropriate mitigation will be determined upon consultation with CDFG.

E. WESTERN LILY (*Lilium occidentale*)

1. Range

Western lilies are found in Humboldt County, California and southern Oregon (Munz and Keck 1970).

2. Specific Habitat Requirements

Habitats for western lilies include sandy loam or peat in thickets and among ferns (Munz and Keck 1970).

3. Status

Western lilies are listed as a California endangered species and a Category 1 candidate for federal listing. The species has undergone a general decline, but recent protection efforts have stabilized populations.

4. Sensitivity to Timber Harvest and Other Impacts

Threats to western lilies include habitat loss, over-collecting of bulbs, and cattle grazing. Protection and studies of the species are being conducted. We found no literature pertaining to potential effects of timber harvest on western lilies.

5. Status and Occurrence on Simpson Timberlands

Because western lilies are listed as endangered in California, Simpson's RPFs survey for them during timber harvest plan layout. No specimens of the species, however, have ever been found on Simpson's ownership.

6. Expected Impacts of HCP

We believe the impacts of the plan on western lilies will be neutral because RPFs will continue to search for the species for timber harvest plans. If the species is found, appropriate mitigation will be determined upon consultation with CDFG.

F. YELLOW-TUBERED TOOTHWORT (*Cardamine gemmata*)

1. Range

Yellow-tubered toothworts are found in southwestern Oregon and Del Norte and Siskiyou counties, California (Munz 1968).

2. Specific Habitat Requirements

Yellow-tubered toothworts grow in wet places in yellow pine and mixed evergreen forests (Munz 1968).

3. Status

Considered rare throughout their range, yellow-tubered toothworts are known from fewer than 10 occurrences (Smith and Berg 1988). The species is a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Although yellow-tubered toothworts may be threatened by mining (Smith and Berg 1988), we found no literature pertaining to potential impacts of timber harvests on the species.

5. Status and Occurrence on Simpson Timberlands

No surveys for yellow-tubered toothworts have been conducted on Simpson's onwership, and no specimens have been found incidentally.

6. Expected Impacts of HCP

We expect the impact of the HCP on yellow-tubered toothworts will be neutral. Simpson foresters will search for the species in wet areas during timber harvest plan layout, and if the plant is found, appropriate mitigation will be determined upon consultation with USFWS.

G. MENDOCINO GENTIAN (*Gentiana setigera*)

1. Range

Medoncino gentians are found in southwestern Oregon and in California from Red Mountain, Mendocino County, to western Sisskiyou County (Munz 1968).

2. Specific Habitat Requirements

Mendocino gentians grow in wet places in yellow pine and red fir forests from 4000 to 6500 feet (Munz 1968).

3. Status

Although Mendocino gentians are listed as threatened in Oregon, the California Native Plant Society noted that more information about the species was needed to determine its status (Smith and Berg 1988). The gentians are a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

We found no literature pertaining to potential impacts of timber harvest or other activities on Mendocino gentians.

5. Status and Occurrence on Simpson Timberlands

No surveys for Mendocino gentians have been conducted on Simpson's ownership, and no specimens have been found incidentally.

6. Expected Impacts of HCP

We expect the impact of the HCP on Mendocino gentians will be neutral. Simpson foresters will search for the species in wet places of yellow and red fir forests at high ($\geq$4000 feet) elevations during timber harvest plan layout. If the plant is found, appropriate mitigation will be determined upon consultation with USFWS.

H. TRACY'S SANICLE (*Sanicula tracyi*)

1. Range

Tracy's sanicle is found in southwestern Oregon and in Trinity, Humboldt (Munz 1968), and Tehama (Smith and Berg 1988) counties, California.

2. Specific Habitat Requirements

Tracy's sanicle grows in mixed evergreen (Munz 1968) low montane forests and cismontane wildlands (Smith and Berg 1988).

3. Status

Considered rare throughout its range (Smith and Berg 1988), Tracy's sanicle is a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Smith and Berg (1988) listed logging as a threat to Tracy's sanicle, but did not describe specific impacts of logging activity on the species.

5. Status and Occurrence on Simpson Timberlands

No surveys for Tracy's sanicle have been conducted on Simpson's ownership, and no specimens have been found incidentally.

6. Expected Impacts of HCP

We expect the impact of the HCP on Tracy's sanicle will be neutral. Simpson's foresters will search for the species during timber harvest plan layout, and if the plant is found, appropriate mitigation will be determined upon consultation with USFWS.

I. KNEELAND PRAIRIE PENNY CRESS (*Thlapsi montanum* var. *californicum*)

1. Range

Kneeland Prairie penny cress is only found in Humboldt County, California (Smith and Berg 1988).

2. Specific Habitat Requirements

Kneeland Prairie penny cress has historically been found in broadleaf upland forests and coastal prairie rock outcroppings (Smith and Berg 1988).

3. Status

Only one known extant occurrence of Kneeland Prairie penny cress exists and is voluntarily protected by the landowner (Smith and Berg 1988). The species is a Category 1 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

The only known occurrence of Kneeland Prairie penny cress would potentially be threatened by road maintenance if not protected by the landowner (Smith and Berg 1988).

5. Status and Occurrence of Simpson Timberlands

No surveys for Kneeland Prairie penny cress have been conducted on Simpson's ownership, and no specimens have been found incidentally.

6. Expected Impacts of HCP

We expect the impact of the HCP on the Kneeland Prairie penny cress with be neutral because the plant is known to exist in one protected location. However, Simpson's foresters will search for the species during timber harvest plan layout in areas with broadleaf upland forests and prairie rock outcroppings. If the plant is found, appropriate mitigation will be determined upon consultation with USFWS.

II. FISH

Except where noted, the following information on salmonids (the only fish addressed) was taken from Moyle et al. (1989) who thoroughly summarized the biology, status, and management needs of fish of special concern in California. In general, timber harvest, especially on unstable slopes of the California Coast Range, can potentially adversely affect salmonids by increasing summer temperatures and erosion. Excessive siltation may cover gravel spawning beds and smother eggs and young fish (CDFG 1968).

A. COASTAL CUTTHROAT TROUT (*Oncorhynchus clarki clarki*)

1. Range

Coastal cutthroat trout range from southeastern Alaska south to Humboldt County, California. In California, the fish are found from the Oregon border south to the Eel River drainage and east to the Coast Range. In the state, Redwood Creek, and the Mad, Klamath and Smith Rivers have been identified as significant spawning sites, with the fish also occurring in the Eel River.

2. Specific Habitat Requirements

Habitats for coastal cutthroat trout are small, low gradient, cool (<18^{o} C), well shaded coastal streams and esturarine habitats. Streams with small gravel substrates are required for spawning.

3. Status

The status of coastal cutthroat trout is difficult to determine because the species is not readily distinguished in the field from steelhead. Populations are thought to have declined because they require small streams with cold water of high quality and such streams are vulnerable to damage by logging and other activities. The trout are listed as a California species of special concern.

In California, the Smith River is considered to be the most important drainage because the species has been reported from nearly all tributaries and populations there are the largest in the state.

4. Sensitivity to Timber Harvest and Other Impacts

Logging may have positive and negative effects upon coastal cutthroat trout (Bisson and Sedell 1984). It can open canopies and result in increases in salmonids for 10-15 years due to increased stream productivity (Murphy et al. 1984) or longer growing seasons (Bisson and Sedell 1984). However, clearcutting without buffer strips appears to reduce winter carrying capacity for parr by removing woody debris, collapsing and undercutting banks, destabilizing or embedding channel substrates (Murphy et al. 1984), or decreasing the number of pools (Bisson and Sedell 1984). Buffer strips have been recommended to protect habitats, increase primary and secondary production, and act as sources of woody debris (Murphy et al. 1984).

Surveys have been suggested to determine anadromous and resident populations in California. Protection of spawning areas, especially in the

Smith River drainage and of resident populations such as that at Little Jones Creek (Smith River tributary) has also been recommended.

5. Occurrence and Status on Simpson Timberlands

Numerous juvenile and occasionally adult salmonids are seen in Class I streams throughout Simpson's ownership. It is presumed that some of these are coastal cutthroat trout, but nothing is known about the specific occurrence or population status of the species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams though measures described in "Overall Resource Management" (see Section 4.C of the HCP). This should reduce siltation of spawning gravels and generally improve water quality, which we believe will have a beneficial impact on coastal cutthroat trout.

B. PINK SALMON (*Oncorhynchus gorbuscha*)

1. Range

Pink salmon occur in coastal streams in northern Asia and North America. In North America, they are found from the MacKenzie River in the Yukon south to coastal streams of California, with the most significant runs having a southernmost extent of range in streams tributary to Puget Sound. In California, populations have been documented as far south as La Jolla, with small numbers reported from the Klamath, Russian, Garcia, Mad, Ten Mile, Sacramento and San Lorenzo Rivers. Spawning has only been reported from the Russian River.

2. Specific Habitat Requirements

Pink salmon spend most of their lives in the ocean, using freshwater habitats for spawning only. Suitable spawning streams contain shallow riffle sections with small gravel substrates.

3. Status

Pink salmon are abundant in Alaska and Canada where they support major commercial fisheries. Because California is at the southern edge of their range, they probably never were common in the state and evidence indicates that they are even less common today. Impoundments and pollution make the existence of former runs in the Russian River unlikely, but the status of the salmon there or anywhere else in California is unknown. Pink salmon are listed as a California species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

Management for pink salmon in California has been recommended to focus on determining the status of the species in the state. Surveys in the lower reaches of the Russian River and other potential spawning areas have been suggested. If viable spawning areas are found, protection of the areas has been recommended.

5. Occurrence and Status on Simpson Timberlands

Numerous juvenile and occasionally adult salmonids are seen in Class I streams throughout Simpson's ownership. It is possible that some of these are pink salmon, but nothing is known about the specific occurrence or population status of the species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams though measures described in "Overall Resource Management" (see Section 4.C of the HCP). This should reduce siltation of spawning gravels and generally improve water quality, which we believe will have a beneficial impact on pink salmon.

C. COHO SALMON (*Oncorhynchus kisutch*)

1. Range

Coho salmon are widely distributed in northern temperate latitudes in North America and Asia. In North America, they spawn in coastal streams from Alaska to California. In California, principal populations of coho salmon are found in the Klamath, Trinity, Mad, Noyo, and Eel Rivers, with other populations in smaller coastal streams south to Santa Cruz county.

2. Specific Habitat Requirements

Coho salmon spawning sites are located at the heads of riffles or tails of pools where beds of loose, silt free, course, medium to small sized gravel are found, with cover for adults nearby. Preferred spawning conditions include a water depth of 10-54 cm and temperatures 6-10° C. Juveniles are found in pools at least 1 m in depth with plenty of shade and overhead cover. Juvenile habitats are also characterized as having high levels of oxygen and food with preferred temperatures 10-15° C. Density of juveniles is often greatest in areas with logs and other debris.

3. Status

Populations of coho salmon in California show large fluctuations with a general downward trend of short run populations of coastal streams. These declines are mostly attributed to poor stream watershed management such as logging practices that cause erosion resulting in increased stream sedimentation and temperatures. Declines of coho salmon may also be due to urbanization, industrialization, agricultural practices, and water diversions (Emig et al. 1988). The salmon are listed as a California species of special concern.

In the Klamath and Mad (Emig et al. 1988) River systems, much of the production of big river fish (fish migrating 100-200 meters or more to spawn) takes place in hatcheries.

4. Sensitivity to Timber Harvest and Other Impacts

Logging may have positive and negative effects upon coho salmon (Bisson and Sedell 1984). In the short term (1-15 years), logging can open canopies and result in increases in salmonids due to improved energy transfer

(Scrivener and Andersen 1984) or longer growing seasons (Bisson and Sedell 1984). However, clearcutting without buffer strips appears to reduce winter carrying capacity for parr by removing woody debris, collapsing and undercutting banks, destabilizing or embedding channel substrates (Murphy et al. 1984), and reducing the number of pools (Bisson and Sedell 1984). Longer term (35-50 year) effects may include deposition of fine particles in low gradient streams or reduction of input of woody debris (Scrivener and Andersen 1984). Buffer strips are recommended to protect habitats, increase primary and secondary production, and act as a source of woody debris (Murphy et al. 1984).

The key to coho salmon management in California is considered to be the protection of spawning and rearing streams and the restoration of damaged habitat. Thus, modifying logging and road construction in coastal drainages and monitoring coho salmon populations is recommended. State habitat restoration projects include removing migration barriers, and planting trees and shrubs to prevent erosion and provide cover (Emig et al. 1988). Better regulation of coho salmon harvests is also recommended.

5. Occurrence and Status on Simpson Timberlands

Numerous juvenile and occasionally adult salmonids are seen in Class I streams throughout Simpson's ownership. It is presumed that some of these are coho salmon, but nothing is known about the specific occurrence or population status of the species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams though measures described in "Overall Resource Management" (see Section 4.C of the HCP). This should reduce siltation of spawning gravels and generally improve water quality, which we believe will have a beneficial impact on coho salmon.

D. SUMMER STEELHEAD (*Oncorhynchus mykiss gairdneri*)

1. Range

In the eastern Pacific, summer steelhead are found from Alaska south to central California and west to Siberia. In California, they occur in north coast streams south to the Eel River. Rivers include the Mad, North and South Fork Trinity, Middle Fork and mainsteam Eel, Van Duzen, Salmon, Klamath drainage, and Redwood Creek. Up to half of California's summer steelhead are concentrated in the Middle Fork Eel River.

2. Specific Habitat Requirements

Summer steelhead adults require temperatures under 20° C, with 10-15° preferred and water with at least 80% saturation of dissolved oxygen. For migrating adults, minimum water depth is 18 cm and for holding pools, 3 m. Ideal pools have cover such as bubble curtains (created by water flowing over rocks) or underwater ledges and caverns.

Spawning streams should be cool, clear, and well oxygenated with gravel of diameters 0.64-13 cm.

3. Status

Populations of summer steelhead rangewide have declined within the past 30-40 years and the trout are listed as a federal sensitive species. In California, population declines are attributed to poaching; habitat degradation due to floods, grazing, and logging on steep slopes; overharvesting; natural predators; use of gillnets; recreational disturbance; and competition and genetic swamping by hatchery reared fish. Poaching is considered to be the most immediate threat to the species in the state, which listed the trout as a species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

Logging may have positive and negative effects upon steelhead (Bisson and Sedell 1984). It can open canopies and result in increases in salmonids due to increased stream productivity (Murphy et al. 1984) or longer growing seasons (Bisson and Sedell 1984). However, clearcutting without buffer strips appears to reduce winter carrying capacity for parr by removing woody debris, collapsing and undercutting banks, destabilizing or embedding channel substrates (Murphy et al. 1984), or decreasing the number of pools (Bisson and Sedell 1984). Buffer strips are recommended to protect habitats, increase primary and secondary productivity, and act as a source of woody debris (Murphy et al. 1984).

Suggested management for summer steelhead includes protecting the fish from poaching in their summering areas; watershed management to keep summer flows up and temperatures down; better regulation of adult harvest; better management of downstream reaches; improving degraded habitat and restoring extinct populations; and protecting the fish from natural predators.

5. Occurrence and Status on Simpson Timberlands

Numerous juvenile and occasionally adult salmonids are seen in Class I streams throughout Simpson's ownership. It is presumed that some of these are summer steelhead, but nothing is known about the specific occurrence or population status of the species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams though measures described in "Overall Resource Management" (see Section 4.C of the HCP). This should reduce siltation of spawning gravels and generally improve water quality, which we believe will have a beneficial impact on summer steelhead.

E. SPRING CHINOOK SALMON (*Oncorhynchus tshawytscha*)

1. Range

Spring chinook salmon range from British Columbia south to California. They are distributed in scattered populations in California in the Klamath, Trinity, and Sacramento drainages. Small numbers are occasionally found in the Smith, Mad, Mattole, and Eel rivers and in Redwood Creek. In the Klamath drainage, the principal remaining run is in the Salmon River and its tributaries, with the South Fork of the Trinity River also supporting a few fish. A large run of spring chinook in the mainsteam Trinity River is maintained by hatchery production.

2. Specific Habitat Requirements

Spring chinook salmon require pools 1-3 m deep with bedrock bottoms and cover in the form of underwater rocky ledges or large rocks. The pools usually have bubble curtains and shade provided throughout the day. Temperatures must be below 27° C. Suitable spawning areas are gravel beds with an optimum mixture of gravel and rubble of mean diameter 1-4 cm with less than 25% under 6.4 mm in diameter.

3. Status

Throughout their range, populations of spring chinook salmon have been depleted or are maintained by hatchery production. Currently eight runs of wild, spring chinook salmon exist in California, with other runs having become extinct within the last 50 years. In both the Sacramento and Klamath-Trinity drainages, the majority of spring run chinooks are the result of hatchery spawning. Declines of California populations are thought due to gold mining, irrigation diversions, impoundments, and flood-induced landslides. The salmon are listed as a California species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

Because spring chinook salmon summer in deep riverine pools before spawning, they are the most vulnerable of California's salmon runs to poaching and thus protection of the salmon in freshwater habitats is stressed. Measures to protect the salmon include providing adults access to holding and spawning areas especially in dry years, protecting adults holding in pools by prohibiting fishing in principal holding areas, increasing patrols by wardens, and providing passage flows in the lower reaches of streams in March and April for out-migrating juveniles. Monitoring of spring chinook salmon populations has also been recommended.

5. Occurrence and Status on Simpson Timberlands

Numerous juvenile and occasionally adult salmonids are seen in Class I streams throughout Simpson's ownership. It is presumed that some of these are spring chinook salmon, but nothing is known about the specific occurrence or population status of the species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams though measures described in "Overall Resource Management" (see Section 4.C of the HCP). This should reduce siltation of spawning gravels and generally improve water quality, which we believe will have a beneficial impact on spring chinook salmon.

III. AMPHIBIANS AND REPTILES

A. RED-LEGGED FROG (*Rana aurora draytoni*)

1. Range

Excluding the Central Valley and deserts of California, red-legged frogs range west of the Cascade/Sierra Nevada from British Columbia to northwestern Baja California (Altig and Dumas 1974). In California, they occur at elevations below 3900 feet in the coast ranges along the length of the state (Zeiner et al. 1990a).

2. Specific Habitat Requirements

Red-legged frogs are found in moist forests and riparian habitats (Nussbaum et al. 1983) where they occupy slow moving creeks and ponds (Bury and Corn 1988b). Key habitat components are dense vegetation close to water level (Hayes and Jennings 1988) that provide surfaces for egg attachment (Nussbaum et al. 1983) and shading of the water (Hayes and Jennings 1988). Little or no water flow is required for reproduction (Nussbaum et al. 1983). Strong evidence suggests that in some areas, red-legged frogs are found in intermittent streams as the result of habitat restriction by aquatic predators such as introduced bullfrogs (Hayes and Jennings 1988).

In California, red-legged frogs live near quiet, permanent pools of streams, marshes, and ponds (Zeiner et al. 1990a). Schlorff (1978) found the frogs to be one of the main amphibians occupying drainage ditches in coastal lowlands near Humboldt Bay.

