Experimental Removal of Barred Owls to Benefit Threatened Northern Spotted Owls

Final
Environmental Impact Statement

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Executive Summary

This Final Environmental Impact Statement (Final EIS) describes and evaluates nine alternatives for an experimental removal of northern barred owls (*Strix varia varia*) (barred owl) on a scale sufficient to determine if the removal would increase northern spotted owl (*Strix occidentalis caurina*) (spotted owl) site occupancy and improve population trends. Results from these experiments would be used by the U.S. Fish and Wildlife Service (Service) to inform future decisions on potential long-term management strategies for barred owls.

S.1 Background

The purpose of the proposed action is to conduct research on the effects on spotted owls of the removal of barred owls. This research would require we obtain a permit under the Migratory Bird Treaty Act for scientific collection of barred owls, a Federal action. As a component of the issuance of that permit we are conducting a National Environmental Policy Act (NEPA) review. Because of the scope and controversy over the potential removal of a number of barred owls from the wild, we developed this Final EIS. We are also conducting a consultation under section 7 of the Endangered Species Act (ESA). Depending on the study area and land management agency involved, the experiment may require additional Federal and State permits. Any experiment on National Parks or Recreation Areas would require a research permit. Study areas on National Forests may require a special use permit. This Final EIS may serve as the NEPA documentation for issuance of these permits.

In the most recent review of the condition of northern spotted owls, the Revised Recovery Plan for the Northern Spotted Owl (Revised Recovery Plan) (USFWS 2011, entire) identified past habitat loss, current habitat loss, and competition from the recently arrived barred owls as the most pressing threats to the northern spotted owl (USFWS 2011, p. I-6.).

The Revised Recovery Plan states, “Barred owls reportedly have reduced spotted owl site occupancy, reproduction, and survival. Limited experimental evidence, correlational studies, and copious anecdotal information all strongly suggest barred owls compete with spotted owls for nesting sites, roosting sites, and food, and possibly predate spotted owls…. Because the abundance of barred owls continues to increase, the effectiveness in addressing this threat depends on action as soon as possible” (USFWS 2011, p. III-62).

Barred owls are native to eastern North America, but only recently arrived in the West. They were first documented in the range of the northern spotted owl in Canada in 1959 and in western Washington in 1973. The range of the barred owl in the western United States now completely overlaps with the range of the northern spotted owl. We observe that as the number of barred owls detected in historical spotted owl territories increase, the number of spotted owls decrease. In the Pacific Northwest, barred owl populations developed first in Washington and spotted owl populations have declined at the greatest rate in these areas.

Although northern spotted owl populations have been declining for many years, the presence of barred owls exacerbates the decline. Recent studies (Olson *et al*. 2005, p. 918; Forsman *et al*. 2011a, pp. 69-70, 75-76) have established negative relationships between barred owl presence and declines in spotted owl population performance across the range of the subspecies. This could result in the extirpation (local extinction) or near extirpation of the northern spotted owl from a substantial portion of their historical range, even if other known threats, such as habitat loss, continue to be addressed. Given the continuing range expansion and population growth of barred owl populations in the western United States and concurrent decline in northern spotted owl populations, information on the effectiveness of a removal program is urgently needed.

Recovery Action 29 in the Revised Recovery Plan focuses on acquiring the information necessary to help identify effective management approaches and guide the implementation of appropriate management strategies for barred owls. It proposes experimental removal of barred owls to determine if the removal would increase spotted owl site occupancy and improve population trends (USFWS 2011, pp. III-62, III-65).

> *"Recovery Action 29: Design and implement large-scale control [removal] experiments to assess the effects of barred owl removal on spotted owl site occupancy, reproduction, and survival.*

While the evidence of threat is strong and very persuasive, it is not yet sufficient for the Service to consider undertaking a wider removal effort. We need data on the effectiveness of barred owl removal in improving spotted owl population trends, as well as the efficiency of removal as a management tool. Conducting this experiment would allow us to develop a better understanding of the impacts barred owls are having on spotted owl populations. It would also allow us to determine our ability to reduce barred owl populations at a landscape level to permit spotted owl population growth. Finally, it would allow us to estimate the cost of barred owl removal.

This Final EIS is specific to implementation of Recovery Action 29—implementation of large-scale removal experiments to assess the effects of barred owl removal on spotted owl populations. This Final EIS is limited to addressing this portion of the barred owl threat, the removal experiment. The Service anticipates using the information from this experiment to assist with future barred owl management decisions. We have no specific direction for future management at this time, nor would the results of this experiment trigger any automatic actions. Future decisions could range from no active management of barred owls to a mix of strategies, including barred owl removal, other methods to reduce barred owl populations, or methods to change the competitive advantage of barred owls. Even if removal of barred owls is chosen as a component of barred owl management, this could range from small removal efforts in specific areas and over short time frames to landscape-level removal efforts for long periods, periodic removal programs, or other actions as yet not described. If a decision is made to manage barred owl populations in the future, implementation would be preceded by completion of any necessary legal requirements and NEPA compliance.

S.2 Purpose of and Need for the Action

The purpose of the proposed action is to contribute to fulfilling the intent of the Act by rapidly implementing experimental research necessary for conservation of the spotted owl in accordance with Recovery Action 29 of the Recovery Plan (USFWS 2011, p. III-65). More specifically, the purpose of the proposed action is to: (1) obtain information regarding the effects of barred owls on spotted owl vital rates of occupancy, survival, reproduction, and population trend through experimental removal; (2) determine the feasibility of removing barred owls from an area and the amount of effort required to maintain reduced barred owl population levels for the duration of the experiment; (3) estimate the cost of barred owl removal in different forested landscapes; and (4) develop the information necessary to make a future decision about the management of barred owls as expeditiously as possible.

The need for the action is that we lack desired information to: (1) determine the response of spotted owl site occupancy, survival, reproduction, and population trend to barred owl removal; (2) evaluate whether barred owls can be effectively removed from an area and level of ongoing removal required to maintain low population levels of barred owls; (3) determine the cost of removal in different types of forested landscapes to inform future management decisions; and (4) inform timely decisions on whether to move forward with future barred owl management.

S.3 Description of the Proposed Action

The proposed action is to conduct an experiment to provide scientifically rigorous results regarding the effects of barred owls on the spotted owl vital rates of occupancy, survival, reproduction, and population trend through experimental removal, and determine the feasibility of experimental removal of barred owls.

All action alternatives include the same experimental approach. Each study area is divided into two comparable portions; barred owls are removed from the treatment area and left in the control area. All areas are surveyed for spotted and barred owls. Spotted owl population data is compared between the control and treatment areas to determine if removal of barred owls in the treatment area resulted in a significant change in spotted owl population dynamics.

Potential study areas were selected from across the range of the northern spotted owl in Washington, Oregon, and California, and may include ongoing spotted owl demographic study areas, inactive spotted owl demographic study areas, or additional areas with varying levels of past spotted owl surveys. Most study areas are focused on Federal lands, including areas within National Forests, Bureau of Land Management managed lands, and National Parks and Recreation Areas (North Cascades National Park, Ross Lake National Recreation Area, Lake Chelan National Recreation Area, Olympic National Park, and Mount Rainier National Park). Some wilderness areas may be included. We are also considering a study area on the Hoopa Valley Indian Reservation. In some cases, interspersed private and State lands may occur within the boundaries of the study area. Where possible, we would seek cooperation from nonfederal landowners. Nonfederal lands would be included in the active experiment only if the landowners are willing.

The experiment will run until sufficient information is gathered to determine the effects of the removal of barred owls on spotted owl population trends. The experiment will begin as soon as possible, and results will be reviewed annually to determine when data are sufficient to answer the research questions. Removal activities will end when data are sufficient to meet the purpose and need. We set a maximum duration of 10 years of barred owl removal for the experiment. If the experiment has not provided enough information to reach a conclusion within 10 years, it is likely that removal of barred owls is not achieving the desired goal, thus other avenues should be considered and the experiment ended.