3. Status

Historical populations of red-legged frogs in California were probably large, with numbers seriously declining near the turn of the century due to commercial exploitation (Jennings and Hayes 1985). Hayes and Jennings (1988) studied the frogs in the Central Valley of California and estimated that the species was extinct on the valley floor and in at least 50% of the surrounding historically occupied habitat. The remaining habitat in the area was threatened with flooding by proposed reservoirs. Although Moyle (1973) believed man-induced alteration of red-legged frog habitat to have been partially responsible for declines, Hayes and Jennings (1988) attributed most extinctions in perennial habitats to predation by fish and introduced bullfrogs. Bullfrogs are considered responsible for declines in other areas, but runoff herbicides, pesticides, and acid rain may also be responsible (Nussbaum et al. 1983). Red-legged frogs are a California species of special concern and a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

According to Hayes and Jennings (1988), red-legged frogs may require immediate management consideration for populations to survive. They recommended preserving preferred habitat where it is ambiguous whether habitat restriction is due to predators or to intrinsic limitations, with management concentrating on areas lacking introduced aquatic predators. Artificial impoundments may be used by red-legged frogs, but must be designed to prevent the establishment of bullfrogs (Hayes and Jennings 1988). Hayes and Jennings (1988) believed that alterations of streams was not likely to retain required vegetative structure for shading and was likely to result in tradeoffs between habitat losses and gains for red- versus yellow-legged frogs. Moyle (1973) suggested that native frog populations would benefit from less restrictive regulations governing the take of bullfrogs. We did not find literature pertaining to potential impacts of timber harvest on red-legged frogs.

5. Occurrence and Status on Simpson Timberlands

Red-legged frogs appear to be locally abundant in moist woodlands and marshes throughout Simpson's ownership. Although no specific surveys have been conducted, 12 different breeding areas have been located incidental to other wildlife surveys. Most of the breeding sites were temporary ponds and puddles created by timber harvest and road building. We have no information on population trends of this species.

6. Expected Impacts of HCP

We believe that the impacts of this HCP will be neutral relative to red-legged frogs. We found no evidence that timber harvest is detrimental to the frogs and all wetlands are protected by California forest practice rules. In addition, anecdotal observations on Simpson's ownership suggest that timber harvest may actually benefit red-legged frogs by producing breeding sites.

B. FOOTHILL YELLOW-LEGGED FROG (*Rana boylei*)

1. Range

Foothill yellow-legged frogs range from northwestern Oregon to northern Baja California where they are found at elevations up to 6700 feet (Zweifel 1968). In California, they occur in the Coast Ranges from the Oregon border to Los Angeles County and in most of northern California west of the Cascades. They also are found west of the Sierra south to Kern County, with isolated populations elsewhere (Zeiner et al. 1990a). In the state they live at elevations from sea level to 6000 feet (Zweifel 1968).

2. Specific Habitat Requirements

Yellow-legged frogs are found in a variety of habitats (Zeiner et al. 1990a), seldom far from (Nussbaum et al. 1983) small permanent streams (Moyle 1973). The streams are characterized as having riffles (Hayes and Jennings 1988) and rocky bottoms (Moyle 1973) comprised of cobble-sized stones (Hayes and Jennings 1988) and may be partly (Hayes and Jennings 1988) to well (Moyle 1973) shaded, but have banks that provide sunning sites (Zweifel 1968).

In California, the frogs are found in valley-foothill riparian, ponderosa pine, mixed conifer, coastal scrub, mixed chaparral, and wet meadow habitats (Zeiner et al. 1990a).

3. Status

In southwestern Oregon, yellow-legged frogs were once considered one of the most common amphibians, but their current status is unknown (Nussbaum et al. 1983). Man-made alterations of habitat and predation and competition by introduced bullfrogs is believed to be responsible for reductions of yellow-legged frogs in foothill streams of the Sierra Nevada and San Joaquin Valley of California. In the California Central Valley, observations indicate that the species no longer occurs in many locations where it once did (Hayes and Jennings 1988) and yellow-legged frogs are a California species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

According to Hayes and Jennings (1988), immediate management consideration may be needed to maintain the remaining populations of yellow-legged frogs. They stressed preserving preferred habitat where it is ambiguous whether habitat restriction is due to predators or to intrinsic limitations, with management concentrating on areas lacking introduced aquatic predators. Hayes and Jennings (1988) believed that habitat manipulation to streams was likely to result in tradeoffs between habitat losses and gains for yellow- versus red-legged frogs (Hayes and Jennings 1988). We did not find literature pertaining to potential impacts of timber harvest on foothill yellow-legged frogs.

5. Occurrence and Status on Simpson Timberlands

Foothill yellow-legged frogs have been observed along Class I streams throughout Simpson's ownership. Anecdotal observations would suggest that although they are ubiquitous along all larger streams throughout the area, they do not occur in large numbers anywhere. This distribution pattern is considered typical for the species (Storm, 1991, pers. comm.). We have no information on population trends of this species.

6. Expected Impacts of HCP

We believe the impacts of this HCP will be neutral relative to foothill yellow-legged frogs because we could find no evidence that timber harvest has any negative impact on the species.

C. TAILED FROG (*Ascaphus truei*)

1. Range

Tailed frogs are found at elevations from sea level to near timber-line throughout the coastal mountains from British Columbia south to Mendocino County and in the inland mountains of southeast Washington, Idaho, and Montana (Metter 1968). In California, they occur from sea level to 6500 feet, mostly at sites receiving over 40" of precipitation annually in Siskiyou, Del Norte, Trinity, Shasta, Tehama, Humboldt, Mendocino, and possibly Sonoma counties (Bury 1968).

Throughout its range the species is distributed as disjunct populations (Metter 1968). Bury and Corn (1988a) believed that isolated, discrete populations most likely occurred in drier forests and heavily managed lands.

2. Specific Habitat Requirements

Tailed frog habitat has been characterized as perennial mountain streams or steep-walled valleys with dense vegetation (Bury 1968). Bury (1968) suggested that the most important factor limiting the distribution of tailed frogs was their requirement for perennial, swift streams of low temperature, for which they are highly specialized (Nussbaum et al. 1983). The frogs may inhabit spray drenched cliff walls near waterfalls (Zeiner et al. 1990a), but avoid marshes, lakes, and slow sandy streams (Daugherty and Sheldon 1982).

To support larval tailed frogs, streams must have suitable stones for attachment sites (Noble and Putnam 1931) and diatoms for food (Bury and Corn 1988a). Streams supporting tailed frogs have been found primarily in mature (Bury and Corn 1988a, Welsh 1990) and old growth (Bury 1983, Welsh 1990) coniferous forests. The frogs seem to be absent from clearcut areas (Bury and Corn 1988a) or managed young forests (Welsh 1990), although they have been observed in young, naturally regenerated forests suggesting that structure rather than age per se of old growth is important to the animals (Welsh 1990).

In California, tailed frogs have been found in Sitka Spruce, redwood, Douglas-fir and ponderosa pine forests. Bury (1968) described one tailed frog site as shaded by a dense canopy of second growth redwoods. However, Bury (1983) found tailed frogs in old growth plots but not in 6-14 year old clearcut plots near Redwood National Park.

3. Status

Tailed frogs were considered rare for many years, but are now known to occur in high densities in suitable habitats (Nussbaum et al. 1983). Welsh (1990) expected numbers of frogs to decline due to timber harvest, to which they seem sensitive (Bury and Corn 1988b). He also speculated that the narrow niche, isolated population distribution, and long generation time of tailed frogs in conjunction with the lack of protection of headwater habitats make the species susceptible to local extirpations. Bury and Corn (1988a) predicted that populations subjected to clearcutting in the Coast Range of Oregon and northern California would probably go extinct following clearcutting, whereas those in the Cascades of Oregon and Washington had a higher probability of surviving. However, Bury (1968) noted that deforestation had a less detrimental effect on tailed frog populations where an influence of maritime climate was present.

Bury and Corn (1988a) and Welsh (1990) believed that long-term, range-wide reductions or extinctions of tailed frogs were likely due to local extirpations, increased population fragmentation, habitat loss, restricted gene flow, and limited recolonization of streams when habitats are re-established (Bury and Corn 1988a). The frogs are a California species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

Removal of timber by logging or fire is believed to result in the disappearance of tailed frogs due to increased stream temperatures (Noble and Putnam 1931, Nussbaum et al. 1983, Bury and Corn 1988a) and sedimentation (Nussbaum et al. 1983, Bury and Corn 1988a). The effects may affect the frogs directly, or indirectly by shifting the larval food base from diatoms to green algae (Bury and Corn 1988a). However, Bury (1968) stated "Presence of the frog in logged areas of coastal Humboldt County suggests that deforestation is less of a threat to the disappearance of *Ascaphus* in coastal than inland streams".

Although the survival of tailed frogs may depend on protection of cool flowing streams and adjacent forest habitats (Bury and Corn 1988b), timber harvest is not incompatible with such protection (Welsh 1990). Bury and Corn (1988a) and Welsh (1990) suggested eliminating harvest adjacent to aquatic habitats and establishing buffer strips to protect current frog populations and act as sources for future repopulation of logged areas. Bury and Corn (1988a) recommended establishing protection zones by retaining deciduous and small (cull) trees around streams while felling merchantable timber away from the streams. They noted that small clumps of trees around streams rather than cover along whole stream courses may be adequate to protect local populations (Bury and Corn 1988a). Retention of course woody debris for nutrient sources and sediment traps, further studies and surveys of tailed frogs, and protection of headwater habitats have also been recommended (Bury and Corn 1988a).

5. Occurrence and Status on Simpson Timberlands

Although no comprehensive surveys have been conducted, tailed frogs have been located by occasional searches in seven different Class I and II drainages throughout Simpson's ownership. The proportion of areas searched where tailed frogs have been found suggests that intensive surveys will likely reveal their presence in most Class I and II streams throughout the ownership. Contrary to the bulk of the literature, we have located tailed frogs in recently clearcut and burned areas, but the highest densities appear to be in our 25-80 year old second growth stands. We have no information on population trends of this species.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams through measures described in "Overall Resource Management" (see Section 4.C of the HCP). In general, these measures should benefit tailed frogs by reducing siltation and maintaining cooler water temperatures.

D. OLYMPIC SALAMANDER (*Rhyacotriton olympicus*)

1. Range

Olympic salamanders occur west of the Cascades from the Olympic Peninsula in Washington south to Mendocino County in California (Anderson 1968). Bury and Corn (1988a) believed that the salamanders are distributed as isolated, discrete populations, especially in heavily managed or drier forests. In California, the species is found in the coastal forests of northwestern California south to Mendocino County (Anderson 1968).

2. Specific Habitat Requirements

Olympic salamanders occupy humid coastal (Anderson 1968) coniferous forests at elevations up to 3900 feet (Welsh 1990). They are associated with cold, well shaded permanent streams (Anderson 1968), springs, headwater seeps (Welsh 1990), waterfalls (Bury and Corn 1988), and moss covered rock rubble with flowing water (Anderson 1968). The salamanders inhabit the splash zone, and are rarely found more than 1 m from water (Nussbaum and Tait 1977). They have been observed wintering in talus slopes (Herrington 1988).

Bury (1983) did not find Olympic salamanders in 6-14 year old logged streams and Bury and Corn (1988a) found the salamanders to be more numerous in uncut 60-500 year old stands than in 14-40 year old regenerated stands (Bury and Corn 1988a).

In northwestern California, Olympic salamanders have also been linked to old growth habitats. Near Redwood National Park, Bury (1983) found Olympic salamanders in old growth stands, but not in logged stands 6-14 years old. In northern California and southern Oregon, Welsh (1990) found significantly more salamanders in mature and old growth than in young stands, but structure rather than age per se was believed to be important. In the northern part of its range, the species may have broader tolerances and thus be found in habitats other than old growth, although not in as great densities (Welsh 1990).

3. Status

Welsh (1990) believed that logging and fragmentation of old growth coniferous forests would cause numbers of Olympic salamanders to decline, with local extirpation of populations due to the species microhabitat requirements and lack of protection of headwater habitats. Bury and Corn (1988a) suggested that recolonization of logged areas would be rare and slow due to isolated population distribution, long generation time, narrow temperature requirements, and susceptibility to water loss limiting overland dispersal of the species (Welsh 1990). Recolonization may be more likely to occur in high gradient streams (Bury and Corn 1988a), but Welsh (1990) thought that local extirpations, increased population fragmentation and habitat loss, and restricted gene flow made populations vulnerable to long-term range-wide extinctions. Olympic salamanders are a California species of special concern.

4. Sensitivity to Timber Harvest and Other Impacts

Short term detrimental effects of logging on Olympic salamander habitat include increased sedimentation which fills crevices, and increased water temperatures (Bury and Corn 1988a). Bury and Corn (1988b) noted that Olympic salamanders were sensitive to timber harvest and suggested that their survival was dependent on the protection of cool flowing streams and adjacent forested habitats which provide shade and maintain stream quality. Timber harvest plans could be designed and implemented to provide such protection (Welsh 1990). Bury and Corn (1988a) recommended protecting streams by felling merchantable timber away from streams and leaving deciduous and small (cull) trees to provide shade cover. To reduce the expense of leaving merchantable timber along whole stream courses, small clumps of trees may be retained to protect current populations and provide sources for future repopulation of logged areas (Bury and Corn 1988a). Retaining course woody debris, conducting preharvest surveys, and obtaining more data on the species' habitat preferences and environmental tolerance have also been recommended (Bury and Corn 1988a).

5. Occurrence and Status on Simpson Timberlands

Olympic salamanders have been found extensively throughout Simpson's ownership. Through incidental observation, we have located Olympic salamanders in 38 different sites. The sites have ranged from recent clearcuts with no protection to residual old growth areas, with a median stand age of 30 years. Anecdotal observations suggest that substrate is more important than stand age in determining abundance of the salamanders. Although Olympic salamanders appear to be abundant in our region, we have no information on population trends.

6. Expected Impacts of HCP

The HCP proposes to increase protection of streams through measures described in "Overall Resource Management" (see Section 4.C of the HCP). In general, these measures should benefit Olympic salamanders by reducing siltation and maintaining cooler water temperatures.

E. DEL NORTE SALAMANDER (*Plethodon elongatus*)

1. Range

Del Norte salamanders occur at sea level to 3900 feet from south-western Oregon south to northwestern California (Brodie and Storm 1971). In California, they are found up to 2500 feet in Del Norte, Siskiyou, western Trinity and Humboldt counties (Zeiner et al. 1990a).

2. Specific Habitat Requirements

Herrington (1988) considered Del Norte salamanders considered to be restricted to forest talus habitats, but the salamanders have also found on the forest floor under litter and in rotten logs (Nussbaum et al. 1983). They are not commonly observed in seepages or very moist areas (Brodie and Storm 1971). The species is thought to be closely associated with mature (Bury and Corn 1988a, Raphael 1988) and old growth (Bury and Corn 1988a, Raphael 1988, Welsh 1990) habitats, although some have been found on harvested sites. The latter were early successional stages of Douglas-fir in eastern Humboldt and western Trinity counties in California and were mostly north facing slopes adjacent to older forests (Welsh 1990). The association of Del Norte salamanders and old growth is probably due more to structure providing suitable temperature and moisture regimes than to age per se (Welsh 1990).

In California, Del Norte salamanders inhabit open to dense, sapling to mature stages of valley-foothill, riparian, montane hardwood-conifer, Douglas-fir and redwood habitats (Zeiner et al. 1990a). They have also been found along coastal highways in talus habitats created by slumping of roadcuts (Stebbins and Reynolds 1947).

3. Status

Raphael (1988) predicted that Del Norte salamanders would be strongly affected by future harvest of old growth Douglas-fir forests in northwest California and projected declines of 75% from historic levels. However, he noted that his projections were highly speculative. Del Norte salamanders are listed as a California species of special concern and a Category 2 candidate for federal listing. Welsh (1990), suggested that the species is probably not susceptible to extinction due to its ability to disperse overland and the suitability of canopy cover provided by early successional forests.

4. Sensitivity to Timber Harvest and Other Impacts

Herrington (1988) summarized talus use by amphibians and reptiles in the Pacific Northwest. He suggested that removal of rocks from talus slopes may immediately or eventually destroy salamanders or their habitats, and that tree removal on talus slopes increases insolation and moisture losses in upper talus layers, and may be detrimental to salamanders. We did not find literature pertaining to potential impacts of timber harvest specific to Del Norte salamanders. However, timber harvest apparently is not always detrimental to terrestrial salamanders. Leeming (1991, pers. comm.) found more western red-backed salamanders (*Plethodon vehiculum*) in recently harvested alder forests in Oregon than in unharvested areas, and Bury (1983) found more clouded salamanders (*Aneides ferreus*) in 6-14 year old regenerating clearcut plots than in old growth plots near Redwood National Park in California.

Herrington (1988) suggested the following to preserve talus habitat in general: excluding harvest of trees on talus slopes, establishing 20-30 m buffers along slopes, and using slopes other than those with sensitive species for road building. Surveying slope areas for salamanders and researching the use of artificial structures by the amphibians have also been recommended (Herrington 1988). We believe that appropriate mitigation for Del Norte salamanders should be decided on a site specific basis. Welsh (1990) thought that sufficient forested areas with appropriate microhabitats between drainages were required to maintain gene flow and repopulation of harvested areas.

5. Occurrence and Status on Simpson Timberlands

Del Norte salamanders have been found extensively on Simpson's ownership north of the Mad River (southern extent of their range). Through incidental observations, we have located Del Norte salamanders in 41 different sites. The majority of the sites have been roadside cut banks in young cut-over areas. The median age of stands in which the salamanders have been found is 25 years. Although based on anecdotal observations, it appears that the salamanders are actually more abundant in harvested areas than in undisturbed areas. We believe this is possible because road building associated with timber harvest creates talus, and heavy rainfall with frequent summer fog that is typical for the area maintains soil moisture even when the tree canopy has been removed. Although Del Norte salamanders appear to be abundant in our region, we have no information on population trends.

6. Expected Impacts of HCP

Since Del Norte salamanders do not seem to be incompatible with timber harvest in this region, it appears that the impacts of the HCP should be relatively neutral to this species. However, the increased protection of streams proposed in "Overall Resource Management" (see Section 4.C of the HCP) may have a beneficial impact on salamanders that occur in the eastern portions of Simpson's ownership outside of the fog belt.

F. WESTERN POND TURTLE (*Clemmys marmorata marmorata*)

1. Range

As a species, western pond turtles occur at sea level to 6000 feet from British Columbia to northwestern Baja California, principally west of the Sierra-Cascades. The subspecies *marmorata* ranges from British Columbia to central California, where an area of intergradation with the subspecies *pallida* occurs. In California, *marmorata* ranges from the Oregon border to Kern County (Bury 1970).

2. Specific Habitat Requirements

Western pond turtles inhabit a wide variety of habitat types with areas of permanent water (Zeiner et al. 1990a) such as ponds, lakes, rivers (Bury 1970), marshes, sloughs (Nussbaum et al. 1983), and drainage ditches (Zeiner et al. 1990a). They require basking sites such as submerged logs, vegetation mats, rocks, and mud banks (Nussbaum et al. 1983). Nests have been found in a variety of soil types from sandy to hard and must be at least four inches deep (Zeiner et al. 1990a).

Bury (1962) observed that western pond turtles inhabiting warmer inland rivers of California congregated in deep or vegetated pools whereas those in the coastal region were dissociated in ponds, sloughs, and dams.

3. Status

Zeiner et al. (1990a) noted that western pond turtles were the only abundant native turtles in California. Bury and Luckenbach (1976) believed that introduced turtles such as common snappers, alligator snappers, and soft-shell turtles posed a serious threat to native fauna. In northern California, Bury (1962) found more reports of pond turtles in the inland upper tributaries of the Mad River than in its lower portions in the coastal fog belt. He suggested that the distribution of the turtles in the north coastal region may be limited by the scarcity of slow moving streams. Western pond turtles are a Category 3c candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Bury and Luckenbach (1976) recommended strict enforcement and tighter controls to protect native turtles from introduction of exotics. We could not find literature pertaining to potential impacts of timber harvest on western pond turtles.