S.4 Considerations Used in Developing the Alternatives

S.4.1 Number of Study Areas

The alternatives range from 1 to 11 study areas. An experiment involving a single study area is logistically simpler to conduct, but would not fully represent the diversity of physical features, habitat types, barred owl density, and invasion history across the range of the northern spotted owl. Given that each study area represents a single experiment, a single study area does not provide for any replication, and results from a single study area may not be representative of effects of barred owl removal in other parts of the northern spotted owls' range. Multiple study areas have greater total costs and require more complicated logistics, but can better represent the range of conditions experienced by spotted owl populations, allowing better inferences across their range. Multiple areas also allow for replication of results. By providing alternatives with an array from 1 to 11 study areas, we can evaluate the costs and benefits of these different approaches.

S.4.2 Distribution of Study Areas

In alternatives with more than one study area, we selected from different portions of the northern spotted owl's range to best represent the variation in conditions across the range. We considered the following information:

- *History of barred owl presence.* Study areas in the north were invaded by barred owls earlier and have a longer history of barred owl site occupancy than areas in southern Oregon and northern California.
- *Current density of territorial barred owls.* Study areas in the north have generally higher densities of barred owls than study areas in southern Oregon and northern California, though this varies by study area.
- *Current density of territorial spotted owls*. Spotted owl population levels and site occupancy on study areas have declined substantially and are declining in northern Oregon. In southern Oregon and northern California, spotted owl populations and site occupancy are higher, but are declining on most study areas.

- *Different habitat types.* Spotted owl habitat varies across its range. There are large differences in habitat type between wet and dry forests (west to east) and between areas north and south of the Klamath Physiographic Province in Oregon.
- *Differences in spotted owl food habits.* North of the Klamath Physiographic Province in Oregon northern flying squirrels represent a primary food source for spotted owls. South of the Klamath Province the dusky-footed woodrat is a primary food source.

Based on these considerations, we divided the range of potential study areas into three basic regions: Washington, northern Oregon, and southern Oregon/northern California.

S.4.3 Type of Study

All experiments described in the alternatives are based on a treatment (removal) and control (non-removal) study design. Under this approach, study areas are divided into two comparable segments. Barred owls are removed from the treatment area but not from the control area. Spotted owl population parameters (e.g., site occupancy, demographic performance, population trend) are estimated using the same methodology in both areas and the population measurements are compared between the treatment and control areas.

Johnson *et al.* (2008, entire) described four basic study designs for barred owl removal experiments to evaluate potential effects on spotted owls: demographic studies, occupancy studies, site-specific studies, and invasion studies. We considered all of these approaches in developing the alternatives, and are proposing to utilize both a demographic and occupancy study approach.

DEMOGRAPHIC STUDY APPROACH. In demographic studies, individual spotted owls are banded with a uniquely numbered leg band and a uniquely colored leg band. Territories are surveyed every year in an effort to determine if the individual is still alive and present. Using this information, scientists can calculate survival and recruitment rates (the rate at which new individuals are added to the population). From this they can estimate the annual population growth rate of spotted owls on the study area (Forsman *et al.* 2011a, p. 8). Additionally, in most demographic studies data on the number of young fledged per year are recorded, allowing for examination of effects on spotted owl reproduction. A primary goal of this approach is to compare changes in population growth rates between treatment (removal) and control (non-removal) areas, with the untreated control areas used to distinguish population changes that might be occurring for other reasons.

A demographic experimental approach has several advantages. It allows us to estimate annual population growth rate for treatment and control areas and assess the effects of barred owl removal on spotted owl population trends. Because individual spotted owls are tracked, we can measure the underlying vital rates (e.g., annual survival and recruitment of new individuals into the population) of the population and determine which of these are influenced by barred owl competition (Johnson *et al.* 2008, p. 19).

However, the demographic experimental approach has some limitations. It requires the capture, banding, and following of individual spotted owls, a relatively intensive method of data collection.

OCCUPANCY EXPERIMENTAL APPROACH. In occupancy studies, spotted owl sites are monitored rather than individual owls (individuals are not banded). Scientists use the presence or absence of spotted owl detections, based on auditory surveys, to determine whether sites are occupied or not. In its simplest form, we record only presence or absence of spotted owl detections, though we can choose to gather information on the number of young produced on each site. Presence/absence data can be used to estimate the rate of population change if the study area is surveyed consistently. This approach provides less information on how the barred owl removal changes the spotted owl population dynamics than the demographic approach; because we cannot determine which vital rate (annual survival or recruitment) has changed in response to barred owl removal. Because individual spotted owls are not banded or followed, we cannot tell if any observed change occurs because individuals are on average surviving longer, or because they are constantly replaced.

An occupancy experimental approach has several advantages. It is a relatively simple process, only requiring comparable surveys on the treatment (removal) and control (non-removal) portions of the experiment. There is no need to capture, band, or relocate individual owls. The occupancy experimental approach has some limitations. Data collected in an occupancy experiment can be used to provide estimates of site occupancy and potentially the rate of population change, but do not provide estimates of annual survival or recruitment. Therefore, we cannot identify which vital rates (survival or recruitment) are most affected by barred owl competition, and obtain less information about the biological mechanisms of interspecies competition than with demographic studies (Johnson *et al.* 2008, p. 19). The lack of banded or individually identified spotted owls delays our ability to detect sink population dynamics, situations where site occupancy is high because a series of individuals continue to occupy the site while the overall population declines. Site occupancy may remain high and the actual loss of birds go undetected until the source of non-territorial spotted owls to fill behind territorial spotted owls is exhausted. Because we intend to terminate the experiment once we have statistically significant data, we could miss the actual population decline altogether. Additionally, occupancy studies provide data and conclusions with a lower ability to detect differences (strength of inference) than the demographic approach, given that few study areas have pretreatment data.

All experimental approaches and action alternatives include the following three basic components:

- Survey spotted owls—survey the entire study area using spotted owl recorded calls and current demographic survey protocols. The data collected varies by type of experiment.
- Survey barred owls—survey the entire study area using barred owl recorded calls to define barred owl density and locate barred owl sites.
- Remove barred owls—using the process described below; remove all barred owls from the treatment area.

S.4.4 Removal Method

All experiments described in the alternatives would substantially reduce barred owl populations in portions of the proposed study areas through the removal of barred owls. All removal methods would avoid removing breeding barred owls with dependent young. There are two basic methods to remove barred owls: lethal and nonlethal.

LETHAL REMOVAL METHOD. We selected a procedure for lethal removal that is as humane and efficient as possible. It is designed to minimize the risk of accidental removal of other species, particularly northern spotted owls and other listed species. The procedure is designed to maximize the potential for specimens to be collected and used for other scientific purposes, within the constraints of a quick and humane death. The general approach involves attracting territorial barred owls with recorded calls and shooting birds that respond when they approach closely

NONLETHAL REMOVAL METHOD. As with lethal removal, we designed a nonlethal removal method that is as humane as reasonably possible and reduces stress on the birds. To accomplish the experiment, any barred owls captured must be removed completely from the study area. To avoid undue stress and problems with inadequate housing, we require that we have a destination ready to take the birds before any capture is attempted. The procedure minimizes the risk to other species, though this is less of an issue with capture as non-target species can be removed from the capture apparatus and released in most cases. The approach involves attracting territorial barred owls with a recorded call, and catching the responding birds in nets or other trapping devices. Birds would be transported to temporary holding facilities, checked for injuries or other health concerns, stabilized, and transported to permanent facilities or release locations.

COMBINED REMOVAL METHOD. A combination of lethal and nonlethal removal may be applied on a single study area. In this instance, we would capture enough birds to meet placement opportunities and remove the remaining birds lethally.

S.5. The Alternatives

In addition to the No Action Alternative, we developed a Preferred Alternative and seven additional action alternatives, two with sub-alternatives, based on an array of considerations. These alternatives span the feasible and reasonable approaches to meeting the purpose and need described in Chapter 1 of this Final EIS. The alternatives vary in number of study areas, distribution of those study areas, type of study, method of removal, and presence or absence of pretreatment data.

S.5.1 No Action Alternative

Under the No Action Alternative, no experimental removal would be conducted by the Service. This would not prevent others from proposing such studies and seeking the necessary permits, but there is no guarantee that any such efforts would occur.