5. Occurrence and Status on Simpson Timberlands

We have very limited data on the occurrence of western pond turtles on Simpson's ownership. One individual was observed crossing a road in a region of mixed forest and grazing lands. We assumed it was traveling to or from one of the stock watering ponds in the area. We have no other information on the species in the plan area.

6. Expected Impacts of HCP

Because western pond turtles are not a species that relies on forest habitats, and California forest rules protect all wetlands, we believe the impacts of the HCP will be neutral relative to this species.

IV. BIRDS

A. GREAT BLUE HERON (*Ardea herodias*) (Rookery Site)

1. Range

Great blue herons breed from southern Canada south to Mexico, Cuba and Jamaica. The species winters south to Panama (Soothill and Soothill 1982). In California, the herons are found throughout most of the state, with many rookeries such as the Indian Island rookery in Humboldt Bay (Ives 1973) scattered throughout northern California (Zeiner et al. 1990b).

2. Specific Habitat Requirements

Great blue herons inhabit a variety of freshwater habitats including streams, rivers, lakes, ponds and swamps; but seem equally tolerant to salt water (Soothill and Soothill 1982). They may breed in bushes, and on rocks, ledges, or the ground (Soothill and Soothill 1982), but prefer to nest in secluded groves of tall trees near shallow water feeding areas (Zeiner et al. 1990b). Throughout its range the species is found at altitudes up to 4900 feet (Soothill and Soothill 1982).

In California, the herons are found in coastal bays, lagoons, intertidal areas, mud flats, and rocks along inland rivers, creeks, ponds, and lakes (Yocum and Harris 1975) and also in croplands, pastures, and mountains above foothills (Zeiner et al. 1990b).

3. Status

Great blue herons are fairly common all year throughout most of California (Zeiner et al. 1990b), mainly west of the Sierra Nevada (Brown et al. 1986). In the northwestern part of the state they are considered to be common residents and breeders (Yocum and Harris 1975). The herons are considered to be a California Department of Forestry and Fire Protection (CDF) sensitive species.

4. Sensitivity to Timber Harvest and Other Impacts

Schlorff (1978) noted that the ability of the Humboldt Bay area to support successful populations of wading birds (including great blue herons) was largely due to the diversity of habitats near nesting sites. The greatest threat to these habitats was regarded as degradation or destruction caused by industrial and residential development and thus protection of such areas was recommended (Schlorff 1978). In Oregon, logging adjacent to nesting great blue herons was believed to have caused lower fledging rates and nest occupancy. Nesting activity within the heronry was observed to shift away from the logging disturbance (Werschkul et al. 1976).

Techniques for creating or maintaining great blue heron habitat include maintaining stands of tall timber near feeding areas for roosts (Schlorff 1978) and protecting nest areas from wind and human disturbance (Ives 1973).

5. Occurrence and Status on Simpson Timberlands

Great blue herons are commonly seen throughout the region, primarily associated with Class I streams, bays, marshes, and grasslands. However, no heronries are known to occur on Simpson's ownership. Apparently the herons use Simpson's lands for foraging only.

6. Expected Impacts of HCP

Because great blue herons are not primarily forest birds and existing forest practice rules provide protection for heronries, we believe the impacts of this plan will be neutral relative to this species.

B. GREAT EGRET (*Casmerodius albus*) (Rookery Site)

1. Range

Great egrets have a wide breeding range including southeast Europe, Central Asia, and Africa. In North America, they breed from eastern Oregon to southeast Minnesota and Lake Erie and southern New Jersey south to southern Chile and Southern Argentina. In North America, they winter south to California, southern Arizona, New Mexico, central Texas and the Gulf Coast (Soothill and Soothill 1982).

In California, great egrets are widespread throughout the state except in high mountains and dry deserts (Brown et al. 1986). In winter they withdraw from the northeastern part of the state (Small 1974).

2. Specific Habitat Requirements

Great egrets are found in open but shallow freshwater ponds, lake margins, rivers, and brackish swamps, and tidal estuaries and nest in platforms in trees or reed beds (Soothill and Soothill 1982). Groves of trees suitable for nesting and roosting are relatively isolated from human activities and are near aquatic foraging areas (Zeiner et al. 1990b).

In California, great egrets inhabit coastal bays and lowlands, pastures, mouths of rivers, freshwater lagoons and rarely among rivers inland (Yocum and Harris 1975). Great egrets have successfully bred in a cypress grove on Indian Island in Humboldt Bay. In this area the egrets also feed in highway medians and drainage ditches (Schlorff 1978).

3. Status

Great egrets were rare at the turn of the century because their plumage was used by the millinery and clothing industries (Soothill and Soothill 1982). After decimation by plume hunters, no egrets were found in California for many years (Cogswell 1977), but now are considered to be common residents and breeders (Yocum and Harris 1975) except in high mountains and deserts (Zeiner et al. 1990b). The egrets are considered by CDF to be a sensitive species.

4. Sensitivity to Timber Harvest and Other Impacts

Wetland drainage has reduced much available great egret habitat (Zeiner et al. 1990b) and current habitat is threatened by industrial and residential development (Schlorff 1978). Schlorff (1978) recommended the following for creating or maintaining the diversity of great egret habitat: protecting known rookeries, maintaining highway drainage ditches and grassy medians, and maintaining stands of tall timber near feeding areas. Protection of nest sites from wind and human disturbance has also been recommended (Ives 1973). Nesting colonies have been abandoned due to human intrusion (Zeiner et al. 1990b).

5. Occurrence and Status on Simpson Timberlands

Great egrets are commonly seen throughout the region, primarily associated with bays, marshes, and grasslands. However, no rookeries are known to occur on Simpson's ownership. Apparently the egrets use Simpson's lands for foraging only.

6. Expected Impacts of HCP

Because great egrets are not primarily forest birds and existing forest practice rules provide protection for rookeries, we believe the impacts of this plan will be neutral relative to this species.

C. Cooper's Hawk (*Accipiter cooperii*) (Breeding)

1. Range

Cooper's hawks breed throughout most of the area from southern Canada to southern United States. The species winters in most of the United states and south to Guatemala and Honduras (Johnsgard 1990).

In California the birds are found throughout the state, but are not common in the northwest and southeast (Small 1974) or in higher mountains (Brown et al. 1986). In northern California, Cooper's hawks are uncommon residents probably breeding in timbered areas and are a more common wintering species (Yocum and Harris 1975).

2. Specific Habitat Requirements

Cooper's hawks nest in patchily distributed open stands of deciduous or mixed forests rather than in the interior of contiguous stands (Johnsgard 1990). In Oregon, the birds nested mostly in dense, 30-70 year-old conifer stands (Reynolds et al. 1982) from sea level to timberline (Reynolds 1983). Cooper's hawks have often been observed nesting near man-made clearings (Johnsgard 1990) and water (Reynolds et al. 1982). Winter habitat is similar to nesting habitat (Johnsgard 1990).

In California, Cooper's hawks most frequently use dense stands of live oak (Asay 1987), riparian deciduous, or other forest habitats near water (Zeiner et al. 1990b). Asay (1987) studied Cooper's hawk nesting habitat near Sacramento and in southern California and found the structure of nest stands to be one or more trees forming a single, continuous canopy. Stand understories were comprised of tree trunks and large branches with few small branches and leaves. Most nests were in bottomlands. Asay concluded that although Cooper's hawks may nest in many different tree species and habitats in California, the primary nesting habitat in the state is live oak woodlands.

3. Status

Recent rangewide declines have been mostly attributed to organochloride pesticides (Evans 1982) and reproductive rates in the East seem to be improving (Johnsgard 1990). Although Evans (1982) noted that the western United States was the only area where severe declines of Cooper's hawk populations had not occurred, in California, breeding populations apparently decreased (Remsen 1978). However, Asay (1987) found densities of active Cooper's hawk nests in California oaklands to be among the highest reported for the species.

Greater numbers of Cooper's hawks in California have been reported in the winter. Based on 1986 Christmas counts, 19,400 individuals winter in the United States, with 3200 birds wintering in California (Johnsgard 1990). The species is listed as a California species of special concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Because Cooper's hawks probably benefit from forest harvest and shortened rotation, if rotation periods are too long, the species' preferred nest site characteristics may cease to exist causing loss of breeding pairs (Postovit and Postovit 1987). Intensive forest management practices producing monotypical habitats in the west do not promote favorable foraging or nesting habitats for Cooper's hawks (Evans 1982). Thus multispecies management has been implied. Also, precommercial or commercial thinning of Cooper's hawk nest stands is not recommended because it reduces stand densities and creates deep crowns (Reynolds 1983).

Reynolds (1983) recommended no timber harvest within Cooper's hawk nest stands, with the shape of the area protected determined by topography. Reynolds et al. (1982) suggested protecting nest sites with a 6 ha buffer zone. Providing two potentially active nest sites and two replacement sites has also been recommended for Cooper's hawks (Reynolds 1983).

In California, destruction of lowland riparian areas was identified by Remsen (1985) to be the main threat to Cooper's hawk populations. Thus protection of such areas was advised.

5. Occurrence and Status on Simpson Timberlands

Cooper's hawks have been seen regularly throughout Simpson's ownership. They appear to be ubiquitous, but their actual abundance is unknown. Although Cooper's hawks probably nest throughout the ownership, no attempt has been make to locate nests, and only one has been located fortuitously. This nest was in a 45 year old second growth stand of Douglas-fir and hardwoods. We have no information concerning population trends.

6. Expected Impacts of HCP

Because Cooper's hawks presumably benefit from Simpson's current management practices, significant changes in these practices could have a detrimental impact on them. The set aside areas may become unsuitable habitat because of the lack of timber harvest, but this should not represent a significant loss in young stands that the hawks apparently prefer.

D. Northern Goshawk (*Accipiter gentilis*) (Breeding)

1. Range

Northern goshawks have a broad, holarctic range. In North America they breed in western Alaska, most of Canada, the Pacific coast of the United States south to California, eastern states south to West Virginia, on the eastern foothills of the Rocky Mountains and Black Hills and in southern Arizona and New Mexico south to western Mexico. They are also widely distributed in Eurasia.

Goshawks winter throughout their breeding range in North America, and also south to southern California, northern Mexico, and Texas (Johnsgard 1990).

In California, the breeding population is probably small and distributed in the Coast Range south to Mendocino county, although isolated breeding populations may occur further south (Remsen 1978). Small (1974) noted that the birds breed at higher elevations. In northwestern California, goshawks are considered rare residents (Yocum and Harris 1975).

2. Specific Habitat Requirements

Kenward (1982) found high goshawk densities in an area of only 12% woodland in Europe, but in North America, goshawk nest sites are in large forest stands and are characterized by a sparse understory for foraging, greater than 50% canopy cover for nest protection (Johnsgard 1990), and areas with gentle or moderate slope (Hall 1984). In northwestern California and throughout the range of goshawks, nests are more frequently found in conifer stands (Hall 1984, Johnsgard 1990) of mature uncut or second growth forests (Bloom et al. 1985), but nest stands among regions may vary according to structure, physiognomy, and vegetation (Hall 1984). Because of this variation, Hall (1984) concluded that goshawks tolerate flexible nesting conditions.

Nest sites in northwestern California were found to differ from those in other regions by having steeper slopes and a relatively intermediate canopy closure. Nest stands in this area were characterized as dense single stage stands of young Douglas-fir with scattered hardwood components and having large, mature trees with a park-like understory. Brushy areas and open hardwood and conifer stands were identified as potential foraging areas (Hall 1982). Bloom et al. (1985) found most goshawk territories studied in California to contain some openings, meadows, or clearings of sagebrush.

During winter months, Goshawks exhibit less habitat specificity and will range into relatively open habitats (Johnsgard 1990).

3. Status

No hard evidence exists to indicate that goshawks range-wide have suffered significant population declines in recent decades (Johnsgard 1990). Destruction of old growth forests is believed to be responsible for declining populations in the Pacific Northwest, although in other parts of their range, goshawks are extending their breeding range southward (Johnsgard 1990).

Although rare in California (Yocum and Harris 1975), goshawks statewide seem to be reproductively healthy, with goshawks in the Northern Coast Ranges-Klamath Mountains doing relatively poorly (Bloom et al. 1985). Bloom et al. (1985) estimated that 275 out of 1,320 breeding territories in the state were in the Northern Coast Range-Klamath mountains. They also estimated that in the early 1980's, goshawks populations in California were 25-50% below historical levels but relatively stable. The birds are a California species of special concern, a CDF sensitive species, and a federal sensitive species (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

In Europe, Kenward (1982) concluded that goshawks are not a species that thrived best in extensive coniferous forest, but have probably benefitted greatly where continuous primal forests have been modified into patchworks. However, in North America, goshawks are closely associated with dense overstories and open understories, so habitat may be improved by silvicultural activities which reduce densities of shrubs and saplings while maintaining or enhancing the canopy of large trees (Crocker-Bedford 1990). Johnsgard (1990) recommended limited forestry to open up some mature forests to promote better nesting habitat. The preservation of meadows, streams, and aspen groves to maintain foraging habitat has also been recommended (Bloom et al. 1985). Reynolds (1983) advocated no harvest within goshawk nest stands, with the shape of the area to be protected dependent on topography. Large scale selective cuts (Bloom et al. 1985) or short rotation periods (Johnsgard 1990) are not beneficial to goshawks and may benefit other raptor competitors. Within time, such areas may become goshawk habitat depending on the type of harvest or silvicultural activities (Bloom et al. 1990). Declines associated with logging may not occur where dense populations of suitable prey occur within abundant, well-protected riparian areas (Crocker-Bedford 1990).

Reynolds et al. (1982) prescribed an unharvested buffer area of at least 8-10 ha around nest sites as minimal protection from logging in the northwest. An experimental test of this prescription in Arizona (Crocker-Bedford 1990) indicated that this was not adequate for goshawks in that region.

Logging has been identified as a potential threat to goshawks in California (Remsen 1978) with an estimated 5-10 territories per year lost due to timber harvest (Bloom et al. 1985). Bloom et al. (1985) suggested protecting 125 acres around goshawk nest sites. Although providing habitat for a density of 4 goshawk territories per township was suggested in Oregon (Reynolds 1983), Bloom et al. (1985) found a maximum of 3 territories per township in California. Most goshawk habitat in the state, however, is believed to be within public lands such as National Forests and Parks, making habitat destruction a relatively small threat to the species (Remsen 1978).

5. Occurrence and Status on Simpson Timberlands

It is presumed that goshawks are very rare or absent from Simpson's ownership because we have not observed the species. Our lack of observations is consistent with the assessment that goshawks are rare residents in northwestern California because we have also not observed them in state or national park or forest lands that are adjacent to Simpson's ownership. We believe that goshawks are rare in this region because forests dominated by redwood are generally lacking in preferred prey species such as diurnal squirrels and forest grouse.

6. Expected Impacts of HCP

Because goshawks are known to prey on spotted owls, it would not be consistent with the recovery of spotted owls to seek a significant increase in populations of goshawks. However, low elevation coastal forests are not now, and possibly never were, good habitat for goshawks, so it is not likely that this plan will have significant impacts on goshawks. The plan may have a minor positive impact because some to the larger proposed set aside areas located on the more interior regions of Simpson's ownership may provide the large undisturbed nest stands apparently required by goshawks.

E. Sharp-shinned Hawk (*Accipiter striatus*) (Breeding)

1. Range

Sharp-shinned hawks breed from western Alaska, most of central and southern Canada and the Pacific Northwest south to central California; in portions of Colorado, Utah, Arizona, and New Mexico; in the Great Lakes Region and northern parts of the gulf states east to South Carolina. They also breed in Central and South America and winter from southern Alaska to South America (Johnsgard 1990).

In California, data are lacking on breeding populations of sharp-shinned hawks, but most records of summer birds have been from northern California (Remsen 1978). The species is a common migrant and winter species in the state (Remsen 1978).

2. Specific Habitat Requirements

Sharp-shinned hawks occupy generalized breeding and wintering habitat characterized by woodlands of young or open forests with a variety of plant life forms (Johnsgard 1990). Breeding habitats vary according to region ranging from coniferous (Evans 1982) to mixed deciduous forests (Johnsgard 1990). In Oregon, sharp-shinned hawks were found to nest in dense, 25-50 year old even age (single canopy layer) conifer stands (Reynolds et al. 1982) from sea level to timberline (Reynolds 1983). In western states, these hawks often migrate downslope after the breeding season to winter in oak woodlands (Johnsgard 1990). In California, the birds winter in all types of habitat except deserts, grasslands, and aquatic or marshy areas (Small 1974). Wintering populations in northwestern California are found in wooded to open country (Yocum and Harris 1975), except in areas with deep snow (Zeiner et al. 1990b).

3. Status

Because data are lacking on sharp-shinned hawks, population estimates are difficult to obtain (Evans 1982, Johnsgard 1990). Populations of these birds are believed to have declined from 1950-1970 due to organochloride pesticides (Evans 1982), but have since improved (Johnsgard 1990). From 1986 data, Johnsgard (1990) estimated that approximately 30,100 birds wintered in Canada and the United States, with California among areas supporting the highest densities of wintering birds. Insufficient historical data exist on breeding populations in California, but numbers appear to be greatly reduced from former levels (Remsen 1978). Sharp-shinned hawks are regarded as the least common breeding accipiter in California and the species is a California species of concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Although logging has been cited as a potential hazard to sharp-shinned hawk populations (Remsen 1978), the birds probably benefit from forest harvest and shortened rotation (Postovit and Postovit 1987) because they nest in relatively young (25-50 year old) stands (Reynolds et al. 1982). If harvest rotation periods are too long, the species' preferred nest site characteristics, and ensuing breeding pairs may disappear (Postovit and Postovit 1987). However, the type of intensive forest management in western states that promotes monotypes does not produce favorable sharp-shinned hawk foraging or nesting habitat (Reynolds et al. 1982). Thus multispecies management is preferred.

Precommercial or commercial thinning of stands occupied by sharp-shinned hawks is not advised as it may make an area unsuitable for the birds by reducing stand densities and creating deeper tree crowns (Reynolds 1983). Reynolds (1983) also recommended no harvest within densely vegetated nest sites, with the shape of the protected area determined by topography. Protecting sites by establishing a 4 hectare buffer zone has also been suggested (Reynolds et al. 1982).

Surveys are recommended to determine the present breeding status of sharp-shinned hawks in California (Remsen 1978).

5. Occurrence and Status on Simpson Timberlands

Sharp-shinned hawks are ubiquitous throughout Simpson's ownership and appear to be one of the most abundant diurnal raptors. Frequent observations of recently fledged juveniles and/or scolding and agitated adult birds suggest that sharp-shinned hawks also commonly nest throughout the region, but only four nest sites have been fortuitously located. The nest sites were in 35-50 year old second growth stands ranging from redwood dominated to hardwood cover types. We have no information concerning population trends.

6. Expected Impacts of HCP

Because sharp-shinned hawks presumably benefit from Simpson's current management practices, significant changes in these practices could have a detrimental impact on them. The set-aside areas may become unsuitable habitat for sharp-shinned hawks because of the lack of timber harvest, but this should not represent a significant loss of the young stands that the hawks apparently prefer.

F. GOLDEN EAGLE (*Aquila chrysaetos*) (Breeding and Wintering)

1. Range

Golden eagles are widely distributed throughout the northern hemisphere (Snow 1973). They breed in western North America from northern Alaska south to the highlands of northern Mexico and also in central and northern Canada. The species winters from south-central Canada south throughout their breeding range. Golden eagles are also widespread in Eurasia and local in northern Africa (Johnsgard 1990).

In California, golden eagles are found in open areas away from human population centers (Remsen 1978) throughout the state (Small 1974), but mostly between the humid coastal region and the Sierra divide (Brown et al. 1986). Small (1974) noted that the birds are scarce in southeastern deserts. In northern California, the bird is a rare to uncommon resident in inland coastal mountains (Yocum and Harris 1975).

2. Specific Habitat Requirements

Johnsgard (1990) listed essential components of golden eagle habitat as a favorable nest site (large tree or cliff), a dependable food supply (medium to large mammals and birds), and broad expanses of open country for foraging.

In California, the birds are found in rolling country with lightly wooded areas, savannahs, grasslands, desert edges, farms, or ranches (Small 1974). Johnsgard (1990) noted that western wintering habitat had available perches plus native shrub-steppe vegetation with good populations of jackrabbits.

3. Status

Breeding densities of golden eagles are relatively low throughout their range (including California [Remsen 1978]) as a reflection of territorial spacing and foraging requirements. In areas with an abundant prey base, relatively higher densities of eagles may be observed (Johnsgard 1990). Nelson (1982) considered golden eagles to be a common bird in the intermountain western United States. In 1986, an estimated 18,500 golden eagles wintered in North America (excluding Alaska and Canadian territories) (Johnsgard 1990). Estimates for the number of birds in North America vary, but Johnsgard (1990) regarded 70,000 as the upper numerical limit.

In California, golden eagle populations near human population centers have been reduced, but those in other areas seem stable. An estimated 500 pairs nested in California in the early 1970's (Remsen 1978) and golden eagles are a species of special concern in the state and are recognized as a sensitive species by CDF.

4. Sensitivity to Timber Harvest and Other Impacts

Most golden eagles do not tolerate extensive human activity such as climbing on or camping near cliffs with active nests and direct or indirect human disturbances appear to be a major factor causing nesting failure (Snow 1973). Human disturbance to golden eagles was also identified as a major threat to the birds in California (Remsen 1978). Therefore, suggested management for golden eagles includes protecting nests during the breeding season, especially during incubation until the young are two weeks old (Snow 1973). For example, climbers should be prohibited from scaling cliffs with eagle nests (Remsen 1978).

Habitat modification due to timber management (Nelson 1982), such as the establishment of large blocks of monotypic communities may also be detrimental to golden eagles by removing prey species (Snow 1973). In California, reclamation of grasslands has also been identified as a means of habitat destruction.

5. Occurrence and Status on Simpson Timberlands

Golden eagles have been seen infrequently in nonforested areas in the interior regions of Simpson's ownership. Most of the observations have been of adult birds in the Upper Mad River region, suggesting a pair may be nesting somewhere in the area. We have no information concerning population trends.

6. Expected Impacts of HCP

Because forest habitats are not critical to golden eagles for any part of their life history, we believe the impact of this plan will be neutral relative to this species.

G. BALD EAGLE (*Haliaeetus leucocephalus*) (Breeding and Wintering)

1. Range

Bald eagles breed in most of central and southern Canada south to the Great Lakes and Maine, along the Atlantic and Gulf Coast, and in the west along the Pacific Coast from Alaska to Baja California.

The species winters throughout its breeding range. Primary wintering areas also include the upper Mississippi River region and from coastal Alaska south along the coast to Washington (Johnsgard 1990).

In California, the birds breed in the northern quarter of the state, with some pairs breeding in southern California on Santa Catalina Island and mainland Santa Barbara County. Bald eagles winter throughout most of California (CDFG 1990) with half of the population in the state wintering in the Klamath Basin (Zeiner et al. 1990b).

2. Specific Habitat Requirements

Johnsgard (1990) listed the essential components of bald eagle breeding habitat as an adequate supply of moderate-sized to large fish, nearby nesting sites, and reasonable freedom from disturbance during the nesting period. In California, the birds breed in mountainous habitats near reservoirs, lakes, and rivers (CDFG 1990).

Winter habitats of bald eagles are less closely associated with water than summer habitats (Evans 1982). Wintering bald eagle require suitable food supplies and roosting sites (Johnsgard 1990). The eagles generally prefer to roost in trees that are taller (Stalmaster and Newman 1979, Keister and Anthony 1983) or that are more open in structure (Keister and Anthony 1983) than trees in the surrounding stand. They also appear to prefer small groups of trees over trees in large stands (Stalmaster and Newman 1979).

Specific characteristics of forest stands and roost trees vary considerably among regions. In California, bald eagles winter at lakes, reservoirs, river systems, rangelands, and coastal wetlands (CDFG 1990). In the Klamath Basin, Douglas-fir was preferred as a roost tree species (Keister and Anthony 1983).

3. Status

Many bald eagle populations began to decline in the 1950's, largely due to organochloride pesticides. Other reasons for declines include habitat loss and destruction by agriculture, industry, and logging and human disturbance such as recreational uses of lakes and rivers (Evans 1982). As a result of the declines, by 1978 the species was listed by the U.S. Fish and Wildlife Service as endangered or threatened in the conterminous United States (Johnsgard 1990). Most populations experiencing declines have since increased or are believed to be increasing (Johnsgard 1990).

Historically, bald eagles in California bred state-wide, but the breeding population was severely reduced in size and distribution by the early 1960's (Lehman 1983). The birds are listed as an endangered species in California (Zeiner et al. 1990b) and as a sensitive species by CDF. In 1989, 83 birds occupied breeding sites and the breeding population is increasing in numbers and range. Winter populations appear to be stable and may exceed 1000 birds (CDFG 1990).

4. Sensitivity to Timber Harvest and Other Impacts

Potential threats to bald eagles include habitat degradation due to acid rain, with northern California lakes among those most susceptible (Evans 1982), and habitat loss due to shoreline development (Evans 1982, Hodges and King 1984). Buehler et al. (1991) viewed the key challenge to eagle managers in the near future as ensuring the existence of enough undeveloped habitat to support viable eagle populations.

Human recreation (Evans 1982) such as boating and fishing, especially in areas where eagles are not habituated to human activity (Stalmaster and Newman 1978) also pose a threat to bald eagles. The eagles have been found to tolerate moderate amounts of human activity (Stalmaster and Newman 1978, Buehler et al. 1991) and are much more tolerant to auditory and visual disturbance if screened by vegetation buffers (Stalmaster and Newman 1978). Distance to disturbance is believed to be the most important aspect of human disturbance, with pedestrian and noisy land or water vehicle activity causing the most disturbance to eagles (Grubb and King 1991). McEwan and Hirth (1979) found that human disturbance did not seem to affect the production of young eagles from pairs that had returned to nest sites, but disturbance during the early phases of reproduction was identified as a problem in some areas in California (Lehman 1983). Because bald eagles in the state exhibited a wide range of tolerance to human disturbance, Lehman (1983) suggested mitigation of disturbance on a site-specific basis. Computer models using site specific variables of selected form of disturbance have been used as management tools to evaluate cumulative effects of human disturbance to eagles in other areas (Montopoli and Andrews 1991).

Habitat losses due to clearcutting (Hodges and King 1984) have also been identified as a possible threat to bald eagles. Postovit and Postovit (1987) noted that in one area, clearcutting of roost trees adjacent to foraging areas was believed to pose the greatest threat to bald eagles. Unrestricted clearcutting where all trees are harvested and no remnant trees are left does not benefit bald eagles (Hodges and King 1984). However, McEwan and Hirth (1979) and (in California) Lehman (1983) concluded that the presence of a nesting population of bald eagles is compatible with an active timber industry and that with small concessions, forest operations can be used to enhance eagle nesting habitats. In Lassen National Forest in California, for example, silvicultural prescriptions were developed to improve bald eagle habitat in timber harvest sales (Burke 1983). Selective timber harvests near eagle sites may improve habitat by providing additional foraging areas for eagles and other forest edge raptors (Postovit and Postovit 1987). In addition, although timber harvest may cause some initial disturbance to bald eagles, many years may pass before timber harvest is resumed (McEwan and Hirth 1979). In the meantime, undisturbed eagle habitat is provided. To minimize initial disturbance to eagles, McEwan and Hirth (1979) suggested harvesting after young eagles have fledged.

Suggested timber management techniques for bald eagles vary and include avoiding clearcutting adjacent to roosting (Keister and Anthony 1983), nesting, or foraging areas, or at least unrestricted clearcutting that leaves no remnant trees in nesting areas (Hodges and King 1984); mimicking hand-logging techniques which left older remnant trees and resulted in suitable bald eagle nesting habitat (Hodges and King 1984); managing uniform stands to optimize the number of larger, open-structured trees (Keister and Anthony 1983); preserving dead and spike top trees (Stalmaster and Newman 1979, Keister and Anthony 1983) and establishing 50 m buffers along shorelines (Stalmaster and Newman 1979), 400 -800 m buffers in high use foraging areas (McGarigal et al. 1991), or buffers near eagle sites. Recommended buffer sizes around sites range from 75 (Stalmaster and Newman 1978) to 1600 m (Grubb and King 1991). Buffers plus restricted access to eagle activity sites may further protect eagles from human disturbance (Stalmaster and Newman 1978, McGarigal 1991).

Throughout California, various groups maintain, monitor, and protect breeding and wintering territories. Research and recovery efforts in the state include captive breeding and release programs (CDFG 1990) and have shown that eagles will use artificial structures for nesting (Lehman 1983).

5. Occurrence and Status on Simpson Timberlands

Although bald eagles are regular inhabitants of the region in winter, only one pair is known to nest in the area. This pair nested in 1990 and 1991 on Simpson's property along the Mad River. The pair successfully fledged two eaglets in 1990 and one in 1991. The nest is in a linear stand of 80 year old second growth about 300 feet wide along one side of the river. The stand contains several residual older trees including a large spike-topped redwood that is the favorite roost site adjacent to the nest. This pair is apparently very tolerant of disturbance because logging activity was conducted within 800 feet of the active nest site before the nest was discovered in 1990. The endangered status of bald eagles insures that the nest will be protected indefinitely. The recent establishment of the first nesting pair in the area suggests that bald eagle populations may be experiencing an increase in northwestern California similar to other parts of their range.

6. Expected Impacts of HCP

Current forest practice rules provide for 75-150 foot buffers (depending on slope class) along each side of Class I streams, which would provide for roost and nest sites for bald eagles. The HCP proposes to increase protection of riparian habitat (see "Overall Resource Management," Section 4.C of the HCP) which should have a beneficial impact on bald eagles by providing additional roost and nest sites.

H. OSPREY (*Pandion haliaetus*) (Breeding)

1. Range

Ospreys have one of the broadest geographical distributions of all birds. In the United States, five regional populations have been identified: Atlantic coast, Florida and the Gulf Coast, Pacific Northwest Coast, Western Interior (focused on the northern Rocky Mountains), and Great Lakes (Henny 1983). The birds also are found in most of central and southern Canada, Baja California, the Bahamas, Cuba, and the Yucatan Peninsula and are widely distributed in the old world (Johnsgard 1990).

Most breeding populations of ospreys in California occur in the northern portion of the state (Remsen 1978) where the species is a common summer visitant and breeder and rare winter visitant (Yocum and Harris 1975). In northern California nests have been found along tributaries east of Humboldt Bay, the Klamath River in Humboldt and Del Norte counties, lower reaches of Redwood Creek, Ruth Reservoir, Big Lagoon, and along the Eel, South Fork Eel, Smith, Trinity, and Van Duzen Rivers. (French 1972). French (1972) did not find nests along the Mad River, but observed birds foraging there.

2. Specific Habitat Requirements

Basic habitat needs of ospreys include an adequate source of fish that can be captured near the surface of water clear enough for them to be seen, and an elevated nest site within a few kilometers of the food source (Johnsgard 1990).

Ospreys in California are associated with large fish-bearing waters, primarily in ponderosa pine through mixed conifer habitats (CDFG 1990). In northern California, ospreys were found to nest on both natural (mostly redwood snags) (French 1972) and artificial (Levensen 1976) structures. Many nests were found adjacent to roads or highways and one site was characterized as a second to third growth redwood stand with an understory of evergreen huckleberry, salal, sword fern, rhododendron, and red alder (French 1972). Merlo (1975) described typical nest sites in the California redwood region as located near a bay or tidewater area in a protected exposure and in a relatively tall tree or snag.

3. Status

Ospreys are a U.S. Department of the Interior "species of special emphasis" and have special conservation status in many states (Johnsgard 1990) including California, which listed the bird as a species of special concern (Zeiner et al. 1990b). CDF also listed ospreys as a sensitive bird species. Organochloride pesticides were largely responsible for population declines and since the pesticides were banned in the U.S., the productivity of most populations has increased (Evans 1982). Johnsgard (1990) estimated from 1986 Audubon Christmas counts that the winter population in the U.S. was approximately 7000 birds.

In California, reasons for apparent declines in breeding populations include degradation of river and lake environmental quality and boating (Remsen 1978). Removal of nest trees was also identified (Remsen 1978), but French (1972) attributed low numbers of nesting ospreys along the coast to factors other than the shortage of nesting sites per se. In recent years populations of ospreys in California have apparently been increasing (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

In a study in northwestern California, the majority of nests found were on private timberlands (French 1972). Ospreys can breed in areas where selective timber harvesting is practiced (Postovit and Postovit 1987). In a California redwood and Douglas-fir stand, Merlo (1975) observed that a selective cut within 100 feet of an osprey nest did not interrupt nesting habits or survival of young. However, disturbance from logging activities during the nesting season (April - early October) may prevent ospreys from using known nest sites, cause early abandonment of nests, keep adults off their eggs long enough to cause lethal chilling of the eggs (Veoka 1974), and induce early flights of young, inexperienced fliers which potentially increases incidence of injury or predation (Garber 1972). French (1972) noted that logging activity apparently caused some ospreys to abandon nests, but noted "others successfully raised young apparently unaffected by the disturbance."

Techniques for managing for ospreys include minimizing disturbance to nesting birds by limiting logging activity during the nesting season or by establishing buffer zones (Johnsgard 1990). Protective zones ranging from 50-1300 feet in radius from nest sites have been suggested (Merlo 1975). Because clearcutting appears to adversely impact ospreys, selective logging near osprey nest sites has been recommended (Postovit and Postovit 1987).

Preserving snags as potential nest sites near waterways used by ospreys (Johnsgard 1990) has also been recommended although the birds will also use artificial nesting platforms (Evans 1982).

5. Occurrence and Status on Simpson Timberlands

Ospreys are common throughout Simpson's ownership in the coastal areas. Fifteen roost/nest sites have been identified through observations during timber harvest plan layouts by Simpson's registered professional foresters (RPF). We suspect that osprey numbers have increased in recent years, but have no specific data to support this.

6. Expected Impacts of HCP

Current protection of osprey nest sites by forest practice rules appears to be highly successful in mitigating the impacts of timber harvest. We know of no osprey nests that were abandoned due to timber harvest. We believe that the only potential negative impact of Simpson's current timber management would be through removal of potential future nest sites by the removal of snags in clearcut harvest units. Because the plan proposes to leave safe snags in all clearcut units (see Section 4.C of the HCP, "Owl Habitat Planning"), future nest sites should be maintained for ospreys.

I. AMERICAN PEREGRINE FALCON (*Falco peregrinus anatum*)

1. Range

As a species, peregrine falcons have one of the largest breeding ranges of all birds, encompassing areas in North and South America and much of the old world including Africa and Australia (Johnsgard 1990). The subspecies *anatum* breeds or formerly bred below tree line (Evans 1982) in North America from Alaska and Canada south locally along the Pacific Coast to Baja California, interiorly in the Rocky Mountains to Arizona; and from eastern Canada south to the Great Lakes and Northern New England; and along the Appalachian Mountains. Probable current breeding populations are mostly concentrated in Alaska and Canada (Johnsgard 1990).

At the southern portion of its range, *anatum* is a resident subspecies, but northern populations typically migrate to the southern United States south to Central America (Evans 1982).

In California, the breeding range of *anatum* includes the Channel Islands, central and southern coast, inland coastal mountains, Klamath and Cascade ranges, and the Sierra Nevada. In winter, the subspecies may be found throughout the state except in desert areas (CDFG 1990).

2. Specific Habitat Requirements

Peregrine falcons are associated with tall cliffs that serve as nesting and perching sites and provide unobstructed views of the surroundings. Nest sites require areas that provide protection from mammalian predators and weather and are often close to water and adequate prey populations. Peregrines breed in a wide variety of habitats ranging from temperate conifers to cities, where they nest on man-made structures such as building ledges (Johnsgard 1990). Wintering habitat requirements are less specific (Evans 1982), requiring perching sites and an adequate prey base (Johnsgard 1990).

In California, peregrine falcons (*anatum*) nest on cliff faces, city buildings, and bridges. Nesting and wintering habitats include wetlands, woodlands, cities, agricultural areas and coastal habitats (CDFG 1990).

3. Status

The subspecies *anatum* was extirpated in the middle and eastern United States and Canada and populations in other areas were dramatically reduced largely due to organochloride pesticides (Evans 1982). Due to recovery efforts such as the release of captive birds in the wild, former breeding sites are now being reoccupied and populations have been increasing. The subspecies is listed as endangered by the U.S. Fish and Wildlife Service and the International Union for Conservation of Nature and Natural Resources (Johnsgard 1990).

In California, peregrines historically nested commonly in most of the state, but DDT pesticides were responsible for reducing the breeding population to 10 known pairs by the mid 1970's. Restrictions on DDT and recovery efforts including the release of over 500 captive birds have resulted in breeding range expansion. In 1989, 90 known pairs nested in the state (CDFG 1990). Coastal populations, however, have relatively poor reproductive success, perhaps due to pesticide loads from migrant prey (Zeiner et al. 1990b). Peregrine falcons are listed as endangered in California (Zeiner et al. 1990b) and are recognized by CDF as a sensitive bird species.

4. Sensitivity to Timber Harvest and Other Impacts

Human encroachment in the form of agricultural wetland drainage, urban development, and recreation destroys habitat for peregrine prey populations and renders nest sites unsuitable. Thus, protection of nest sites from such activities is recommended. Habitat modification of cliffs including digging potholes has been successful in creating suitable nesting sites for peregrines (Evans 1982).

In California, recovery efforts have included release of captive raised birds (e.g. Hunt 1979), protection of nest sites including restrictions on development and disturbance near nest sites, enhancement of nesting ledges, and acquisition of nesting habitat (CDFG 1990).

We could not find literature pertaining to potential effects of timber harvest on peregrine falcons.

5. Occurrence and Status on Simpson Timberlands

Peregrine falcons have been infrequently observed on Simpson's ownership. The most common sightings have been near Simpson's administrative office on the coastal lowlands near Humboldt Bay. Several birds have also been observed flying over forested regions, but we have no evidence that these birds are nesting on Simpson property. We have no information concerning population trends.

6. Expected Impacts of HCP

Because we have no evidence that peregrine falcons are impacted by timber harvest, we assume the impacts of the plan will be neutral relative to this species.

J. RUFFED GROUSE (*Bonasa umbellus*)

1. Range

Ruffed grouse are residents from central Alaska and southern Canada to the northern United States and south along the Appalachian Mountains in the east to South Carolina (Johnsgard 1973). In California the birds live and breed in Humboldt, Del Norte, Siskiyou and Trinity Counties (Yocum 1978).

2. Specific Habitat Requirements

Ruffed grouse require a variety of habitats. Males need areas with little ground cover with thick shrubs above and an elevated platform such as a log or rock on which to drum (Johnsgard 1989). Vertical cover at ground, understory, and overstory levels are used for concealment and nesting and open grasslands provide insects for young grouse (Brenner 1989).

Most ruffed grouse habitat requirements are met by a mosaic of habitat including grasslands, dense shrubby and brushy areas (Brenner 1989), and mixed age woodlands (Barber et al. 1989). Ideally these habitat components are found within the smallest area possible (Gullion 1989).