S.5.2 Action Alternatives

The action alternatives vary by location and number of study areas (1 to 11), type of experiment (demographic or occupancy), and removal method (lethal or combined). We did not include the nonlethal removal method because, based on early efforts, we do not anticipate being able to find placement for more than 100 barred owls. All the action alternatives require the removal of more than 100 barred owls. Since we would not capture barred owls without a location ready to accept them, none of the alternatives could be implemented if limited to nonlethal removal. Because of the limitations placed on using nonlethal removal methods for the experiment, the limited options for placement of captured birds, the stress on the birds, and the likely outcome if released elsewhere, use of nonlethal removal as the sole removal method in the experiment is not included in the action alternatives.

S.5.2.1 Preferred Alternative

This alternative involves a demographic study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on four study areas with pre-treatment demography data spread across the range of the northern spotted owl, including the Cle Elum in Washington, one-half the combined Oregon Coast Ranges and Veneta in northern Oregon, the Union/Myrtle in southern Oregon, and the Hoopa (Willow Creek) in California. Given the size and number of spotted owl sites in the combined study areas, this alternative would require an estimated duration of 4 years of barred owl removal to detect significant results.

S.5.2.2 Alternative 1

This alternative involves a demographic study approach using lethal removal methods. This experiment would be conducted on a single study area, out of the nine ongoing spotted owl demographic study areas. We are considering the use of any one of these nine areas and are analyzing the effects for each area. The estimated duration of barred owl removal for this alternative varies from 4 to 7 years by study area, due primarily to the size of the study area and the number of spotted owl sites. Smaller study areas or areas with fewer spotted owl sites would take longer to detect statistically significant results.

S.5.2.3 Alternative 2

This alternative involves a demographic study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on three study areas spread across the range of the northern spotted owl. To ensure that this represents the various conditions across the range of the northern spotted owl, the three study areas would be distributed such that one in Washington, one in northern Oregon, and one in southern Oregon or northern California. Given the size and number of spotted owl sites in the combined study areas, this alternative would require an estimated duration of 4 years of barred owl removal to detect significant results.

S.5.2.4 Alternative 3

This alternative involves a demographic study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on two study areas in Oregon that are not spotted owl demographic study areas, but that have data to allow an estimate of pretreatment spotted owl population trends: Veneta and Union/Myrtle. The Union/Myrtle area has long-term monitoring data and the Veneta area has research and monitoring data that would allow us to estimate pretreatment spotted owl population trends and survival rates. Both have current or recent data on most spotted owl sites and banded spotted owls. Because they are relatively small, we paired these treatment (removal) areas with control (non-removal) areas on adjacent ongoing spotted owl demographic study areas. The Union/Myrtle area would be paired with the Klamath Spotted Owl Demographic Study Area; the Veneta area would be paired with a comparable portion of the Oregon Coast Ranges and Tyee Spotted Owl Demographic Study Areas. Given the size and number of spotted owl sites in the two study areas, this alternative would require an estimated duration of 4 years of barred owl removal to detect statistically significant results.

S.5.2.5 Alternative 4

This alternative involves a demographic study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on two study areas that lack current demographic data—Columbia Gorge in Washington and McKenzie in Oregon. These two study areas have some past and current spotted owl survey data.

Alternative 4 includes two sub-alternatives. Under sub-Alternative 4a, we would take time to gather pretreatment demographic data before beginning the removal portion of the experiment. Under sub-Alternative 4b, we would start removal on the treatment portion of the study area after year 2, immediately after establishing a population of banded spotted owls, and rely on differences between the control and treatment areas to determine the effects of removal. Lack of pretreatment data reduces the strength of the experimental approach.

Sub-Alternative 4a would require 5 years of pre-removal data collection to establish demographic values (population trend, survival, recruitment), and 5 years of barred owl removal to establish changes in these demographic measures between the control and treatment areas, for a total of 10 years. Sub-Alternative 4b would require approximately 8 years: 2 years to develop a population of banded spotted owls for analysis, and 6 years of barred owl removal to develop the demographic measurements and detect differences between the control and treatment areas.

S.5.2.6 Alternative 5

This alternative involves an occupancy study approach using lethal removal methods. Occupancy studies can be done as simple occupancy (presence or absence of spotted owls on each site) or, with added effort, we can add information on reproductive success. This experiment would be conducted on three study areas with existing and recent occupancy data distributed across the range of the northern spotted owl. We selected the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas for this alternative. As described in Alternative 3, the Veneta and Union/Myrtle areas would be treatment (removal) areas paired with control (non-removal) areas on adjacent ongoing spotted owl demographic study areas.

Given the size and number of spotted owl sites on the three study areas, a simple presence/absence occupancy experiment would require 3 years of barred owl removal to detect differences between the control and treatment areas (Option 1). If we add reproductive success to the experiment, it would require an additional 2 years, bringing the duration to 5 years of barred owl removal (Option 2).

S.5.2.7 Alternative 6

This alternative involves an occupancy study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on three study areas that do not have current occupancy data. The McKenzie and Horse/Beaver Study Areas would contain both treatment and control areas. Removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area with a control (non-removal) area on the Olympic Peninsula Spotted Owl Demographic Study Area. These cover the three regions of the spotted owl range described in Alternative 2.

Alternative 6 includes two sub-alternatives. Under sub-Alternative 6a, we would take time to gather pretreatment occupancy data before beginning the removal portion of the experiment. Under sub-Alternative 6b, we would start removal on the treatment portion of the study area immediately and rely on differences between the control and treatment areas to determine the effects of the removal. Lack of pretreatment data reduces the strength of the experimental approach.

Sub-Alternative 6a would require 3 years of pre-removal data collection to establish occupancy values and 3 years of barred owl removal data to establish changes in occupancy between the control and treatment areas, for a total of 6 years for simple occupancy data, and 2 additional years of barred owl removal if we add reproductive success measurements. Sub-Alternative 6b would require approximately 4 years of barred owl removal for simple occupancy, and 2 additional years of barred owl removal if we add reproductive success measurements.

S.5.2.8 Alternative 7

This alternative involves both demography and occupancy study approaches, depending on the study area, using a combination of lethal and nonlethal removal methods. For this experiment, we selected a total of 11 study areas. We attempted to select one from each physiographic province to provide stronger information from across the range of the northern spotted owl. In some cases, where study areas have few potential spotted owl sites, more than one was selected within a province to provide sufficient sample size. In very large provinces, additional study areas were included to provide better distribution of results.

For most study areas we estimated the duration of barred owl removal based on the time required to detect achieve significant results relative to the effects of removal on spotted owls. These vary from 3 to 10 years. For four study areas spread across the range of the spotted owl, we chose to continue the barred owl removal for 10 years to determine if there were any different long-term effects of removal. For example, whether observed changes in spotted owl populations continue past the initial phase, taper off, or even reverse after the initial years of the experiment.

S.6. Action Area

For this Final EIS, the action areas are the study areas, and the action area for each alternative is made up of a combination of study areas. One study area may occur in more than one alternative, and alternatives may have more than one study area in the action area. In most cases, each study area is independent—actions on one study area do not affect those on other study areas. This is due to the distance between study areas and the lack of significant effects of the experiment beyond the study area boundary.

The study areas include Ross Lake, Wenatchee, Cle Elum, Olympic Peninsula, Olympic Revised (Olympic Peninsula), Rainier, Cowlitz Valley, and Columbia Gorge in Washington; Oregon Coast Ranges, Veneta (Oregon Coast Ranges/Tyee), Tyee, McKenzie, HJ Andrews, Union/Myrtle (Klamath), Klamath, South Cascades, and Rogue Cascade (South Cascades) in Oregon, and Horse/Beaver, Goosenest, Hoopa (Willow Creek), and Corral in California.

S.7. Environmental Consequences

For this Final EIS, we conducted an analysis of the potential effects to the human environment (environmental consequences and cumulative effects). We identified potential effects for the following resource areas: barred owls, northern spotted owls, other species, social and ethical, economic, cultural resources; and recreation and visitor use, and are summarized below. We determined no potential for effects to the remaining resource areas such as air, water, and wetlands.