Aspen trees, a preferred food item, are regarded as the most important component of ruffed grouse habitat range-wide covering 92% of the bird's native range and supporting probably more than 95% of the ruffed grouse population (Gullion 1989).

The importance of conifer cover to wintering grouse is debated. Dense conifer groves may be important for providing cover in areas with little snowfall (Barber et al. 1989), but such cover may constitute better protection for ruffed grouse predators than for the grouse themselves (Gullion 1989). The birds can survive reasonably well without dense conifer stands if hardwood trees, especially aspen, are well distributed throughout young conifer stands (Gullion 1989).

In the west, ruffed grouse prefer deciduous stands, with Douglas-fir and grand fir utilized by the species in Idaho. The birds are found up to 8,000 feet in elevation in early successional conditions rather than in mature forests (Barber et al. 1989). Little information exists about habitat of ruffed grouse in California (Zeiner et al. 1990b). In northern California, ruffed grouse are found in riparian lowlands and headwaters of streams to elevations of 4000 ft (Yocum and Harris 1975).

3. Status

Compared with populations in prime habitats of the midwestern, northern, and northeastern United States, ruffed grouse numbers are relatively low in the west (Brenner 1989). In California, the species is considered to be a rare resident (Yocum and Harris 1975) and a state species of special concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Trees of high commercial value often are of little or no value to ruffed grouse (Gullion 1989), but coordination with logging operations in the west is regarded as holding great promise for grouse habitat (Stauffer 1989). Stauffer (1989) recommended that, wherever possible, cuts should be small because clearcuts larger than 1 hectare make the distance from food to cover too great for grouse to safely use them (Gullion 1989). Stauffer (1989) suggested the following additional management techniques: protecting riparian areas (brood rearing habitat) with buffer zones; seeding abandoned logging roads and decks with grouse foods such as clover, grass, or cinquefoil; encouraging young stages of forest succession and improving grouse habitat through practices such as controlled burning; and prohibiting grazing in riparian and other critical areas during brood rearing.

Observations by Yocum (1978) suggest that such management practices may not work to create or improve ruffed grouse habitat in the northwestern California coastal area. Despite a history of redwood and Douglas-fir timber harvest in this region, noticeable increases in ruffed grouse populations have not resulted. Yocum attributed this to the species (e.g. red alder) that occur in succession to logging in the area. Such species are apparently poor substitutes for aspen (Yocum 1978).

5. Status and Occurrence on Simpson Timberlands

Ruffed grouse are observed occasionally on Simpson's ownership from the Oregon border south to the north fork of the Mad River, the apparent extreme southern limit of their range. The grouse are normally associated with riparian habitats in young second growth stands. Reproduction does not seem to be good in this area because broods are seldom seen. We have no information concerning population trends.

6. Expected Impacts of HCP

Northern California is at the southern limit of the ruffed grouse's range and it is apparent that the habitat is marginal, at best, in this area. Simpson's current timber management creates the structural habitat that should favor ruffed grouse, but apparently some other key element of their life history requirements is lacking. It seems likely that the population in northern California is not self sustaining, but maintained by immigration from the north. Certain aspects of this plan such as enhanced stream protection zones could potentially be beneficial to ruffed grouse, but given the apparent marginal nature of habitat in this region, we believe the plan will have little impact on ruffed grouse.

K. MARBLED MURRELET (*Brachyramphus marmoratus*) (Breeding)

1. Range

Marbled murrelets are found around the northern Pacific rim from Asia to North America. They breed in North America from the Aleutian Islands and Gulf of Alaska south to Santa Cruz County, California (Singer et al. 1991). California breeding populations are divided into three regions (Carter and Erickson 1988): 1) Del Norte and Northern Humboldt, from Smith River south to Little River (south of Trinidad); 2) South-Central Humboldt, along the Van Duzen and Eel Rivers; and 3) Southern San Mateo and northern Santa Cruz, between LaHonda and Santa Cruz. Redwood forests opposite Arcata and Humboldt Bay have not been adequately checked for murrelets (Carter and Erickson 1988). After breeding, marbled murrelets disperse along the coast of California south to San Diego County (Sowls et al. 1980).

2. Specific Habitat Requirements

Little is known about nesting habitats of marbled murrelets, as less than 15 nests have been found for the entire species. Quinlan and Hughes (1990) regarded marbled murrelets rangewide as a species plastic in nesting habitat requirements because they have nested on tree branches, on the ground, and in ground cavities. In different parts of the marbled murrelet's range, different nesting substrates may be chosen due to availability, predators, food availability, and other environmental factors (Quinlan and Hughes 1990). In California, it is unlikely that the species nests on the ground due to the scarcity of alpine areas to provide suitable ground-nesting habitat (Carter and Erickson 1988). All (four) nests south of Alaska have been found in old growth Douglas-fir or mountain hemlock trees (Singer et al. 1991) and evidence is accumulating that nests in this region are restricted to old growth forests (Singer et al. 1991).

Characteristics of nests and nest sites found to date south of Alaska include the following (Singer et al. 1991): an open canopy stand (large trees with open crown structure [Quinlan and Hughes 1990]); a >120 cm dbh, decadent tree; nest in the middle to lower part of crown; and a mossy, horizontal branch at least 36 cm in diameter (to support and camouflage nest [Quinlan and Hughes 1990]). As indicated by current information, 30-40 year old second growth stands regenerated after clearcutting do not provide the characteristics required for nesting by marbled murrelets (Quinlan and Hughes 1990).

In California, evidence suggests that the species is found primarily in old growth redwood forests (Quinlan and Hughes 1990). Paton and Ralph (1988) noted that small (≤ 100 acres) stands of old growth in California had few birds, while stands traversed by the majority of murrelets were greater than 500 acres. In the state, the birds use habitats up to 40 km inland (Carter and Erickson 1988).

3. Status

Marbled murrelets are widely distributed and locally abundant in nearshore waters of the North Pacific (Quinlan and Hughes 1990). The total population of marbled murrelets in California is small (Remsen 1978) with an estimated 1650 birds in the 1979-1980 season (Carter and Erickson 1988). Little historical data on numbers and distribution of murrelets at sea are available to determine if a population decline has occurred or is occurring, but the current small size of the population probably reflects a population decline due mainly to extensive loss of old growth forests by logging over the past century (Carter and Erickson 1988). About 75% of the current breeding population in California is believed to be concentrated along the coast of Del Norte and Humboldt counties (Zeiner et al. 1990b). Marbled murrelets are listed as a threatened species in California and a sensitive species by CDF. The USFWS is considering listing the bird as threatened (Paton et al. 1990).

4. Sensitivity to Timber Harvest and Other Impacts

Some evidence suggests that marbled murrelets in California die as the result of oil pollution and gill net fishing (Carter and Erickson 1988) and that recreational facilities may indirectly interfere with murrelet nesting by making food at picnic areas available to predators such as Stellar's jays, and common ravens (Singer et al. 1991). Habitat destruction of old growth redwood/douglas-fir forests by lumber operations, however, is regarded as the most significant threat to the birds (Remsen 1978). Paton and Ralph (1988) estimated that timber harvest of the remaining coastal private old growth forests would result in an immediate loss of 10-20% of the breeding population of marbled murrelets in California. Likewise, Carter and Erickson predicted declines, possibly leading to extinction of murrelets in the state unless extensive management action was taken in the near future. Possible isolation of the California population from northern populations has also been identified as a concern (Paton and Ralph 1988).

Because the breeding population in northern California appears to have the greatest chance of persisting into the future, recommended management should focus on this region (Carter and Erickson 1988). Suggested management practices include avoiding cutting trees near breeding sites (Remsen 1978) and minimizing visitor activities that favor corvid populations (Singer et al. 1991). To determine the effects of timber harvest on the birds, Carter and Erickson (1988) suggested censusing and monitoring areas for murrelets before and after harvest, respectively. Because so little of the biology of marbled murrelets is known, surveying for breeding populations (Remsen 1978) and locating additional nests (Singer et al. 1991) are also suggested to determine the distribution of nesting birds and ultimately formulate appropriate management strategies (Carter and Erickson 1988).

5. Occurrence and Status on Simpson Timberlands

General surveys throughout Simpson's ownership for marbled murrelets have not been conducted. However, as part of the forest practice rules requiring certain wildlife surveys prior to submission of timber harvest plans, 48 stands have been partially or completely surveyed for the presence or absence of murrelets. Seven of these stands had positive detections (birds observed demonstrating "occupied behavior"), but the number or reproductive status of these birds is unknown. We have no information on population trends for this species on Simpson's ownership.

6. Expected Impacts of HCP

We believe that the habitat requirements for marbled murrelets are too specific to address under the provisions of a conservation plan for spotted owls. None of the set-aside areas have been surveyed for murrelets, and if they are currently not occupied by the birds, it may take hundreds of years before they become suitable habitat for the species. However, forest practice rules in

California require complete surveys of suspected murrelet habitat and require consultation with California Fish and Game if positive detections are made. The consultation is designed to insure a "no take" of murrelets that could occur through direct harm to the birds or degradation of their habitat. For these reasons, we believe murrelets will be properly protected by state regulations, and this plan will not negatively impact them.

L. BANK SWALLOW (*Riparia riparia*) (Nesting Colony)

1. Range

Bank swallows have a circumpolar distribution, breeding over the entire northern hemisphere and wintering in South America, Africa, and India. In North America the breeding range extends north to northern Alaska, east to the Atlantic coat, south to southern Texas, and west to the Pacific coast. Wintering bank swallows in the western hemisphere are concentrated in central South America (Bent 1942).

In California, most breeding populations of bank swallows occur along the upper Sacramento River, with scattered population in portions of the northern, north coastal, central coastal and Inyo-Mono regions (CDFG 1990). An estimated 75% of the current breeding population is concentrated in the Central Valley (Zeiner et al. 1990b). Zeiner et al. (1990b) included western Del Norte County as part of the summer range of bank swallows in California.

2. Specific Habitat Requirements

Bank swallows excavate burrows in which to nest usually near the top of a nearly vertical bank of a lake, stream, or man-made excavation such as those of railways and gravel or sand pits (Bent 1942). Bank swallows appear to require relatively specific soil conditions for nesting including a good quality construction-grade sand having a low organic content and a specific stability (John 1991). Bank swallows are thus more numerous in glaciated sections of the United States where abundant deposits of glacial sand and gravel provide suitable nesting substrates.

Rarely, bank swallows nest in alternate substrates such as old sawdust (Greenlaw 1972) or iron tailing (Van Duesen 1947) piles or a concrete wall with galvanized metal lined holes (Hollom 1943). In Canada, Erskine (1979) categorized 40% of nest sites (that could be categorized) as natural and 60% as man-made. Man-made sites were mostly excavations but also included sawdust piles.

In California, bank swallows inhabit riparian and other lowland habitats west of deserts (Small 1974) where eroding or sandy riverbanks or vertical bluffs provide potential nest sites (CDFG 1990). They have successfully colonized artificial bank cuts created as mitigation for riprap (rock revetment) erosion control (Garrison et al. 1988).

3. Status

Erskine (1979) argued that the greater availability of man-made cut banks and excavations allowed a more general distribution of bank swallows than in former times, but populations of the birds in Europe and Canada have apparently declined (John 1991). Data are considered too imprecise to determine whether declines have occurred throughout North America (John 1991).

The range of bank swallows in California has been reduced by 50 percent since 1900, with the species being extirpated from southern California. Declines in inland populations have been due to waterway channelization, with many coastal colonies abandoned due to human disturbance (CDFG 1990). Garrison et al. (1988) noted that populations along the Sacramento River were stable from 1986-1988, but were not confident that mitigation efforts for riprap projects could fully offset habitat losses. The species was listed as a California threatened species in 1989 (Zeiner et al. 1990b). Bank swallows are considered to be casual migrants in northwestern California (Yocum and Harris 1975).

4. Sensitivity to Timber Harvest and Other Impacts

Due to substrates chosen by nesting bank swallows, the species' habitat is naturally susceptible to erosion and slumping. Banks exposed to wave and current action and streams subject to spring flooding are particularly vulnerable (Greenlaw 1972). Bank swallows nesting in banks near highways may risk mortality from automobile collisions and colonies nesting in active gravel pits may be destroyed by excavations (Bent 1942).

Channelization of rivers (Remsen 1978) and related erosion control and bank stabilization (riprapping) measures are considered to be the most serious threat to bank swallows in California (CDFG 1990). Human disturbance is also a threat (Remsen 1978). To prevent further losses of bank swallow populations, protection of nesting colonies from habitat destruction and human harassment is suggested (Remsen 1978). Potential mitigation techniques are suggested to target the Sacramento River population. Mitigation measures of cutting vertical bank faces above rip rap installations have proved successful in providing suitable habitat for bank swallows (Garrison et al. 1988). Other suggested measures include annual monitoring, establishing habitat preserves for bank swallows, and conducting additional research on the habitat requirements of the species (Garrison et al. 1988). We found no literature pertaining to potential effects of timber harvest on bank swallows.

5. Occurrence and Status on Simpson Timberlands

No individual or colonies of bank swallows have been observed on Simpson's ownership or adjacent areas. As indicated above, they apparently are only casual migrants to the area.

6. Expected Impacts of HCP

Because there is no known impact of timber harvest on bank swallows, we assume the impacts of this plan will be neutral relative to this species.

M. PURPLE MARTIN (*Progne subis*) (breeding)

1. Range

Purple martins breed from central and southern Canada south to southern Florida in the east and to Baja California in the west. Wintering populations of martins are concentrated in Brazil (Bent 1942).

In California, purple martins are found throughout the state west of the deserts from sea level to 6000 ft. (Small 1974).

2. Specific Habitat Requirements

Purple martins nest in abandoned woodpecker cavities (Allen and Nice 1952) of isolated tall trees or snags (Zeiner et al. 1990b), on cliffs (Bent 1942), or in man-made structures such as martin houses which are commonly used in the east (Allen and Nice 1952).

In California, purple martins inhabit a variety of open-wooded, low elevation habitats including valley foothill and montane hardwood and hardwood-conifer areas, riparian habitats, and coniferous forests comprised of Douglas-fir, redwoods, ponderosa pine, or Monterey pine (Zeiner et al. 1990b). In California (Small 1974) and throughout the west (Allen and Nice 1952), martins do not frequently inhabit martin houses.

3. Status

Purple martins were once common breeders in the California coast ranges, but drastic decreases have occurred in southern California (Remsen 1978). Declines have been attributed to competition for nesting cavities with introduced starlings, removal of snags (Remsen 1978) and loss of riparian habitat (Zeiner et al. 1990b). Numbers along the north coast and in the Sacramento area appear to be stable (Remsen 1978). Yocum and Harris (1975) considered the species to be an uncommon summer breeder in northwestern California. Purple martins are a California species of special concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Remsen (1978) recommended the following to manage for purple martins: experimenting with starling control at martin sites, retaining snags wherever possible, and erecting nest boxes in areas where martins still nest. We found no literature pertaining to potential effects of timber harvest on purple martins.

5. Occurrence and Status on Simpson Timberlands

No purple martins have been observed on Simpson's ownership or adjacent areas. We assume they are rare or absent from this region.

6. Expected Impacts of HCP

The apparent rare status of purple martins in this area suggests the coastal redwood region is marginal habitat for the species. Consequently, the plan is likely to have little impact on them. However, the retention of snags and greater protection of stream zones that are proposed in sections 3C.1.b and 3C.1.c. of this plan could potentially benefit purple martins if other aspects of their life history could adequately be met.

N. BLACK-CAPPED CHICKADEE (*Parus atricapillus*)

1. Range

Black-capped chickadees range in North America from treeline south to the central United States (Bent 1946). In California, they are residents in the northwest corner of the state (Brown et al. 1986) in Del Norte, Humboldt, and Siskiyou counties (Small 1974). The species breeds regularly near Requa and are found wintering in Crescent City, Arcata, Blue Lake, Eureka, and the mouth of the Mad River (Yocum and Harris 1975).

2. Specific Habitat Requirements

In California, black-capped chickadees are found in riparian areas (Small 1974, Yocum and Harris 1975) associated with deciduous trees (Brown et al. 1986) such as willows (Small 1974), alder, or birch (Zeiner et al. 1990b). The species occasionally is found in conifer stands near riparian areas (Zeiner et al. 1990b).

3. Status

Black-capped chickadees are considered to be rare local residents and breeders in California (Yocum and Harris 1975) and the total population in the state is small (Remsen 1978). The species is listed as a California species of special concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Destruction of riparian habitat in northwestern California is a potential threat to black-capped chickadees and thus recommendations for managing chickadee habitat includes protecting riparian areas known to support the species (Remsen 1978).

5. Status and Occurrence on Simpson Timberlands

Chickadees are commonly observed throughout Simpson's ownership, but most are the coastal chestnut-backed species and only occasionally have we verified sightings of the black-capped species. All of the latter have been from the northern portion of Simpson's ownership from Klamath to the Oregon border. We have no information concerning population trends of this species.

6. Expected Impacts of HCP

Similar to the ruffed grouse, northern California is the southern limit of the range of the black-capped chickadee, which is widespread and abundant throughout most of its range. Being at the edge of its range suggests that habitat is marginal here, so the plan is not likely to have a significant impact on the species. If there is an impact, the proposed increased protection of streamside vegetation (see Section 4.C of the HCP, "Overall Resource Management") should benefit the species.

O. YELLOW-BREASTED CHAT (*Icteria virens*) (breeding)

1. Range

Yellow-breasted chats breed throughout most of the United States and northern Mexico and parts of southern Canada. They winter from southern Baja California and southern Texas south to western Panama (Dennis 1958).

In California, yellow-breasted chats are found in suitable habitats the length of the state (Small 1974) at elevations up to 6500 ft. (Zeiner et al. 1990b).

2. Specific Habitat Requirements

Yellow-breasted chats breed and winter in dense second growth and scrub habitats. They are typically associated with early successional stages of forest regeneration such as those found in abandoned agricultural lands, fields, and stream valleys (Thompson and Nolan 1973).

In California, yellow-breasted chats are found in dense thickets of willow or other brushy tangles (Zeiner et al. 1990b) of riparian woodlands (Small 1974). Gaines (1974) characterized the bird in the Sacramento Valley as an edge-nester, nesting between the forest-field and gravel-bar interface.

3. Status

Once a fairly common summer resident in riparian woodland throughout California, yellow-breasted chats are now much reduced in numbers especially in southern California. Reasons for decline are not well understood and include destruction of riparian woodland and possibly cowbird parasitism (Remsen 1978). Remsen (1978) reported numbers of yellow-breasted chats to be high in northwestern California, where Yocum and Harris (1975) regarded the species as an uncommon summer breeder. Yellow-breasted chats are a California species of special concern (Zeiner et al. 1990b).

4. Sensitivity to Timber Harvest and Other Impacts

Remsen (1978) recommended protecting riparian habitats and determining the impact of cowbird parasitism on yellow-breasted chats to manage for the species.

5. Status and Occurrence on Simpson Timberlands

We have made no observations of yellow-breasted chats on Simpson's ownership or adjacent lands. We believe the habitat to be largely unsuitable because it is dominated by conifers, and as noted above, chats tend to be more associated with agricultural lands and stream valleys.

6. Expected Impacts of HCP

Because the plan area does not include significant chat habitat, we believe the impacts of the plan will be neutral relative to this species.

V. MAMMALS

A. TOWNSEND'S BIG-EARED BAT (*Plecotus townsendii*)

1. Range

Townsend's big-eared bats range from British Columbia south to southern Mexico and east to Oklahoma with scattered populations also in Missouri, Arkansas, West Virginia, and Kentucky (Hall 1981). They occur throughout California, but details of their distribution are poorly known (Marcot 1984). In northwestern California, Marcot (1984) discovered hibernacula of big-eared bats in four limestone caves in Shasta Trinity National Forest.