S.7.1 Effects on Barred Owls

Under the No Action Alternative no barred owls would be removed from this experiment. The lowest number of barred owls we estimate would be removed, 321, occurs if we chose the Hoopa (Willow Creek) Study Area in Alternative 1. The highest estimated number, 8,892, would be removed under Alternative 7 (Table S-1). Under the Preferred Alternative, we estimate the removal of 3,603 barred owls over the course of a 4 year experiment.

There are no estimates of the total population of barred owls in the range of the northern spotted owl or throughout their range in North America with to compare these values. Therefore, to provide the regional and rangewide context, we considered the percent of habitat from which barred owls would be removed. Because no habitat estimates exist for barred owls, we used spotted owl habitat as a conservative estimate within the range of the northern spotted owl.

The smallest treatment area from which barred owls would be removed occurs if we chose the Tyee Study Area in Alterative 1. Removal would occur on approximately 0.31 percent of the habitat in the range of the northern spotted owl and 0.01 percent of the range of the barred owl. The largest treatment area occurs in Alternative 7, approximately 6.55 percent of the habitat in the range of the northern spotted owl and 0.20 percent off the range of the barred owl. Under the Preferred Alternative, removal would occur on 1.72 percent of the habitat in the range of the northern spotted owls and 0.05 percent of the range of the barred owl.

Table S-1. Summary of the estimated number of barred owls removed, percent of habitat in the range of the northern spotted owl, and percent of habitat in the range of the barred owl.

Alternative/ Sub-Alternative	Estimated Barred Owls Removed During Experiment	Percent of Total Habitat within Range of Spotted Owl [1]	Percent of North American Range of Barred Owl [2]
Preferred Alternative	3,603	1.72	0.05
Alternative 1	321 to 2,242	0.31 to 1.59	Less than 0.01 to 0.05
Alternative 2	1,450 to 5,784	1.33 to 3.90	0.04 to 0.12
Alternative 3	2,003	1.13	0.04
Sub-Alternative 4a	2,183	1.42	0.05
Sub-Alternative 4b	2,509	1.42	0.05
Alternative 5	2,494 to 3,463	2.05	0.07
Sub-Alternative 6a	2,007 to 2,787	2.08	0.10
Sub-Alternative 6b	2,397 to 3,175	2.08	0.10
Alternative 7	8,892	6.55	0.20

[1] Approximately 12,104,100 acres of spotted owl habitat occurs within the range of the northern spotted owl. We use spotted owl habitat as a surrogate for barred owl habitat which has not been mapped or defined.
[2] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

S.7.2 Effects on Northern Spotted Owls

Depending on the study area(s) chosen, the percentage of spotted owl habitat from which barred owls would be removed ranges from 0.31 percent to 6.55 percent, and between 38 and 630 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. The Preferred Alternative would remove barred owls from 1.72 percent of the habitat in the range of the northern spotted owls, and effect up to 363 potential spotted owl sites in the treatment areas. The magnitude of positive effect would vary based on current barred owl population levels, likely being greatest where barred owl densities are low enough to have allowed some spotted owls to persist on the treatment area. The proportion of spotted owl sites with barred owl detections ranges from 18 percent to 71 percent within each of the study areas, and the overall magnitude of positive effect would vary based on current spotted owl site occupancy. Higher current occupancy allows spotted owls to reoccupy sites from which barred owls are removed more quickly. Current spotted owl site occupancy varies from 22 percent of the sites occupied, to 67 percent occupancy, and an average of 48 percent occupancy on the study areas of the Preferred Alternative

The primary effect we anticipate is a positive change in spotted owl demographic performance on the treatment portions of the study areas. Some minor and short-term negative effects may result from the survey and removal activities.

S.7.3 Effects on Ongoing Spotted Owl Demographic Study Areas

Alternative 4 does not include any ongoing spotted owl demographic study areas. Alternatives 3, 5, and 6 do not include any removal on ongoing spotted owl demographic study areas. We anticipate no significant effect from these surveys.

Alternatives 1, 2, and 7 include removal from up to one-half of one to three ongoing spotted owl demographic study areas. The Preferred Alternative includes removal on three ongoing spotted owl demography study areas, including two that are part of the Northwest Forest Plan Effectiveness Monitoring Program. This would reduce the sample size of spotted owls for the ongoing demographic study on the included study areas by up to 50 percent, increasing the variance of estimates of demographic rates for both treatment and control areas. Because three areas would be used for removal in the Preferred Alternative and Alternatives 2 and 7, the overall impact of these effects would be larger than for Alternative 1. Once the removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s).

S.7.4 Effects on Other Species

Depending on the study area chosen, the treatment area would potentially provide temporary relief from predation and competition from 4 to 25 State- or Federal-listed species. Thirteen of the 21 potential study areas include at least some area within the likely inland range of the marbled murrelet: Ross Lake, Olympic Peninsula, Olympic Revised (Olympic Peninsula), Wenatchee, Cle Elum, Rainier, Cowlitz Valley, Oregon Coast Ranges, Veneta (Oregon Coast Ranges/Tyee) Tyee, Union/Myrtle (Klamath), Klamath, and Hoopa (Willow Creek). The Hoopa portion of the Hoopa (Willow Creek) Study Area lies within the potential inland range of the marbled murrelet; however, extensive surveys of the Hoopa portion of the Hoopa (Willow Creek) Study Area have not verified any marbled murrelet use. If any of these are chosen, some late-nesting marbled murrelets may be disturbed during barred owl removal. The overall primary effect on other wildlife species is reduced predation and competition from barred owls.

S.7.5 Effects on the Social Environment

Ethical considerations in the removal of barred owls are very important to individuals and will affect the way in which each person views the various alternatives in this Final EIS. The Service has taken these perspectives, as expressed by commenters and the Barred Owl Stakeholders Group into consideration in developing the approach and alternatives identified in this Final EIS, including setting a clearly defined end point for removals (until information is sufficient to answer the questions, and no more than 10 years) and a detailed removal protocol to ensure as humane a removal process as possible. However, these are individual-level issues. We do not anticipate that the proposed experimental removal of barred owls would change or impact individual values in a manner that would affect the larger regional social environment.

We have identified three ways in which the alternatives may impact the social environment: (1) public health and safety, (2) environmental justice, and (3) economic effects. The risk to public health and safety is insignificant due to the use of shotguns by trained, authorized professionals only, and a tight removal protocol. There are no foreseeable effects from any of the alternatives that create any pollution or other deleterious environmental justice effects. Therefore, the removal experiments do not raise concerns about environmental injustice. Potential effects to the economy are described in Chapter 3.8 of this Final EIS.

S.7.6 Effects on Recreation and Visitor Use

Selecting one of the three potential study area including National Parks, Ross Lake, Rainier or Olympic Peninsula Study Areas could result in impacts to the visitor experience through changes in the soundscape from the discharge of shotguns during removal. Selecting any of the other study areas would have no significant effect on recreation or visitor use as these Federal lands, nonfederal lands, and wilderness areas are all open to hunting. The sound of firearms would not significantly change the soundscape of the area. The Primary effect is a result of the use of lethal removal methods on National Parks where visitors are not anticipating the sound of firearms. National Parks may experience barred owl removal under Alternatives 1, 2, and 7. No removal on National Parks would occur under the Preferred Alternative.

S.7.7 Effects on the Economy

The primary mechanism for effect is the potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas. Due to State law and habitat conservation plans, there is no effect on timber harvest in study areas in Washington and California. For Oregon study areas, the potential economic effect is between zero and the value of the timber on 2,893 acres of land, for the 3- to 13-year duration of barred owl removal and recovery of barred owl populations, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after cessation of the barred owl removal. The potential though temporary economic effect of the Preferred Alternative is up to the value of the timber on 2,400 acres of forest for the 4 years of the barred owl removal experiment and 3 years for recovery of the barred owl populations, again depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement.

S.7.8 Effects on Costs of the Experiment

The cost of the experiments described in the alternatives range from a total of $398,000 on the Hoopa (Willow Creek) Study Area in Alternative 1, to $11,831,000 to implement Alternative 7. The estimated cost of the Preferred Alternative is $2,910,000.

S.7.9 Effect on the Cultural Environment

We identified no effects to the cultural environment. If Hoopa (Willow Creek) is the selected study area, this would be responsive to the Hoopa Valley Tribe’s concerns for maintaining the culturally significant spotted owl on their lands.

Chapter 1
Purpose of and Need for Action

1.0 Changes between Draft and Final EIS

- Added information on public involvement with the Draft EIS.

1.1 Introduction

The Revised Recovery Plan (USFWS 2011, entire) identified past habitat loss, current habitat loss, and competition from the recently arrived northern barred owl (*Strix varia varia*) (barred owl) as the most pressing threats to the northern spotted owl (*Strix occidentalis caurina*) (spotted owl) (USFWS 2011, p. I-6.). Concern for the effects of competition from barred owls resulted in 11 recovery actions in the Revised Recovery Plan, including Recovery Action 29.

This Final Environmental Impact Statement (Final EIS) addresses the proposed action to implement Recovery Action 29: Design and implement large-scale control [removal] experiments to assess the effects of barred owl removal on spotted owl site occupancy, reproduction, and survival. This Final EIS is limited to the barred owl threat. Threats from habitat loss are being addressed through other processes, such as the revision of spotted owl critical habitat and implementation of Recovery Actions 10 and 32 (USFWS 2011, pp. III-43, III-67).

The Revised Recovery Plan states, "Barred owls reportedly have reduced spotted owl site occupancy, reproduction, and survival. Limited experimental evidence, correlational studies, and copious anecdotal information all strongly suggest barred owls compete with spotted owls for nesting sites, roosting sites, and food, and possibly predate spotted owls…. Because the abundance of barred owls continues to increase, the effectiveness in addressing this threat depends on action as soon as possible" (USFWS 2011, p. III-62). Given the continuing range expansion and population growth of barred owl populations in the western United States and concurrent decline in northern spotted owl populations, information on the effectiveness of a removal program is urgently needed.

Recovery Action 29 focuses on acquiring the information necessary to help identify potential effective management approaches and contribute to future decisions on the implementation of appropriate management strategies for barred owls. It proposes experimental removal of barred owls on a scale sufficient to determine if the removal would increase spotted owl site occupancy and improve population trends (USFWS 2011, pp. III-62, III-65) , which in turn would contribute toward recovery of the species. Results from these experiments would be used to inform future decisions on potential long-term management strategies for barred owls.

To implement Recovery Action 29, the U.S. Fish and Wildlife Service (Service) is proposing to conduct research on the effects of the removal of barred owls on spotted owls. This research requires a permit under the Migratory Bird Treaty Act for scientific collection of barred owls, a Federal action. As a component of that permit, we are conducting a National Environmental Policy Act (NEPA) review. Because of the scope and potential for controversy over the proposed removal of a substantial number of barred owls from the wild, we chose to complete an EIS. We are also conducting a consultation under section 7 of the Endangered Species Act of 1973, as amended (ESA). Therefore, we are undertaking this review of alternatives for the proposed action, identifying the likely environmental effects, analyzing the potential effects of implementing experimental barred owl removal, recording the information, and responding to comments received on the Draft EIS in this Final EIS.

1.2 Background

The northern spotted owl was listed as a threatened species under the ESA in June of 1990. The primary reason for listing was the widespread habitat loss throughout the subspecies' range. Since 1990, conservation efforts have focused primarily on securing forest habitat with characteristics essential for the spotted owl's survival. In the initial listing, competition from the barred owl was identified as a potential threat, though the level of this threat was unknown.

Based on increasing evidence, we now consider competition from the barred owl to pose a significant threat to the continued existence of the northern spotted owl. Barred owls are native to North America, but only recently arrived in the West. They were first documented in the range of the northern spotted owl in Canada in 1959 and in western Washington in 1973. Barred owls are slightly larger and more aggressive than spotted owls, and compete for the same habitat. Because barred owls may compete with spotted owls and may exclude them from substantial amounts of otherwise useable habitat, securing habitat alone may not be sufficient for spotted owl recovery.

Barred owls are generalist predators, able to eat a much wider variety of food than spotted owls. Thus, barred owls are able to occupy habitat in much higher densities than spotted owls. Because they also eat the prey of spotted owls, barred owls likely affect the food supply of the remaining spotted owls. In addition, barred owls are aggressive and may attack, or even kill, spotted owls. The competition for food and the aggressive nature of barred owls may explain why spotted owls are less likely to remain in their territories in the presence of barred owls (See Appendix A of this Final EIS for details on the life history of barred owls).

The range of the barred owl in the western United States now completely overlaps with the range of the northern spotted owl. Increased detections of barred owls in historical spotted owl territories is associated with a decrease in the number of spotted owls detected, a pattern that holds true across the range of the northern spotted owl (Olson *et al*. 2005, p. 918; Forsman *et al*. 2011a, pp. 69-70). The density of barred owl detections is greater in the northern part of the range where barred owls have been present the longest; this pattern is consistent with the range expanding from north to south. Spotted owl populations have also declined at the greatest rate in the north where barred owls have been present the longest.

Although spotted owl populations have been declining for many years, the presence of barred owls likely exacerbates the decline. While earlier demography studies (Anthony *et al*. 2006, entire) did not detect clear relationships between barred owl presence and declines in spotted owl populations, more recent studies (Olson *et al*. 2005, p. 918; Forsman *et al*. 2011a, pp. 69-70, 75-76) have established negative relationships between barred owl presence and declines in spotted owl population performance across the range of the subspecies. If these trends persist, extirpation (local extinction) or near extirpation of the northern spotted owl from a substantial portion of its historical range may occur, even if other known negative effects, such as habitat loss, are ameliorated.

The information supporting the potential negative effects of barred owl competition on spotted owl populations is persuasive but not definitive. Unfortunately, most of our information comes from incidental data collected as part of ongoing spotted owl surveys, which may not locate all barred owls. These data are generally limited to presence or absence of barred owl responses near known spotted owl sites, do not provide complete coverage of the landscape, and therefore do not allow us to determine actual barred owl site densities. In most areas, the data underestimates barred owl populations and complicates efforts to relate barred owl population increases with spotted owl population decreases.

Given the evidence described above and the extensive overview of the impacts associated with barred owls (Appendix A of this Final EIS), and the risk of extirpation or extinction of the northern spotted owl, some stakeholders recommend that we proceed immediately with a wider application of barred owl removal as a management tool and forego further studies. While the evidence of threat is strong and very persuasive, it is not yet sufficient for the Service to undertake a wider barred owl management effort involving removal efforts. We need data on the effectiveness of barred owl removal in improving spotted owl population trends, as well as the efficiency of removal as a management tool before considering committing public resources to any form of wider application of barred owl removal as a management tool. Conducting this experiment would allow us to develop a better understanding of the correlation between barred and spotted owl populations. It would also allow us to determine our ability to reduce barred owl populations at a landscape level and keep them low enough to permit spotted owl population growth. Finally, it would allow us to estimate the cost of barred owl removal.

Managing the potential negative effects of barred owl competition is an essential component of the recovery of the northern spotted owl. Removal of barred owls is one possible tool. To make future decisions about the use of removal in the management of barred owls, we need to learn more about its efficacy (will removal work?) and efficiency (feasibility and cost). To address efficacy, the removal experiment would measure how much the reduction in barred owl populations on a portion of the study area affects spotted owl site occupancy, survival, reproduction, and population trend. To address efficiency, the removal experiment would document costs and techniques. We believe that the best way to gather this information is to conduct a focused removal experiment. We developed the purpose and need for this action to address these information needs (Section 1.3 of this Final EIS).

Section 7(a)(1) of the ESA requires Federal agencies to use their authorities to further the conservation of listed species. This proposed experiment would provide some of the information necessary to implement that objective. However, we realize that the proposal to remove substantial numbers of barred owls, even if not native to the Northwest, will be controversial with some stakeholders for ethical, scientific, and other reasons, and warrants public review and comment.

ISSUES, ETHICS AND OTHER CONSIDERATIONS. We recognize that some members of the public are concerned about potential large-scale removal of barred owls. The lack of data showing that the removal of barred owls will have the desired effect on spotted owl populations makes many even more concerned about large-scale application. The proposed experiment allows us to test the effectiveness and feasibility of barred owl removal at a smaller scale. However, even a smallscale removal is objectionable to some.