2. Specific Habitat Requirements

Townsend's big-eared bats are most common in mesic sites, but are found in a variety of habitats including coastal conifer and broad-leaf forests, oak and conifer woodlands, arid grasslands and deserts, and high-elevation forests and meadows. Roosting, maternity and hibernacula sites must be free of human disturbance, and in California include limestone caves, lava tubes, mine tunnels, buildings, and other man-made structures (Williams 1986).

In northern California, Marcot (1984) found caves occupied by the bats in an oak woodland with subdominants of Douglas-fir and ponderosa pine. Cave entrances were at 2600-3900 feet in elevation, faced southeast to southwest, and were 16-490 feet from perennial streams.

3. Status

Little data are available on population trends of Townsend's big-eared bats, but in recent years populations seem to have declined throughout the United States. Several historic sites in California no longer support the bats, possibly due to human disturbance (Williams 1986). The species is listed as a California species of special concern (Williams 1986) and a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Townsend's big-eared bats are extremely sensitive to human disturbance. A single visit by humans can cause the bats to abandon a roost. Thus, protecting roost sites has been recommended. Collecting more data on the distribution and population status of the species has also been recommended (Williams 1986). We could not find literature pertaining to potential impacts of timber harvest on Townsend's big-eared bats.

5. Status and Occurrence on Simpson Timberlands

We have no observations of Townsend's big-eared bats on Simpson's ownership or adjacent lands. However, no attempts have been made to survey for bats.

6. Expected Impacts of HCP

Because there is no evidence that timber harvest impacts this species, we believe the impacts of this plan will be neutral relative to big-eared bats.

B. WHITE-FOOTED VOLE (*Arborimus albipes*)

1. Range

White-footed voles occur in the humid areas of western Oregon from Clatsop County south along the coast to Humboldt Bay (Maser 1966) in northern California. The extent of the range in California is not well documented, occupying a "coastal strip of unknown width" (Maser 1966).

2. Specific Habitat Requirements

White-footed voles are terrestrial and are associated with small, clear streams flowing through coniferous forests (Maser 1966). Most records of white-footed voles are from forested areas, but the mammals have been captured in a clearcut less than four years old (Maser 1966). Small clearings made by individual fallen trees and supporting herbaceous growth may be important habitat for the species (Williams 1986).

In California, white-footed voles inhabit streamside thickets in redwood forests (Jameson and Peeters 1988), with all records from lowlands (Williams 1986).

3. Status

No data are available to determine the population status of white-footed voles (Williams 1986). Maser (1966) suspected that with more study, white-footed voles would rank with red tree voles as a common, yet unique species of the Pacific Northwest. In California, the vole has been captured infrequently and thus is considered rare (Williams 1986). It is a California species of special concern (Williams 1986) and is a Category 2 candidate for federal listing.

4. Sensitivity to Timber Harvest and Other Impacts

Because the association of white-footed voles with small streams may make the species sensitive to logging and other alterations of riparian habitats, Williams (1986) recommended that the voles should be given special consideration in forest management plans. Because so little is known about white-footed voles, studies of their distribution, habitat requirements, and population status have also been recommended (Williams 1986).

5. Occurrence and Status on Simpson Timberlands

We have no observations of white-footed voles on Simpson property. Although we have not conducted small mammal surveys, if they are common in the area, we would expect some to be taken by spotted owls. We have identified 714 prey in spotted owl pellets, none of which were white-footed voles. Thus, we resume that the species is absent or rare in this region.

6. Expected Impacts of HCP

The HCP proposes to increase protection of riparian habitat (see Section 4.C of the HCP, "Overall Resource Management"), which should be beneficial to white-footed voles if they occur in the plan area.

C. RED TREE VOLE (*Arborimus longicaudus*)

1. Range

Red tree voles are found in humid areas of western Oregon and northwestern California (Maser 1966). In California they occur in coastal forests in the humid fogbelt (Jameson and Peeters 1988) south to Sonoma County on the coast and to Mendocino County in the Coastal Mountains, and east to Trinity County (Maser 1966). In the state they have been found at elevations from 150 to 3100 feet. (Maser 1966). The distribution of red tree voles in California suggests a spotty dispersion pattern (Williams 1986).

2. Specific Habitat Requirements

The ecology of red tree voles is not well described (Carey et al. 1991). Red tree voles nest, feed, breed, and sleep in trees (Carey 1991), although males may be relatively more terrestrial than females (Corn and Bury 1986). Douglas-firs are the predominant tree species used, with grand fir, sitka spruce (Meiselman 1987), and western hemlock (Williams 1986) also utilized. Carey et al. (1991) noted that the voles seem closely associated with old growth forests. Williams (1986) suggested that they require fairly dense mature stands of conifers with some Douglas-firs or grand firs, and generally prefer large trees. Habitat records of red tree voles reviewed by Maser (1966), however, revealed the animals to use young second growth Douglas-fir trees 7-15" dbh. The voles were also found to use habitats described as broken, isolated, and scattered by clearcuts, open grass, bracken fern and cultivated fields; or 30-50 year old stands with a few interspersed older trees, but little evidence of dense forest (Maser 1966).

In California, red tree voles are associated with open stands of Douglas-fir (Jameson and Peeters 1988), but also are found using grand firs in Mendocino County and along the Mad River (Maser 1966). Nests have been found in redwood trees (Maser 1966), but the voles do not eat redwood needles and therefore are not found in pure redwood stands (Williams 1986).

Meiselman (1987) suggested that the moist, cool habitats in which red tree voles were found in northern California could be attributed to the climatic buffering of a dense, multilayered canopy provided by older, riparian Douglas-fir forests. However, she noted that red tree vole nests have been found in young, mature, and old growth stands in that area.

3. Status

Maser (1966) considered red tree voles to be common, though unique in the Pacific Northwest, with large populations in northern California. Williams (1986) concluded that the voles were always rare in California, but locally common in the foothills of the eastern edge of the coastal plain in

Humboldt County (Williams 1986). Red tree voles are a California species of special concern (Williams 1986).

4. Sensitivity to Timber Harvest and Other Impacts

Clearcuts, forest fires, construction of roads or powerlines and other activities creating openings reduce and fragment habitat and therefore may be detrimental to red tree voles (Williams 1986). The inability of the voles to cross nonforested areas may be the most limiting factor for colonization of second growth forests by the species (Carey et al. 1991). The low reproductive potential of these voles (relative to other voles) in conjunction with increased mortality associated with logging presumably jeopardizes populations of the species (Williams 1986).

Carey et al. (1991) noted that forest management at the landscape level (including cutting pattern, rate, and rotation) will determine the existence of future red tree vole populations. Meiselman (1987) recommended maintaining Douglas-fir forests in mesic locations and microclimates for red tree vole habitat. Large Douglas-firs with many limbs left as seed trees or remaining after fires may help to re-establish tree vole populations after harvest or fire (Maser 1966). Williams (1986) prescribed selective cutting over clearcutting for red tree voles and emphasized the need for more detailed information on the distribution and population status of the species.

5. Occurrence and Status on Simpson Timberlands

Red tree voles have been found commonly in stands south of the Bald Hill Road that have a significant component of fir. Red tree vole nests have been incidentally located in 24 different stands. These stands ranged in age from 20-110 years, with a median age of 35. Nest trees ranged in dbh from 3.0-45.2 inches, with a median of 11.0 inches. Seventy-two red tree voles (approximately 10% of all prey identified) have been identified as prey of spotted owls living in managed young growth stands, providing additional evidence that the voles commonly occur in managed stands. We have no information on population trends of this species.

6. Expected Impacts of HCP

Assuming that red tree voles do benefit from retention of older stands or components of the same, several attributes of the HCP should benefit the species and include: retaining more structure along stream courses ("Overall Resource Management", Section 4.C of the HCP), leaving residual patches in harvest units ("Owl Habitat Planning," Section 4.C), and establishing set-aside areas ("Set-Asides", Section 4.C).

D. PACIFIC FISHER (*Martes pennanti pacifica*)

1. Range

Martes pennanti range from central and southern Canada south to central California, in the Rocky Mountains to Utah, the Great Lakes region, and along the Appalachian Mountains to Tennessee (Hall 1981). The subspecies *pacifica* is found along the Pacific coast from southern Alaska and British

Columbia south to central California and east to the Blue Mountains in Oregon (Hall 1981).

In California, Pacific fishers occur from the Oregon border south to Sonoma County on the coast, to Lake County in the coastal mountains, and to Kern County in the Sierra Nevada. In northern California they range east to Lassen County (Williams 1986). Fishers are found at low elevations in the northwestern part of the state, but at elevations of at least 3300 feet in the Cascade-Sierra (Jameson and Peeters 1988).

2. Specific Habitat Requirements

Most suitable habitat for *Martes pennanti* has been described as dense forested stands comprised primarily of large diameter conifer trees which provide suitable winter cover (Thomasma et al. 1991). Many researchers have associated fishers with mature forests (Mullis 1985), but the furbearers are often found in second growth forests, and sometimes in forest openings (Williams 1986).

Little is known about the biology of fishers in California (Mullis 1985). In Trinity County, Pacific fishers were studied by Buck (1982) and Mullis (1985). They found the subspecies to occur primarily in multiple species stands of mixed conifer/hardwoods (Mullis 1985) or mature, closed conifers (Buck 1982), with Douglas-fir the primary conifer species. Den sites were in unharvested or selectively cut areas where less than 20% of the overhead canopy was taken (Buck 1982). The animals were not frequently found in relatively early successional conifer/non-commercial timber types (Mullis 1985). The importance of hardwoods to fishers in the area was ambiguous as in one study the animals seemed to avoid pure hardwood stands (Buck 1982), but in the other, no avoidance or preference towards hardwoods was detected (Mullis 1985).

Fishers also inhabit pine and true fir stands, but avoid redwood forests (Jameson and Peeters 1988). Yocum and McCollum (1973) noted only one record of a fisher in the redwood forest type. At elevations to over 11,000 feet, fishers are found in red fir, lodgepole pine, and mixed evergreen/broadleaf forests (Williams 1986). Riparian areas are regarded as important fisher habitat (Buck 1982), especially for travel and escape (Mullis 1985).

3. Status

In California, evidence suggests that fishers were relatively common in the north coast region, but rare or uncommon in the Sierra Nevada where they appear to be decreasing (Williams 1986). In 1942, Hall (1942) noted that the fisher was near extinction in the state and numbers were declining based on trapping records from 1926-1940. Over-trapping and habitat destruction were believed responsible for the declines, and in 1946 trapping of the furbearer was closed (Mullis 1985).

Yocum and Harris (1973) thought fishers were absent from northeastern California, but noted increases of the mammals in Humboldt, Del Norte, and Trinity Counties in the 1960's and 70's. Their records indicated increases along the Klamath and Trinity Rivers and Shasta-Trinity National Forest. However, Raphael (1988) identified fishers as a species to be most strongly affected by future harvest of old-growth Douglas-fir forests in northwestern

California. He projected a 26% decline from historic levels of fisher abundance, but noted that his projections were highly speculative. Pacific fishers are listed as a California species of special concern (Williams 1986) and a federal sensitive species.

4. Sensitivity to Timber Harvest and Other Impacts

Mullis (1985) suggested that an adequate proportion of mature timber needs to be present through time to maintain Pacific fisher habitat. Because selective or clearcut logging, road building, or other land use changes (Mullis 1985) decrease the apparent preferred closed conifer habitat of fishers (Buck 1982), they are thought to cause decreases in fisher numbers (Buck 1982, Mullis 1985). Logging is also suspected to increase intraspecific competition (resulting in increased juvenile mortality) in areas adjacent to timber harvests due to the influx of displaced animals (Mullis 1985).

New clearcuts in particular are considered to have little habitat value to fishers, as most den sites found by Mullis (1985) were found more than 250 m away from clearcuts. Once a dense cover of vegetation is established in clearcuts, however, fishers use the areas for hunting as suggested by snow tracking (Mullis 1985).

To ensure regeneration of mesic closed forests for fisher habitat, planting drought-resistant Douglas-fir over ponderosa pine has been recommended, with short rotations of ponderosa pine not recommended (Mullis 1985). Because the removal of snags reduces the number of potential den/nest sites (Mullis 1985), retention of snags has been suggested. Mullis (1985) noted that monitoring fisher response to timber harvest is needed to understand impacts of habitat modification on the species.

5. Occurrence and Status on Simpson Timberlands

We know very little about the occurrence of fishers in the plan area. We have made nine fortuitous observations of fishers or their tracks on Simpson property. The observations were made at higher elevations in this region and in stands not dominated by redwoods. Stand ages where fisher observations have been made ranged from 10-50 years. We have no information on population trends for this species.

6. Expected Impacts of HCP

The HCP proposes to retain more older stands and components of the same through set-asides ("Set-Asides", section 4.C of the HCP), retention of residual patches, green culls, and snags in harvest units ("Owl Habitat Planning," section 4.C), and increased retention of streamside vegetation ("Overall Resource Management", section 4.C). All of these should benefit Pacific fishers.

VI. LITERATURE CITED

Allen, R. W. and M. M. Nice
1952 A study of the breeding biology of the purple martin (*Progne subis*). Am. Midl. Nat. 47:606-665.

Altig, R. and P. C. Dumas
1974 *Rana aurora.* P. 160 *in* R. G. Zweifel, ed. 1974. Catalogue of American amphibians and reptiles. American Society of Ichthyologists and Herpetologists.

Anderson, J. D.
1968 *Rhyacotriton, R. olympicus.* P. 68 *in* R. G. Zweifel, ed. 1974. Catalogue of American amphibians and reptiles. American Society of Ichthyologists and Herpetologists.

Asay, C. E.
1987 Habitat and productivity of Cooper's hawks nesting in California. Calif. Fish and Game 73:80-87.

Barber, H. L., R. Kirkpatrick, J. Kubsiak, D. Rusch, F. A. Servello, S. K. Stafford, D. F. Stauffer, and F. R. Thompson III
1989 The ecological niche. Pp. 15-20 *in* S. Atwater and J. Schnell, eds. Ruffed Grouse. Stackpole Books. 370 pp.

Bent, A. C.
1942 Life histories of North American flycatchers, larks, swallows, and their allies. Smithsonian Institution Bulletin 179, U. S. Government Printing Office, Washington, D. C. 555 pp.

1946 Life histories of North American jays, crows, and titmice. Smithsonian Institution Bulletin 191, U. S. Government Printing Office, Washington, D. C. 495 pp.

Bisson, P. A. and J. R. Sedell
1984 Salmonid populations in clearcut v. old-growth forests of western Washington. Pp. 121-129 *in* W. R. Meehan, T. R. Merrell, Jr., and T. A. Hanley (eds.). Fish and wildlife relationships in old-growth forests. Amer. Inst. Fish Res. Biol. Juneau Alaska.

Bloom, P. H., G. R. Stewart, and B. J. Walton
1985 The status of the northern goshawk in California, 1981-1983. Calif. Dept. Fish and Game Wild. Manage. Branch Admin. Rep. 85-1. 25 pp.

Brenner, F. J.
1989 The essentials of habitat. Pp. 322-326 *in* S. Atwater and J. Schnell, eds. Ruffed Grouse. Stackpole Books. 370 pp.

Brodie, E. D., Jr. and R. M. Storm
1971 *Plethodon elongatus.* P. 103 *in* R. G. Zweifel, ed. 1974. Catalogue of American amphibians and reptiles. American Society of Ichthyologists and Herpetologists.

Brown, V., H. Weston, Jr., and J. Buzzell
1986 Handbook of California birds. Naturegraph, Happy Camp, CA. 223 pp.

Buck, S.
1982 Habitat utilization by fisher (*Martes pennanti*) near Big Bar, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 85 pp.

Buehler, D. A., T. J. Mersmann, J. D. Fraser, and J. K. D. Seegar
1991 Effects of human activity on bald eagle distribution. J. Wildl. Manage. 55:282-290.

Burke, M.
1983 Bald eagle nesting habitat improved with silvicultural manipulation in northeastern California. Pp. 101-105 *in* D. M. Bird, N. R. Seymour, and J. M. Gerrard, eds. Biology and management of bald eagles and ospreys. Harpell Press, Ste. Anne de Bellevue, Quebec. 325 pp.

Bury, R. B.
1962 Occurrence of *Clemmys m. marmorata* in north coastal California. Herpetologica 18:283.

1968 The distribution of *Ascaphus truei* in California. Herpetologica 24:39-46.

1983 Differences in amphibian populations in logged and old growth forests. Northwest Sci. 57:167-178.

Bury, R. B. and R. A. Luckenbach
1976 Introduced amphibians and reptiles in California. Biol. Conserv. 10:1-14.

Bury, R.B. and P. S. Corn
1988a Douglas-fir forests in the Oregon and Washington Cascades: Relation of the herpetofauna to stand age and moisture. Pp. 11-20 *in* Szaro, R. C., K. E. Severson, and D. R. Patton, tech. coords. Management of amphibians, reptiles, and small mammals in North America. USDA For. Serv. Gen. Tech. Rept. RM-166.

1988b Responses of aquatic and streamside amphibians to timber harvest: a review. Pp. 165-180 *in* K. J. Raedeke, ed. 1988. Streamside management: Riparian wildlife and forestry interactions. Univ. Wash. Inst. of Forest Res. #59.

California Department of Fish and Game (CDFG)
1968 An evaluation of the fish and wildlife resources of the Mad River as affected by the U. S. Corps of Engineers' Mad River project with special reference to the proposed Butler Valley reservoir. Calif. Fish and Game, Sacramento. 56 pp.

1990 1989 Annual Report on the status of California's state listed threatened and endangered plants and animals. Calif. Dept. Fish and Game, Sacramento. 188 pp.

Carey, A. B., B. L. Biswell, and J. W. Witt
1991 Methods for measuring populations of arboreal rodents. USDA For. Serv. Gen. Tech. Rep. PNW-GTR-273. 24 pp.

Carter, H. R., and R. A. Erickson
1988 Population status and conservation problems of the marbled murrelet in California 1892 - 1987. Calif. Dept. Fish and Game, Sacramento. 74 pp.

Cogswell, H. L.
1977 Waterbirds of California. Univ. of Calif. Press, Berkeley. 399 pp.

Corn, P. S. and R. B. Bury
1986 Habitat use and terrestrial activity by red tree voles *(Arborimus longicaudus)* in Oregon. J. Mamm. 67:404-406.

Crocker-Bedford, D. C.
1990 Goshawk reproduction and forest management. Wildl. Soc. Bull. 18:262-269.

Daugherty, C. H. and A. C. Sheldon
1982 Age specific movements of the frog *Ascaphus truei.* Herpetologica 38:468-474.

Dennis, J. V.
1958 Some aspects of the breeding ecology of the yellow-breasted chat (*Icteria virens*). Bird Banding 29: 169-183.

Emig, J., P. Baker, and F. Reynolds
1988 Coho salmon on the comeback trail. Outdoor Calif. 49:1-4.

Erskine, A. J.
1979 Man's influence on potential nesting sites and populations of swallows in Canada. Can. Field-Nat. 93: 371-377.

Evans, D. L.
1982 Status reports on twelve raptors. USDI Fish and Wildl. Serv. Spec. Sci. Rep. 238. 68 pp.

French, J. M.
1972 Distribution, abundance, and breeding status of ospreys in northwestern California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 58 pp.

Gaines, D.
1974 A new look at the nesting riparian avifauna of the Sacramento Valley, California. West. Birds 5:61-80.

Garber, D. P.
1972 Osprey nesting ecology in Lassen and Plumas Counties, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 59 pp.

Garrison, B. A., R. W. Schlorff, J. M. Humphrey, S. A. Laymon, and F. J. Michny
1989 Population trends and management of the bank swallow (*Riparia riparia*) on the Sacramento River, California. Pp. 267-271 *in* D. L. Abell, Tech. Coord. Proc. of the Calif. Riparian Systems Conf. Sept. 22-24, 1988, Davis Calif. USDA For. Serv. Gen. Tech. Rep. PSW-110. 544 pp.

Greenlaw, J. S.
1972 The use of sawdust piles by nesting bank swallows. Wilson Bull. 84:494-496.

Grubb, T. G. and R. M. King
1991 Assessing human disturbance of breeding bald eagles with classification tree models. J. Wild. Manage. 55:500-511.

Gullion, G. W.
1989 Managing the woods for the bird's sake. Pp. 334-349 *in* S. Atwater and J. Schnell, eds. Ruffed Grouse. Stackpole Books. 370 pp.

Hall, E. R.
1981 The mammals of North America, 2nd. ed. John Wiley and Sons, N. Y.

Hall, P. A.
1984 Characterization of nesting habitat of goshawks (*Accipiter gentilis*) in northwestern California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 70 pp.

Hall, R.
1942 Gestation period in fisher with recommendations for the animal's protection in California. Calif. Fish and Game 28:143-147.

Hayes, M. P. and M. R. Jennings
1986 Decline of ranid frog species in western North America: Are bullfrogs (*Rana catesbeiana*) responsible? J. Herp. 20:490-509.

1988 Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. Pp. 144-158 *in* Szaro, R. C., K. E. Severson, and D. R. Patton, tech. coords. Management of amphibians, reptiles, and small mammals in North America. USDA For. Serv. Gen. Tech. Rept. RM-166.

Heidsiek, C.
1990 Population and habitat characteristics of leafy reed grass (*Calamagrostis foliosa*) in the King Range Natural Conservation Area, California. Unpubl. M.S. thesis, Humboldt State University, Aracata, CA. 61 pp.

Henny, C. J.
1983 Distribution and abundance of nesting ospreys in the United States. Pp. 175-186 *in* D. M. Bird, N. R. Seymour, and J. M. Gerrard, eds. Biology and management of bald eagles and ospreys. Harpell Press, Ste. Anne de Bellevue, Quebec. 325 pp.

Herrington, R. E.
1988 Talus use by amphibians and reptiles in the Pacific Northwest. Pp. 216-221 *in* Szaro, R. C., K. E. Severson, and D. R. Patton, tech. coords. Management of amphibians, reptiles, and small mammals in North America. USDA For. Serv. Gen. Tech. Rept. RM-166.

Hodges, J. I., and J. G. King
1984 Bald eagle breeding population survey of coastal British Columbia. J. Wild. Manage. 993-998.

Hollom, P. A. D.
1943 Bank swallows nesting in artificial holes. Auk 60:270-271.

Hunt, H. E.
1979 Behavioral patterns of breeding peregrine falcons. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 51 pp.

Ives, J. H.
1973 The breeding biology of the common egret on Humboldt Bay, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 74 pp.

Jameson, E. W. and H. J. Peeters
1988 California Mammals. Univ. of Calif. Press, Berkeley. 403 pp.

Jennings, M. R. and M. P. Hayes
1985 Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): the inducement for bullfrog (*Rana catesbeiana*) introduction. Herpetologica 41:94-103.

John, R. D.
1991 Observations on soil requirements for nesting bank swallows *Riparia-riparian*. Can. Field-Nat. 105:251-254.

Johnsgard, P. A.
1973 Grouse and quails of North America. Univ. of Nebraska, Lincoln. 553 pp.

1989 The king of gamebirds. Pp. 2-7 *in* S. Atwater and J. Schnell, eds. Ruffed Grouse. Stackpole Books. 370 pp.

1990 Hawks, eagles, and falcons of North America. Smithsonian Institution Press, Washington D. C. 403 pp.

Keister, G. P., Jr. and R. G. Anthony
1983 Characteristics of bald eagle communal roosts in the Klamath Basin, Oregon and California. J. Wildl. Manage. 47:1072-1079.

Kenward, R. E.
1982 Goshawk hunting behavior, and range size as a function of food and habitat availability. J. Anim. Ecol. 51:69-80.

Leeming, J. P.
1991 Dept. Forest Sciences, Oregon State University, personal communication.

Lehman, R. N.
1983 Breeding status and management of bald eagles in California -- 1981. Calif. Dept. Fish and Game Wild. Manage. Branch Admin. Rep. 83-1. 24 pp.

Levenson, H.
1976 Behavior and energetics of ospreys nesting in northern California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 107 pp.

McEwan, L. C. and D. H. Hirth
1979 Southern bald eagle productivity and nest site selection. J. Wild. Manage. 43:585-594.

McGarigal, K., R. G. Anthony, and F. B. Isaacs
1991 Interactions of humans and bald eagles on the Columbia River estuary. Wild. Monog. 115:1-47.

Marcot, B. G.
1984 Winter use of some northwestern California caves by western big-eared bats and long-eared myotis. Murrelet 65:46.

Maser, C.
1966 Life histories and ecology of *Phenacomys albipes, Phenacomys longicaudus, Phenacomys silvicola.* Unpubl. M. S. Thesis, Oregon State Univ., Corvallis. 221 pp.

Meiselman, N.
1987 Red tree vole habitat and microhabitat utilization in Douglas-fir forests of northern California. Calif. Dept. Fish and Game Wild. Manage. Div. Final Rep. 74 pp.

Merlo, J.
1975 Logging around an osprey nest site: an observation. J. Forest. 73:724-725.

Metter, D. E.
1968 *Ascaphus, A. truei.* P. 69 *in* R. G. Zweifel, ed. 1974. Catalogue of American amphibians and reptiles. American Society of Ichthyologists and Herpetologists.

Moyle, P. B.
1973 Effects of introduced bullfrogs, *Rana catesbeiana,* on the native frogs of the San Joaquin Valley, California. Copeia 1973:18-22.

Moyle, P. B., J. E. Williams, and E. D. Wikramanayake
1989 Fish species of special concern of California. Final rep. Calif. Dept. Fish and Game, Inland Fisheries Div. Rancho Cordova. 222 pp.

Mullis, C.
1985 Habitat utilization by fisher (*Martes pennanti*) near Hayfork Bally, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 91 pp.

Munz, P.A.
1968 A Caifornia Flora: supplement. Univ. of Calif. Press, Berkeley. 224 pp.

Munz, P.A. and D.D. Keck
1970 A California flora. Univ. of Calif. Press, Berkeley. 1681 pp.

Murphy, M. L., J. Heifetz, S. W. Johnson, K. V. Koski, and J. K. Thedinga
1986 Effects of clear-cut logging with and without buffer strips on juvenile salmonids in Alaskan streams. Can. J. Fish. Aquat. Sci. 43:1521-1533.

Nelson, M. W.
1982 Human impacts on golden eagles: a positive outlook for the 1980's and 1990's. Rapt. Res. 16:97-103.

Noble, G. K. and P. G. Putnam
1931 Observations on the life history of *Ascaphus truei* Stejneger. Copeia 3:97-101.

Nussbaum, R. A. and C. K. Tait
1977 Aspects of the life history and ecology of the Olympic salamander, *Rhyacotriton olympicus* (Gaige). Am. Midl. Nat. 98:176-199.

Nussbaum, R. A., E. D. Brodie, Jr., and R. M. Storm
1983 Amphibians and reptiles of the Pacific Northwest. Univ. Press of Idaho. 332 pp.

Paton, P. W. C. and C. J. Ralph
1988 Geographic distribution of the marbled murrelet in California at inland sites during the 1988 breeding season. Calif. Dept. Fish and Game, Sacramento. 35 pp.

Paton, P. W. C., C. J. Ralph, H. R. Carter, and S. K. Nelson
1990 Surveying marbled murrelets at inland forested sites: a guide. USDA For. Serv. Gen. Tech. Rep. PSW-120. 9 pp.

Postovit, H. R. and B. C. Postovit
1987 Impacts and mitigation techniques. Pp. 183-213 *in* B. A. G. Pendleton, B. A. Millsap, K. W. Cline, and D. M. Bird, eds. Raptor Management Techniques Manual. National Wildlife Federation, Washington D. C. 420 pp.

Quinlan, S. E. and J. H. Hughes
1990 Location and description of a marbled murrelet tree nest site in Alaska. Condor 92: 1068-1073.

Raphael, M. G.
1988 Long-term trends in abundance of amphibians, reptiles, and mammals in Douglas-fir forests of northwestern California. Pp. 23-31 *in* Szaro, R. C., K. E. Severson, and D. R. Patton, tech. coords. Management of amphibians, reptiles, and small mammals in North America. USDA For. Serv. Gen. Tech. Rept. RM-166.

Remsen, J. V.
1978 Bird species of special concern in California. Calif. Dept. Fish and Game Wild. Manage. Admin. Rep. No. 78-1. 54 pp.

Reynolds, R. T.
1983 Management of western coniferous forest habitat for nesting accipiter hawks. USDA For. Serv. Gen. Tech. Rep. RM-102. 7 pp.

Reynolds, R. T., E. C. Meslow, and H. M. Wight
1982 Nesting habitat of coexisting *Accipiter* in Oregon. J. Wild. Manage. 46:124-138.

Schlorff, R. W.
1978 Predatory ecology of the great egret at Humboldt Bay, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, CA. 136 pp.

Scrivener, J. C. and B. C. Andersen
1984 Logging impacts and mechanisms that determine the size of spring and summer populations of Coho salmon fry (*Oncorhynchus kisutch*) in Carnation Creek, British Columbia. Can. J. Fish. Aquat. Sci. 41:1097-1105.

Singer, S. W., N. L. Naslund, S. A. Singer, and C. J. Ralph
1991 Discovery and observations of 2 tree nests of the marbled murrelet. Condor 93:330-339.

Small, A.
1974 The birds of California. Winchester Press, N. Y. 310 pp.

Smth, J. P., Jr. and K. Berg, eds.
1988 California Native Plant Society's inventory of rare and endangered vascular plants. California Native Plant Society, Sacramento. 168 pp.

Snow, C.
1973 Golden eagle (*Aquila chrysaetos*). Habitat management series for unique or endangered species. USDI Bur. Land Mgmt. Tech. Note T-N-239. 52 pp.

Soothill, E. and R. Soothill
1982 Wading birds of the world. Blandford Press, Poole, U.K. 334 pp.

Sowls, A. L., A. R. DeGagne, J. W. Nelson, and G. S. Lester
1980 Catalog of California seabird colonies. USDI Fish Wild. Serv. Biol. Serv. Prog. FWS/OBS 37/80.

Stalmaster, M. V. and J. R. Newman
1978 Behavioral responses of wintering bald eagles to human activity. J. Wild. Manage. 42: 506-513.

1979 Perch-site preferences of wintering bald eagles in northwest Washington. J. Wild. Manage. 43: 221-224.

Stauffer, D. F.
1989 A home on the range. P. 331 *in* S. Atwater and J. Schnell, eds. Ruffed Grouse. Stackpole Books. 370 pp.

Stebbins, R. C. and H. C. Reynolds
1947 Southern extension of the range of the Del Norte salamander in California. Herpetologica 4:41-42.

Storm, R. M
1991 (retired) Dept. Zoology, Oregon State University, personal communication.

Thomasma, L. E., T. D. Drummer, and R. O. Peterson
1991 Testing the habitat suitability index model for the fisher. Wild. Soc. Bull. 19:291-297.

Thompson, C. F. and V. N. Nolan, Jr.
1973 Population biology of the yellow-breasted chat (*Icteria virens*) in southern Indiana. Ecol. Monog. 43:145-171.

Van Duesen, H. M.
1947 Bank swallow and belted kingfisher nests in man made niche. Auk 64:624-625.

Veoka, M. L.
1974 Feeding behavior of ospreys at Humboldt Bay, California. Unpubl. M. S. Thesis, Humboldt State Univ., Arcata, California. 76 pp.

Werschkul, D. F., E. McMahon, and M. Leitschuh
1976 Some effects of human activities on the great blue heron in Oregon. Wilson Bull. 88:660-662.

Williams, D. F.
1986 Mammalian species of concern in California. Calif. Dept. Fish and Game Wild. Manage. Div. Admin. Rep. 86-1. 112 pp.

Yocum, C. F.
1978 Status of the Oregon ruffed grouse in northwestern California. Calif. Fish and Game 64:124-127.

Yocum, C.F. and S. W. Harris
1975 Status, habitats, and distribution of birds in northwestern California. C. F. Yocum and S. W. Harris, Humboldt State Univ., Arcata, CA. 74 pp.

Yocum, C.F. and M. McCollum
1973 Status of the fisher in northern California, Oregon, and Washington. Calif. Fish and Game. 59:305-309.

Zeiner, D. C., W. F. Laudenslayer, Jr., K. E. Mayer, and M. White, eds.
1990a California's Wildlife, Volume I: Amphibians and Reptiles. Calif. Dept. Fish and Game, Sacramento. 272 pp.

1990b California's Wildlife, Volume II: Birds. Calif. Dept. Fish and Game, Sacramento. 732 pp.

Zweifel, R. G.
1968 *Rana boylii.* P. 71 *in* R. G. Zweifel, ed. 1974. Catalogue of American amphibians and reptiles. American Society of Ichthyologists and Herpetologists.

APPENDIX D

APPENDIX D
CALCULATION OF INDIRECT TAKE OF OWL SITES ON SIMPSON'S PROPERTY DUE TO REMOVAL OF ADJACENT HABITAT

Take (owl displacement) was defined as occurring when a stand with an owl site was entered for timber harvest. However, harvest of stands surrounding an owl site could potentially remove enough habitat to cause owl displacement, even though the stand in which an owl site was located was not harvested. Thus, we recognized and estimated the potential for additional, indirect take resulting from owl displacement when a stand with an owl site was not entered for timber harvest but nearby stands were. We first tried to estimate indirect take by using a discriminant function analysis (which used a combination of habitat variables). This approach proved to be unsuccessful (see Appendix E), so we used a simpler approach based on two variables--the amount of stands 46 years and older (considered the best potential nesting habitat on the property) and the amount of stands 31 years and older (including all potential nesting habitat, including marginal habitat, and foraging habitat). This approach was supported by analysis of 60 nest and 60 random mosaics, which indicated that nest mosaics had significantly more stands in the 31-45 and 46-60 year age classes than random mosaics.

To quantify the effect of future timber harvest on the amount of nesting habitat in owl sites we needed to know: (1) the current covertype and age-class distribution of each site and (2) the dates for which stands around each site were to be harvested. Although we did not have manually collected covertype and age-class data available for all owl sites, we did have such data for 60 nest mosaics mentioned above. These mosaics were studied in 1990 or 1991 to quantify habitat within a 0.5-mile radius (502-acre) circle of the nest tree. (The 502-acre size was chosen on the basis of work done by Meyer et al. [1990] who tested circles of various sizes in western Oregon and suggested that site selection by spotted owls was most strongly affected by habitat within an inner core of $\leq$500 acres.) To estimate the total number of sites indirectly taken, we multiplied the proportion of the 60 nest sites estimated to be indirectly taken by the total number of owl sites on or adjacent to Simpson property.

To determine which stands around each nest site were to be harvested by 2001 and the date at which such harvest was to occur, each 502-acre nest mosaic was plotted on a sourcing map used by Simpson to plan timber harvests. Of the 60 sites, 9 were among those whose nest stands were to be harvested (i.e., taken and included in the calculation of "direct" take), 26 contained mosaics not affected by timber harvest, and 25 contained mosaics with stands (other than nest stands) to be harvested by 2001. The mosaics of the latter 25 stands were then projected for the year 2001 (i.e., growth and harvest within the mosaic was accounted for) and compared to the 60 1990/1991 mosaics, particularly in relation to the amount of stands greater than 31 and 46 years old (31+ and 46+).

The 60 original (1990/1991) mosaics had a mean 352 acres of 31+, with a standard deviation of 119 acres, and a mean 239 acres of 46+, with a standard deviation of 150 acres (Table 1). We considered mosaics in 2001 to be potentially indirectly taken by timber harvest if the projected acreage of 31+ or 46+ was below the original mean minus one standard deviation for each of these age classes. Thus, if the projected acreage was below 233 acres of 31+ or 89 acres of 46+, the stand was considered to be indirectly taken. Nine sites had a projected acreage of 31+ below 233 acres, three of which also had less

TABLE 1
DISTRIBUTION OF AGE-CLASSES AND COVERTYPES IN 502-ACRE (0.5 MILE RADIUS) MOSAICS AROUND 60 1990 OR 1991 NEST SITES

	Age-Class/Covertype (in acres)				
	0-7 Years	8-30 Years	31-45 Years	46 & Over Years	Nonforest
Minimum	0	0	0	0	0
Maximum	262	453	476	500	189
Mean	42 (8.4%)	59 (11.8%)	112 (22.3%)	239 (47.7%)	49 (9.8%)
Standard Deviation	64	94	148	150	48

than 89 acres of 46+ (no other sites had less than 89 acres of 46+). For each of these nine sites, we compared the original 1990/1991 mosaic to its projected 2001 mosaic. One of the sites had more than 89 acres of 46+, but less than 233 acres of 31+. However, the acreage of 31+ was projected to increase between 1991 and 2001. Another site was projected to gain 160 acres of 31+ (with losing only 4 acres of 46+). Thus, we believed that habitat in two sites would improve by 2001 and including them as sites indirectly taken might not be inappropriate. However, to ensure that indirect take was not underestimated, the two were included in the calculations. As a result, we estimated a proportion of 9 (15 percent) of 60 nest sites to be indirectly taken by 2001.

To estimate the total number of sites indirectly taken, we multiplied the proportion above (15 percent) by the total number of owl sites on and adjacent to Simpson property (146) to yield a total of 22 sites indirectly taken. However, we regard this result as an overestimate because owl sites off Simpson's property were included in the calculation. We included these sites because they would be affected by harvest of Simpson's stands, but sites on the property have a much greater potential to be affected than sites off the property.

An exercise examining the distribution of the spotted owls on a landscape basis supported the use of 89 acres of 46+ (per 502-acre mosaic) as a threshold for determining indirect take and suggested that the 233 acres of 31+ was a high (conservation) threshold. A complete description of this analysis is in Section 2.G of the HCP, but briefly, the distribution of owls in thoroughly surveyed areas was broken into three areas: a northern portion of low owl density, a southern portion of high owl density, and regions (95 percent in the north) where no owls were present.

The proportion of stand age classes was determined for each of the areas encompassed by the three owl density categories (Table 2). To apply the results of the amount of 31+ and 46+ found in each area to the 502-acre circle, we multiplied the proportion of 31+ and 46+ found in each area by 502 acres. This yielded approximately 309 acres of 31+ in high density owl areas, 136 acres for low density areas, and 133 acres for areas with no owls. For 46+, the acreage was 184 acres for high owl density areas, 78 acres for low owl density areas, and 29 acres for areas with no owls. This suggests that for a 502-acre circle to represent an area supporting owls, a minimum value of 46+ is between 29 and 78 acres and supports the use of 89 acres as a threshold in determining indirect take as described above. Because the threshold used for 31+ (233 acres) was well below the landscape value in areas of low owl density (136 acres), we believe it represents a high, conservative threshold. It should be noted that on a landscape basis, the interaction of age classes and not just the proportion of 31+ and 46+ is important in making an area suitable for owls, but such interaction is unknown. However, due to cutting practices, mosaics comprised of stands of different ages will continually be produced. Furthermore, we examined sites projected to have more than 89 acres of 46+ (and thus determined not be taken) and found them to have future mosaics with stands well distributed among younger (0-7, 8-30 years) and older (31-45, 46+) age classes.