One question that influences how many people view removal of barred owls is whether humans were the cause of the barred owl's move into the range of the northern spotted owl or whether it is a purely natural process. Changes in conditions and habitat across the Great Plains and northern boreal forest due to human activities in the last 100 years may have removed prehistoric barriers to range expansion by the barred owl, but we have insufficient data to determine the specific trigger for the barred owl's westward expansion. Regardless of the effects of humans on the barred owl's range expansion, human activities have undoubtedly removed, changed, and fragmented spotted owl habitat prior to the barred owl's arrival. These changes substantially impacted spotted owl populations before the arrival of the barred owl. Therefore, humans have likely increased the potential severity of the barred owl's effect on spotted owl populations.

Many people support this experimental approach. Scientists and other stakeholders have proposed or recommended removal studies to fill information gaps, and there is strong scientific support for this experiment. For example, Gutierrez *et al.* (2007, p. 181) propose that "only through carefully designed experiments involving removal of barred owls will we be able to determine if recent declines in spotted owl populations are caused by barred owls or by other factors." Buchanan *et al.* (2007, p. 687) state, "[W]e believe that research on various aspects of Barred Owl life history and interspecific interactions…in combination with removal experiments…will be the most useful." In their comments on scoping for the Draft EIS, The Wildlife Society and the Society for Conservation Biology stated their support for "careful experimental removals of barred owls given the declining status of the threatened northern spotted owl and the need to reduce all stressors contributing to the decline of the species. Such experimental removals would serve as a much-needed addition to the research on spotted owls." It is very challenging to demonstrate the effects of interspecific competition, and removal experiments of the type proposed here are one of the accepted scientific standards for achieving strong inference in studies of competition.

RECOVERY ACTION 29. As mentioned above, the Revised Recovery Plan describes the need to address barred owl management in a timely manner. To develop future barred owl management options, managers need specific information on efficacy, feasibility, and costs of removal as a management tool. This led to the development of Recovery Action 29:

> ***Recovery Action 29: Design and implement large-scale control* [removal] *experiments to assess the effects of barred owl removal on spotted owl site occupancy, reproduction, and survival.***
>
> We believe removal of barred owls would provide benefits to spotted owls in the vicinity of the removal and may have larger population effects. Given the rapidity and severity of the increasing threat from barred owls, barred owl removal should be initiated as soon as possible in the form of well-designed removal experiments. These experiments will have the potential to substantially expand our knowledge of the ecological interactions between spotted owls and barred owls (Dugger *et al.* in press) and the effectiveness of barred owl removal in recovering spotted owls. Removal experiments should be conducted in various parts of the spotted owl's range, including a range of barred owl/spotted owl densities, to provide the most useful scientific information" (USFWS 2011, p. III-65).

This Final EIS is specific to implementation of Recovery Action 29—implementation of large-scale removal experiments to assess the effects of barred owl removal on spotted owl populations. The Final EIS is limited to addressing this portion of the barred owl threat, the removal experiment. The Service anticipates using the information from this experiment to assist in developing future barred owl management decisions. We have no specific direction for future management at this time, nor would the results of this experiment trigger any automatic actions. Future decisions could range from no active management of barred owls to a mix of strategies, including barred owl removal, other methods to reduce barred owl populations, or methods to change the competitive advantage of barred owls. Even if removal of barred owls is chosen as a component of barred owl management, a variety of removal approaches could be used, including: (1) limiting removal to specific areas over short time frames; (2) landscape-level removals for long periods; (3) periodic removal programs; or (4) other actions as yet not described.

Options for future management of barred owls are so uncertain and broad that we could not attempt to address them in this Final EIS. Because we do not know the feasibility of barred owl control as a management tool, because there is no proposal to implement any specific barred owl management option at this time, and because to try to guess what a future proposal for management might be, even if feasible, is entirely speculative, future barred owl management does not represent a cumulative effect (reasonably foreseeable future action) for this Final EIS. If a decision is made to manage barred owl populations in the future, implementation would be preceded by completion of any necessary legal requirements, including compliance with NEPA.

This EIS does not preclude the Service from making a decision to develop a barred owl management strategy prior to final completion of the experiment, if enough information becomes available to support a decision. Some of the parameters we measure may allow us to detect statistically significant results early in the experimental process and information from other studies may become available before we conclude the experiment. If this information is sufficient to justify initiating a barred owl management strategy planning process, we may do so before we complete this experiment. However, as stated above, additional NEPA analysis would be completed prior to such a decision.

1.3 Purpose of and Need for the Action

The purpose of the proposed action is to contribute to fulfilling the intent of the Act by rapidly implementing experimental research necessary for conservation of the northern spotted owl in accordance with Recovery Action 29 of the Recovery Plan (USFWS 2011, p. III-65). More specifically, the purpose of the proposed action is to: (1) obtain information regarding the effects of barred owls on spotted owl vital rates of occupancy, survival, reproduction, and population trend through experimental removal of barred owls; (2) determine the feasibility of removing barred owls from an area and the level of effort required to maintain reduced barred owl population levels for the duration of the experiment; (3) estimate the cost of barred owl removal in different forested landscapes; and (4) develop the information necessary to contribute to developing future options for potential management of barred owls as expeditiously as possible.

The need for the action is that we lack adequate information to: (1) determine the response of spotted owl site occupancy, survival, reproduction, and population trend to barred owl removal; (2) evaluate whether barred owls can be effectively removed from an area and level of ongoing removal required to maintain low population levels of barred owls; (3) determine the cost of removal in different types of forested landscapes to inform future management decisions; and (4) inform timely decisions on whether to move forward with future barred owl management.

1.4 General Description of the Proposed Action

The proposed action is to experimentally remove barred owls to provide scientifically rigorous results regarding (1) the effects of barred owls on the spotted owl vital rates of occupancy, survival, reproduction, and population trend, and (2) the feasibility of removal of barred owls to conserve spotted owls.

All action alternatives include the same basic experimental approach. Each study area is divided into two comparable portions; barred owls are removed from the treatment area and left in the control area. All areas are surveyed for spotted and barred owls. Spotted owl population data are compared between the control and treatment areas to determine if removal of barred owls in the treatment area resulted in a significant change in spotted owl population dynamics.

Potential study areas were selected from across the range of the northern spotted owl in Washington, Oregon, and California. These included (1) ongoing spotted owl demography study areas that are used for long-term monitoring of spotted owl population trends, survival, and reproduction; (2) inactive spotted owl demography study areas, and (3) additional areas with varying levels of past spotted owl surveys. Most study areas are focused on Federal lands, including areas within National Forests, Bureau of Land Management (BLM) managed lands, and National Parks and Recreation Areas (North Cascades National Park, Ross Lake National Recreation Area, Lake Chelan National Recreation Area, Olympic National Park, and Mount Rainier National Park). Some wilderness areas may be included. We are also considering a study area on the Hoopa Valley Indian Reservation. In some cases, interspersed private and State lands may occur within the boundaries of the study area. Where possible, we would seek cooperation from nonfederal landowners. Removal of barred owls on nonfederal lands would be conducted only if the landowners are willing.

The experiment will run until sufficient information is gathered to determine the effects of the removal of barred owls on spotted owl population trends. The experiment will begin as soon as possible, and results will be reviewed annually to determine when data are sufficient to answer the research questions. Removal activities would end when the data are sufficient to meet purpose and need. We set a maximum duration of 10 years of barred owl removal for the experiment. If the experiment has not provided enough information to reach a conclusion within 10 years, it is likely that removal of barred owls is not achieving the desired goal, thus other avenues should be considered and the experiment ended.

1.5 Decisions to be Made

This EIS is for the decision to issue a Migratory Bird permit to allow the experimental removal of barred owls. The issues related to this decision are: (1) Whether or not the proposed action includes appropriate avoidance, minimization, and mitigation measures and (2) whether or not the potential benefits of the proposed action outweigh the risks to the human environment identified through the environmental analysis contained herein, are scientifically justifiable, and thus warrant approval and implementation.

1.6 Public Involvement

SCOPING. Public involvement in the development of the Draft EIS was twofold. First we invited a group of stakeholders, with the help of an ethicist, to help us explore ethical questions and concerns about barred owl removal. Second, we also published a scoping notice and took comments on the proposal to develop a Draft EIS.

The over 40 stakeholders included representatives from the timber industry, animal protection organizations, conservation groups, State and tribal governments, and other stakeholders. Members were invited to participate in two meetings and one set of conference calls. The process was designed to explore ethical questions and concerns about barred owl removal, educate participants on a range of relevant ethical ideas about animals in environmental policy and wildlife management, gather individual stakeholder perspectives on the ethical issues, identify specific ethical concerns with the removal experiment, and provide individual recommendations.

On December 10, 2009, the Service published a Notice of Intent to prepare an EIS to consider a range of possible alternative ways to conduct experimental removal, and to identify significant issues needing to be addressed through the NEPA process. Information was released to the press, we conducted additional email notification, and a letter was sent to the Native American tribes in the area. The public comment period ran until January 11, 2010. We received 54 comments from 29 different organizations (including environmental, conservation, animal welfare, and industry groups, tribes, professional societies, government agencies, and zoological parks) and 25 individuals. A summary of the process and comments can be found in Appendix B of this Final EIS.

In addition, we conducted several meetings, conference calls, and discussions with the Federal agencies potentially involved in implementation of this action. We did this because lands they manage represent the majority of the lands within potential study areas and conducting the experiment on Federal lands may require additional permits or processes. We attempted to ensure that the EIS also meets the requirements of these agencies to expedite the permit process.

Information from the individual stakeholders, the scoping notice comments, and meetings with Federal agencies were used in the development of the Draft EIS.

DRAFT EIS. The Draft EIS was released for public review and comment on March 8, 2012. Comments were due on June 6, 2012. We conducted one public meeting in Seattle on May 3, 2012. We also conducted five informational webinars for the public and a webinar for the stakeholder group in May. We provided an informational booth at the Spotted Owl Critical Habitat public meetings, one of which occurred before the close of the comment period.

In addition, we conducted several meetings with Federal land managing agencies, Federal agencies involved in the Northwest Forest Plan, State wildlife agencies, the Hoopa Valley Tribe, and involved researchers to coordinate on issues related to the alternatives.

We received 66 comments by the end of the comment period and 9 additional comments in the following weeks. Fifty-two of the comments were from individuals, including three scientists. The remaining public comments were received from organizations including environmental, conservation, animal welfare, and industry groups; tribe; professional societies; and Federal, State, and County governments or their agencies. A summary of the issues raised in the comments and our responses can be found in Appendix K of this Final EIS.

1.7 Permits and Consultations

The proposed action would require several permits and consultations.

THE MIGRATORY BIRD TREATY ACT PERMIT. A Scientific Collection permit under the Migratory Bird Treaty Act is required to remove barred owls from treatment areas. The Migratory Bird Treaty Act, originally passed in 1918, implements the United States' commitment to four bilateral treaties, or conventions, for the protection of a shared migratory bird resource. The original treaty upon which the Migratory Bird Treaty Act was passed was the Convention for the Protection of Migratory Birds, signed with Great Britain in 1916 on behalf of Canada for the protection "of the many species of birds that traverse certain parts of the United States and Canada in their annual migration." The primary motivation for negotiation of the 1916 treaty and the passage of the Migratory Bird Treaty Act was to stop the "indiscriminate slaughter" of migratory birds by market hunters and others. The Migratory Bird Treaty Act was subsequently amended as treaties were signed with Mexico (1936, amended in 1972 and 1999), Japan (1972), and Russia (1976).

Each of the treaties protects selected species of birds. The Migratory Bird Treaty Act protects over 1000 species of birds, including the barred owl, by implementing the four treaties within the United States. The Migratory Bird Treaty Act provides that it is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior.

As authorized by the Migratory Bird Treaty Act, the Service may issue permits for scientific collecting (50 CFR §21.23). Migratory bird permits are issued by the Regional Bird Permit Offices. The permit for this experiment would be issued by the USFWS Pacific Region Bird Permit Office in Portland, Oregon.

ENDANGERED SPECIES ACT CONSULTATION. Consultation under section 7 of the ESA will be completed prior to issuance of a Migratory Bird Scientific Collecting Permit. This consultation is required because of potential effects on northern spotted owls and any other listed species that may be affected. The proposed research is anticipated to have positive effects on spotted owl populations in the treatment areas, though these effects would be ephemeral and end soon after the completion of the experiment. There is a small possibility of accidental injury or death of a spotted owl during the proposed barred owl removal process, though the procedures developed for any form of proposed removal reduce this to a very low potential. Other listed and candidate species occur within the potential study areas. See Section 3.5 of this Final EIS for more details. The consultation addresses the potential effects to spotted owls and marbled murrelets from this experiment.

OTHER PERMITS. Depending on the study area and land management agency involved, the experiment may require additional Federal permits. Any experiment on National Parks or Recreation Areas would require a research permit. Study areas on National Forests may require a special use permit. This Final EIS may serve as the NEPA documentation for issuance of these permits.

We anticipate the potential need to acquire permits from the States of Washington, Oregon, and California to carry out the proposed barred owl removal actions. Formal permit application would be made following completion of the EIS.

Chapter 2
Alternatives

2.0 Changes between Draft and Final EIS

- Added a Preferred Alternative and a description of the factors considered in its development.
- Updated and expanded Section 2.2.2.3 concerning our estimate of the duration of the various alternatives.
- Clarified the duration experiment to include not only barred owl removal portion, but also pre and post removal work (survey and reporting) necessary to complete the experiment.

The following provides a discussion of considerations used to develop the alternatives in this Final EIS and a description of the alternatives, including the No Action Alternative, the elements common to all action alternatives, the Preferred Alternative, and a description of the seven additional action alternatives. It also contains a description of alternatives considered but not fully analyzed.

2.1 Considerations Used in Developing the Alternatives

We developed the Preferred Alternative and seven additional action alternatives, two with sub-alternatives, based on an array of considerations. These included concepts presented in comments received during the scoping process and our own internal analysis. In this Final EIS, we include the description and analysis of our Preferred Alternative, developed after consideration of the information included in the Draft EIS, as well as information and comments provided to us during review of that draft document. This final array of action alternatives span the feasible and reasonable approaches to meeting the purpose and need described in Chapter 1 of this Final EIS. The alternatives vary in number of study areas, distribution of those study areas, type of study, method of removal, and presence or absence of pretreatment data.

2.1.1 Number of Study Areas

The alternatives range from 1 to 11 study areas. An experiment involving a single study area is logistically simpler to conduct, but would not fully represent the diversity of physical features, habitat types, barred owl densities, and invasion histories across the range of the northern spotted owl. Given that each study area represents a single experiment, so a single study area does not provide for any replication, and results from a single study area may not be representative of effects of barred owl removal in other parts of the northern spotted owls' range. Multiple study areas have greater total costs and require more complicated logistics, but can better represent the range of conditions experienced by spotted owl populations, allowing better inferences across their range. Multiple areas also allow for replication of results. By providing alternatives with an array from 1 to 11 study areas, we can evaluate the costs and benefits associated with different tradeoffs between ability to detect differences (strength of inference) and logistical or cost issues.

2.1.2 Distribution of Study Areas

In alternatives with more than one study area, we selected from different portions of the northern spotted owl's range to represent the variation in conditions across the range. We considered the following information:

- *History of barred owl presence.* Study areas in the north were invaded earlier and have a longer history of barred owl site occupancy than areas in southern Oregon and northern California.
- *Current density of territorial barred owls.* Study areas in the north have generally higher densities of barred owls than study areas in southern Oregon and northern California, though this varies by study area.
- *Current density of territorial spotted owls*. Spotted owl population levels and site occupancy on study areas have declined substantially in Washington and are declining in northern Oregon. In Southern Oregon and northern California, populations and occupancy are higher, but are declining on most study areas.
- *Different habitat types.* Spotted owl habitat varies across its range. There are large differences in habitat type between wet and dry forests (west to east) and between areas north and south of the northern border of the Klamath Physiographic Province in Oregon.
- *Differences in spotted owl food habits.* North of the Klamath Physiographic Province in Oregon northern flying squirrels represent a primary food source for spotted owls. South of the Klamath Province the dusky-footed woodrat is a primary food source.