TABLE 2
PROPORTION OF AGE-CLASSES AND COVERTYPES BY AREAS OF OWL DENSITY

Owl Density (owls/1,000 acres)	Area in Acres	Percent Acreage/Covertype in Age Class				
		0-7 Years	8-30 Years	31-45 Years	46 & Over Years	Nonforest
1.8 (high)	75,508	16.2	13.8	25.0	36.6	8.4
0.5 (low)	66,802	6.5	61.9	11.7	15.5	4.4
0.0 (no owls)	46,449	2.4	70.0	20.7	5.8	1.1

APPENDIX E

APPENDIX E
ATTEMPT TO USE THE NESTING MOSAIC MODEL TO CALCULATE TAKE

In addition to estimating incidental take based on the number of owl sites directly affected by timber harvesting, an attempt was also made to use the nesting mosaic model to determine potential displacement of owls due to harvest of potential foraging stands within a 0.5-mile radius of owl activity centers and nest sites. The analysis focused on owl sites not projected to be harvested and entailed adapting the nesting mosaic model to distinguish between nest and random sites.

To develop the model, age-class and cover-type variables were manually measured on 0.5-mile radius (502-acre) circles drawn around 30 nest sites identified in 1990 and 30 random sites plotted on aerial photographs. Circles of some random sites included areas where owls had been located and small portions of nest circles, but they did not include known nest sites. Discriminant function analysis was then performed on the data to build a model that would classify a given owl site as a nest or random (non-nest) site. Several combinations of variables measured in the 502-acre nest and random circles were tested, and the model which best discriminated between sites included five variables: acreage of age-class 0-7 years, age-class 8-30 years, age-class 46+ years, cover-type non-forested, and number of different habitat patches (distinguished by cover-type and/or age-class). Using a combination of these variables, the model accurately classified 24 of 30 (80 percent) of the nest sites and 25 of 30 (83 percent) of the random sites, for an overall correct site classification of 82 percent ($P < 0.5$).

The model was then applied to 0.5 mile radius (502-acre) circles centered on 1991 activity centers and nest sites. Determination of displacement of owls due to timber harvest in the proximity of nest or activity centers required having maximum information on future forest management of an area. Because such information was not available for lands adjacent to Simpson property, the model was applied to 502-acre circles having at least 450 acres (approximately 90 percent) of Simpson ownership. Furthermore, a random sample of 30 nest sites and activity centers (among 47 meeting the Simpson acreage criteria) was selected to be analyzed.

The model was used to determine take of the 30 sample sites by classifying them as nest or non-nest (random) sites. An owl site was considered taken if the model classified it as a non-nest site by 2001 and not taken is the model classified it as a nest site. To extrapolate results obtained from the sample of 30 sites to all 1991 owl sites, the proportion of owls taken in the 30 sample sites containing 450 acres of Simpson property was to be applied to the remaining sites (including those containing less than 450 acres of Simpson ownership). Sites in which nest or activity center stands were directly harvested also were to be examined using the model to determine if the areas were classified as nest sites despite harvest. This analysis was to be used to evaluate whether displacement of owls was likely to be local or distant.

Although discriminant function analysis was successfully employed to forecast owl nesting habitat, it proved to be a poor tool for determining potential take of spotted owls in response to timber harvest of potential foraging areas and thus was not used to refine estimates on take based on sourcing map analysis. It was assumed that potential displacement of owls due to harvest of foraging stands would be offset by owls who remained in the same general area after their activity centers or nest stands were harvested.

One problem was that the initial model correctly classified 80 percent of 1990 sites as nesting or random sites. Thus, at best, the model would be expected to initially misclassify the status of 20 percent of owl sites. For a habitat forecast model, such an error is not critical because the model is used to show overall trends over time and is not dependent on the status of individual pieces of habitat. To calculate take, however, determining the status of each individual site, initially and over time, is paramount to estimating owl displacement. The significance of this problem was apparent when the model was applied to 30 confirmed owl sites on Simpson's property in 1991 and classified 60 percent of them as random sites. Also, examination of the behavior of the model showed that it could potentially classify an owl site as taken in the future even though no harvest occurred within its 502-acre circle.

The discriminant function analysis model was the last of a series of models developed by Simpson to calculate take of spotted owls. None of the models proved satisfactory or provided adequate insight into what level of harvesting within the 0.5-mile radius of an owl site would cause owl displacement. This inadequacy is probably due to several factors, one of which being that 500 acres may be too large an area to develop a model based on differences between nest and random sites. The 500-acre circle was chosen on the basis of work done by Meyer et al. (1990), who tested circles of various sizes in western Oregon and suggested that site selection by spotted owls is most strongly affected by habitat within an inner core of ≤500 acres. Five hundred acres, however, was the smallest size circle they tested. High densities of owls in the Simpson plan area suggest that home ranges of the birds in this area are smaller than those in western Oregon, supporting the likelihood that habitat within an area smaller than 500 acres may be important to owls on Simpson property.

The inability of the model to be an instrumental tool in determining take may also have been due to attributes of the data used to build the model, such as small sample size, not many nests from the northern ownership, overlapping random and nest circles, and nesting site data used to predict status of both nest and non-nest sites. However, a primary factor making characterization of owl nesting habitat based on vegetational analysis alone was the wide variety of habitats in which the original 30 nest sites were located. This suggests that other variables such as those pertaining to the woodrat prey base may be important in distinguishing owl habitat from non-habitat.

Simpson regards developing an appropriate owl nesting model as an evolving process and is currently analyzing data that will increase sample sizes and test the validity of previous models and their sensitivity to using plot sizes less than 500 acres. Future studies will provide more insight on habitats in the northern ownership and prey base data, which, in conjunction with vegetative data, is anticipated to greatly improve modelling abilities.

Finally, an obvious obstacle in using a model or any other technique to estimate take due to displacement of spotted owls is that no scientific study has been carefully designed to empirically determine spotted owl responses to various levels of timber harvest. The cooperative USFWS/Simpson telemetry study proposed in this plan provides an excellent opportunity to design such a study and produce. much needed answers to questions regarding potential owl displacement due to timber harvest. Data obtained from the studies would be instrumental in developing better research and management strategies for public and private lands with owl habitat.

Supplement to the Habitat Conservation Plan Dated April 15, 1992 for the Northern Spotted Owl on the California Timberlands of Simpson Timber Company

On September 17, 1992, the U.S. Fish and Wildlife Service (USFWS) signed a federal incidental take permit and implementing agreement authorizing Simpson Timber Company's California subsidiaries to displace northern spotted owls in conjunction with otherwise lawful timber harvesting. This action marked the end of nearly three years of planning and the beginning of a 30-year conservation program encompassing all of Simpson's California properties. The conservation program and the biological studies on which it is based are described in the habitat conservation plan (HCP) that was submitted with Simpson's permit application in April 1992. This supplement presents the changes to the HCP that resulted from the USFWS's review of the permit application. The changes include three refinements of conservation and mitigation measures and four clarifications of statements and data in the HCP.

A. Refinements of the Conservation and Mitigation Measures

The following refinements have been made to the conservation and mitigation measures described under "Mitigation Measures" and "Plan Implementation" on pages 21 to 25 of the Summary and on pages 192 to 205 of Chapter 4 of the HCP.

1) Special Management Area

As an additional component of the conservation program, Simpson has established a 36,500-acre special management area in which no take of spotted owls will be allowed (see description under "Clarifications Requested by USFWS" below). The area is located in the Upper Mad River subarea of Simpson's property, has been entirely surveyed for owls, is known to have at least 26 owl sites on and adjacent to Simpson's ownership, and includes four of the 39 set-asides identified in the HCP. Timber management will be allowed in the special management area outside of the four set-asides, provided that no take of spotted owls occurs. All monitoring measures that apply to set-asides also will apply to the special management area.

2) Protection of Nest Sites and Young Owls During the Nesting Season

The following provision is a clarification of the nest site protection measures described on pages 20, 22, 193, and 201 of the HCP.

> If Simpson discovers a nest site pursuant to the pre-harvest surveys required under the plan, Simpson shall (a) mark the nest tree; (b) postpone timber falling and yarding within a 0.25-mile radius until it is determined that the nest has failed or the young have left the nest; and (c) when a young owl has left the nest, postpone timber falling or yarding within 500 feet from the primary activity center of the young owl and maintain connectivity to continuous habitat until the young owl is fully capable of avoiding harvest activities.

3) Adequacy Review

The following monitoring measure has been added under "Plan Implementation" as described on pages 22 to 25 and pages 202 to 205 of the HCP.

> If, within five years after the effective date of the permit, the sum of the numbers of owl displacements identified in annual reports to USFWS exceeds two-thirds of the total estimate of take identified in the HCP for the first 10 years of the permit (50 pairs), USFWS and Simpson will undertake a review of the adequacy of existing measures to minimize and mitigate the impacts of taking.

B. Clarifications Requested by USFWS

During the review of the permit application, USFWS requested and was provided the following information: (a) an expanded discussion of why future stands would likely support spotted owls; (b) data on the distribution of nest sites within different age-classes, (c) a description of the characteristics of stands 50 years olds, and (d) a description of the special management area.

1) Expanded Discussion of the Future Habitat Issue

The following discussion of the future habitat issue is intended to clarify and supplement the information provided in Chapters 2 and 3 of the HCP and to respond to questions raised during the review process.

A primary issue raised in the review of the permit application was whether timber stands on Simpson's property would provide suitable nesting habitat for northern spotted owls in the future. More specifically, two interrelated concerns were expressed: (1) will the stands that mature into the 46+ age-class during the permit period be capable of supporting spotted owls in a way that is comparable to existing conditions? and (2) what is the risk to spotted owls if the answer is no? Since a mandatory review of permit terms and conditions would occur at the end of the first ten years, the scope of this concern can be narrowed to the risks posed by allowing removal of existing habitat between now and 2002. The question then becomes: what is the probability that in 2002 the youngest stands currently in the 46+ age-class and stands currently 31 to 45 years old will have the characteristics of stands currently used by spotted owls?

Two facts supported by data and analysis in the HCP provide a reasonable basis for assuming that the younger stands will become suitable for spotted owls.

1. Nest sites currently in the plan area are not concentrated in older stands (60+ years) and occur in stands as young as 35 years; and

2. The 77,400+ acres of stands currently in the 31-45 age-class are regrowth in areas that were logged prior to 1960 and inherently have key characteristics of occupied owl habitat in the plan area.

Regarding the distribution of nest sites in different age-classes, 16 (53 percent) of 30 nest sites studied in 1990 were located in stands 31 to 60 years old, with 7 in the 31-45 age-class and 9 in the 46-60 age-class (see Table 18 on page 112 of the HCP). Data provided at USFWS's request on these sites plus an additional 30 nests (see "2)" below) show a similar pattern. Of 60 sites, 36 (60 percent) were in stands 35 to 65 years old, with 23 in the 35-55 age-class and 13 in the 56-65 age-class. These data demonstrate that owl sites are not concentrated in the older stands and that the occurrence of nest sites in the younger stands is not an exception to the rule on Simpson's property.

The premise that the 31-45 age-class is potential owl habitat also is supported by the history of the stands, which dates back to logging that occurred between 1946 and 1960. As discussed in the HCP (page 60), these stands are largely the result of logging that removed old-growth timber in two to four harvests over 10 to 20 years.

Conifer restocking was not always successful, and in some areas hardwoods became more predominant. As a result, these stands inherently have key characteristics of occupied owl habitat on the property, such as residual older trees, a hardwood component, and more than one cover type (see HCP Section 2.G).

Given the presence of owl sites in and the characteristics of the 31-45 age-class, it is reasonable to consider these stands potential spotted owl habitat. Moreover, such stands cover more than 77,400 acres -- 10,000 more than the 67,200 acres of stands currently 46+ (Table 36 on page 158 of the HCP). This "bank" of potential habitat provides added assurance that displaced and dispersing spotted owls will have access to suitable habitat within the plan area for the foreseeable future.

2) Supplemental Data on the Distribution of Nest Sites among Age-Classes

As noted in the HCP (page 107), Simpson classified stands aged 46 and older as the best roosting and nesting habitat on the property. This classification was based on analysis of 60 nest stands, which showed that nests were in stands as young as 35 years old with a residual component of older trees and in stands as young as 46 years old regardless of their silvicultural history (even or uneven age management). The data below (and Table 18 of the HCP) demonstrate that nests were distributed throughout the range of ages in the 46+ category and were not concentrated in the older age-classes.

Age Class (years)	Nests (number)
35-45	11
46-55	12
56-65	13
66-75	12
76-100	4
101-200	2
Old Growth	6
Total	60

Preliminary analysis showed no correlation of reproductive success to nest stand age.

It should be noted that the data above and in Table 18 include sites identified in Simpson's early owl surveys and studies, which were concentrated in older stands where timber harvest was likely to occur. Since the completion of the 1990-1991 nest studies, proportionately more nests have been found in younger stands.

3) Description of Stands at Age 50

The majority of Simpson's timberlands (75 percent) can be grouped into one of three forest type/site class associations: redwood site class II, redwood site class III, and Douglas-fir site class III. The following paragraphs briefly describe the forest structure and composition that can be expected to develop on these species/site combinations by age 50. It is assumed that intensive forest management practices will be applied wherever possible to ensure that stands continue to grow and develop at close to their maximum potential. It also should be noted that, for most stand and site conditions, Simpson's management practices are designed to produce stands that contain 200 to 250 conifer stems >5 inches dbh per acre.
In redwood/site class II forests, the dominant redwoods in a stand will average 115 feet in height at 50 years and the average diameter of all conifers will be approximately 18 inches. The overstory will be dominated by redwood, but other conifer species, principally Douglas-fir, will occur as secondary components. On north slopes and in riparian areas, red alder may occur as an intermediate or codominant. Tanoak will make up a small percentage of the stands, and, for the most part, share the understory with suppressed and intermediate redwood trees, huckleberry, salal, salmonberry, and ferns. Stands will contain 350 to 400 square feet of basal area per acre. Due to the relatively large degree of variation associated with redwood stands, tree diameters will vary considerably; dominants will often exceed 24 inches in diameter whereas suppressed individuals will have diameters less than 6 inches.

On medium redwood sites (site class III), dominant conifers will average 95 feet in height at 50 years and the average diameter of all conifers will approach 16 inches. The overstory composition of these stands will be similar to that described above for site class II stands, but with some increase in the percentage of Douglas-fir and the emergence of tanoak as an occasional intermediate crown class component. Salmonberry and ferns will no longer be common understory components and ceanothus subspecies will appear. On average, stands will contain approximately 300 to 350 square feet of basal area per acre. Diameter distributions will contain trees as small as six inches and greater than 22 inches.

Most of Simpson's Douglas-fir stands are classified as site class III timberlands. Douglas-fir will dominate the overstory, with tanoak or madrone occurring as scattered codominants and intermediates. The understory will be predominantly tanoak, madrone, and ceanothus subspecies. Dominant conifers at age 50 will average 100 feet in height and the average diameter of all tress will approach 14 inches. Most stands will contain between 200 and 250 square feet of basal area per acre. In general, the diameter distributions of Douglas-fir stands will be much more homogeneous (i.e., bell-shaped) than their redwood counterparts. Most trees will have diameters between 8 and 20 inches.

4) Description of the Special Management Area

The special management area consists of portions of the Wiggins and Hunter/Bliss ranches in the Upper Mad River subarea of the plan area (see pages 54 to 62 of the HCP).

a) Location, Cover Types, and History

The Upper Mad River subarea comprises Simpson's ownership within the Mad River drainage south of the line between Townships (T) 4N and 5N, plus Sections 34 and 35 in T5N-R3E. These holdings are located 17 to 36 miles from the coast and vary in elevation from 400 to 4,600 feet. All but 2,000 acres are on the east side of the Mad River drainage, extending at various points to the divide between Mad River and Redwood Creek.

Except for a 580-acre parcel at the extreme southern end and a few small interior parcels held by other owners, Simpson's holdings in this area are contiguous, forming two linked blocks. The property is bordered on the north, west, and south by small private holdings and ranches and on the east by Six Rivers National Forest, Simpson's Upper Redwood Creek properties, and some smaller private holdings.

Except for the northeastern corner, the entire property is outside of the coastal redwood zone. Distance from the coast, elevation, and predominantly south to west aspects of the property have produced a natural mosaic of Douglas-fir/hardwood mixtures, pure hardwood stands, and prairies. At higher elevations (ca. 4000+ feet), white fir, ponderosa pine, and incense cedar become common stand components. The hardwood element transitions from predominantly evergreen habitat mixed with red alder in the north to a deciduous hardwood type in the south, with a pronounced change around the north/south midline of the property.

Simpson acquired the bulk of this ownership in two major acquisitions, and the names of the former properties persist as labels. The northern block (about 19,000 acres) is known as the Wiggins Ranch; the southern block (about 17,500 acres) as the Hunter/Bliss Ranch. The two blocks have fairly distinct vegetative patterns and stand structures, reflecting both natural conditions and past logging practices.

About one-half of the Wiggins Ranch (T4N and T5N) is conifer forest, with the balance nearly evenly divided between hardwood stands and prairies. The area was logged by various owners primarily between the late 1940s and late 1960s. Some scattered logging activity persisted through the early 1970s, and in 1991 Simpson harvested 75 acres of timber acquired by trade from the Six Rivers National Forest. However, most of the harvesting activity that defined current cover types occurred by 1960. It appears that reforestation efforts were not undertaken prior to

Simpson's ownership, resulting in a shift from a Douglas-fir/hardwood dominated landscape to hardwood/Douglas-fir types over most of the area. The vegetative structure also changed, shifting from a two-layered mature conifer/hardwood forest to a closed, single layer canopy of dense hardwood and Douglas-fir young growth. No old-growth conifer stands remain, but isolated residuals and snags are scattered throughout most of the area. Grasslands in the area are currently leased to a local rancher and used for grazing.

The Hunter/Bliss Ranch is about 40 percent conifer forest, 40 percent hardwood forest, and 20 percent grassland. Prior to Simpson's acquisition of this tract in 1959, standing timber over 18 inches diameter at breast height (dbh) was sold and logged by the purchaser between the early 1950s and late 1960s. This logging appears to have removed only the highest quality timber on the milder slopes, leaving behind a significant number of trees over the diameter limit. Simpson's only timber harvesting occurred during 1975 and 1976 and was concentrated in a few units on the north end of the tract. As a result of this management history, residual old-growth is patchily distributed in the area and occurs at densities that vary from a few trees per acre to some small stands that have barely been impacted by logging. Post-logging sites have been invaded by grass and hardwoods, resulting in an understory composition that contains varying amounts of Douglas-fir regeneration. As at the Wiggins Ranch, grasslands are leased to ranchers and currently used for grazing.

b) Owl Sites and HCP Set-Asides

The entire special management area has been surveyed for spotted owls and found to have at least 26 owls sites on and immediately to Simpson's property (16 on, 10 off). The maximum distance between owl sites in the area is 1.5 miles. In 1991, 18 pairs were found (12 on the property, 6 off), with 14 nesting (9 on, 5 off) and fledging 12 young (7 on, 5 off). In 1992, 22 pairs were found (14 on, 8 off), with 16 nesting (11 on, 5 off) and fledging at least 19 young (14 on, 5 off).

Four of the 39 set-asides identified in the HCP (see pages 196 to 201) are in the special management area. Combined, the four set-asides include a total of 3,223.8 acres: 168.4 acres in Humbug Creek, 371.7 acres in Bug Creek, 681.2 acres in Little Deer Creek, and 2005.5 acres in Boulder Creek. As of June 30, 1991, these set-asides contained nine owl sites, one each in Humbug and Bug Creeks, two in Little Deer Creek, and five in Boulder Creek.