Based on these considerations, we divided the range of potential study areas into three basic regions: Washington, northern Oregon, and southern Oregon/northern California.

WASHINGTON. Study areas in Washington have the longest history of barred owl presence. These study areas show evidence of moderate to high density of territorial barred owls as measured by spotted owl surveys and a few specific barred owl surveys (e.g., Singleton *et al.* 2010, entire). The Washington study areas also have lower levels of spotted owl site occupancy of historical sites and the largest observed declines in spotted owl populations. These areas include moist coniferous forest on the west side of the Cascade Mountains and dry coniferous forests on the east side of the Cascades, but not a mixed-conifer/mixed-hardwood type. Flying squirrels are the primary food source for spotted owls in most of the area, with greater diet diversity east of the Cascade Crest.

NORTHERN OREGON. Study areas in north and central western Oregon have a fairly long history of barred owl presence. Substantial barred owl populations have been observed for about a decade on most study areas, with evidence of moderate to high density of territorial barred owls as indicated by incidental responses of barred owls during spotted owl surveys. These areas also have moderate (lower than in the past) levels of spotted owl site occupancy of historical sites. Some study areas show declines in spotted owl populations, particularly in recent years.

These areas include primarily moist coniferous forest. Flying squirrels are the primary food source for spotted owls in most of the area.

SOUTHERN OREGON/NORTHERN CALIFORNIA. Study areas in southern Oregon and northwestern California have the most recent influx of substantial populations of barred owls, though a few individual barred owls have been present since the 1970s. Barred owls have been found for less than a decade on most study areas. These study areas show evidence of low to moderate, though growing, populations of territorial barred owls as measured by incidental responses spotted owl surveys. Most study areas still have fairly high levels of spotted owl site occupancy and most have not exhibited large-scale population declines. These areas also have moderate (lower than historical) levels of spotted owl site occupancy of historical sites. Some study areas show declines in spotted owl populations, particularly in recent years. Most study areas include dryer forest, mixed-conifer types, though some contain redwood forest and coastal mixed-conifer/hardwood. Dusky-footed woodrats are a primary food source for spotted owls in many of these study areas.

2.1.3 Type of Study

All the alternatives are based on a treatment (removal of barred owls) and control (non-removal) experimental design. Under this approach, study areas are divided into two comparable segments. Barred owls are removed from the treatment area but not from the control area. Spotted owl population parameters (e.g., occupancy, demographic performance, population trend) are estimated using the same methodology in both areas and the population measurements are compared between the treatment and control areas.

Johnson *et al.* (2008, entire) described four basic experimental designs for barred owl removal experiments to evaluate potential effects on spotted owls: demography studies, occupancy studies, site-specific studies, and invasion studies. We considered these approaches in developing the alternatives.

2.1.3.1 Demography Study Approach

In demography studies, individual spotted owls are banded with a uniquely numbered leg band and a uniquely colored leg band. Territories are surveyed every year in an effort to determine if the individual is still alive and present. Using this information, scientists can calculate survival and recruitment rates (the rate at which new individuals are added to the population). From this they can estimate the annual population growth rate of spotted owls on the study area (Forsman *et al.* 2011a, pp. 18-19). Additionally, in most demography studies, data on the number of young fledged per year are recorded, allowing for examination of changes in spotted owl reproduction. A primary goal of this approach is to compare changes in population growth rates between treatment and control areas, with the untreated control areas used to distinguish population changes that might be occurring for other reasons.

A demography experimental approach has several advantages. It allows us to estimate annual population growth rate for treatment and control areas and assess the effects of barred owl removal on spotted owl population trends. Because individual spotted owls are tracked, we can measure the underlying vital rates (e.g., annual survival and recruitment of new individuals into the population) and determine which, if any, of these are likely to be influenced by barred owl competition (Johnson *et al.* 2008, p. 19). This approach provides substantial ability to detect differences between the treatment and control (strength of inference or a high likelihood that an observed difference in vital rates between treatment areas and control areas represents a real difference in rates rather than mere chance or the influence of confounding factors), particularly where conducted on spotted owl demography study areas with extensive pretreatment data (15 to 20 years of monitoring data) (Johnson *et al.* 2008, p. 19). Because this type of experiment is conducted at a landscape level, it reduces the influence of confounding biotic or abiotic factors at the site level. Individual sites are more likely to be affected by other factors, such as surrounding habitat conditions or microclimate issues, making it difficult to separate effects of these site-specific conditions from effects of barred owl removal. In a landscape-level experimental approach measuring population dynamics, these site-specific differences can be better addressed (Johnson *et al.* 2008, p. 19). Demography studies allow us to collect information on occupancy as well as population dynamics.

The demography experimental approach has some limitations. It requires the capture, banding, and following of individual spotted owls, a relatively intensive method of data collection. If barred owl removal studies are conducted on ongoing spotted owl demography study areas, it may affect the analysis of spotted owl demographic rates for future Northwest Forest Plan Spotted Owl Effectiveness Monitoring Program analyses, at least for the portions of the study areas where barred owls are removed (See Appendix I of this Final EIS) (Johnson *et al.* 2008, p. 19). If conditions on the treatment portion of an ongoing spotted owl demography study area are fundamentally changed by removing barred owls, population trends may be different from those on the control where removals do not occur. The primary effect would be different population trends on the treatment (removal) and control (non-removal) areas, and associated small increases in the standard error of the demographic rate estimates due to smaller sample size and more pronounced variation through time. If we wish to choose studies with pretreatment data, we are limited to 11 areas where current and ongoing demographic data are available or can be estimated (Johnson *et al.* 2008, p. 19) (See Appendix E of this Final EIS for more information).

2.1.3.2 Occupancy Experimental Approach

In occupancy studies, spotted owl sites are monitored rather than individual owls (individuals are not banded). Scientists use the presence or absence of spotted owls, based on auditory surveys, to determine whether sites are occupied or not. In its simplest form, we record only presence or absence of spotted owls, though we can choose to gather information on the number of young produced on each site. Presence/absence data can be used to estimate the rate of population change if the study area is surveyed consistently. This approach provides less information on how the barred owl removal changes the spotted owl population dynamics than the demographic approach because we cannot determine which vital rate (annual survival or recruitment) has changed in response to barred owl removal. Because individual spotted owls are not banded or followed, we cannot tell if any observed change occurs because individuals are on average surviving longer, or because they are constantly replaced.

An occupancy experimental approach has some advantages. It is a relatively simple process, only requiring comparable surveys on the treatment (removal) and control (non-removal) portions of the experiment. There is no need to capture, band, or relocate individual spotted owls. We can choose to collect data on reproductive success (number of young fledged) in addition to occupancy information, but that would make the effort more intensive. An occupancy approach also gains strength to detect change in spotted owl population responses from the presence of pretreatment data. Since we do not need to capture and band a population spotted owls, we anticipate that this would provide a wider set of potential study areas. However, most spotted owl monitoring has concentrated on demography studies so few areas exist with current occupancy data that are not part of the ongoing spotted owl demography study areas. Occupancy studies are landscape-level studies, and have the same advantage over site-specific studies as the demography experimental approach; they reduce the influence of confounding factors (biotic or abiotic) at the site level. Individual sites are more likely to be affected by other factors, such as surrounding habitat conditions or microclimate issues, making it difficult to separate the effects of site-specific conditions from those of barred owl removal (Johnson *et al.* 2008, p. 19).

The occupancy experimental approach has some limitations. Data collected in an occupancy experiment can be used to provide estimates of site occupancy and potentially the rate of population change, but do not provide estimates of annual survival or recruitment. Therefore, we cannot identify which vital rates (survival or recruitment) are most affected by barred owl competition, and obtain less information about the biological mechanisms of interspecies competition than with demography studies (Johnson *et al.* 2008, p. 19). The lack of banded or individually identified spotted owls delays our ability to detect sink population dynamics, situations where site occupancy is high because a series of individuals continue to occupy the site while the overall population declines. Site occupancy may remain high and the actual loss of birds go undetected until the source of non-territorial spotted owls to fill behind territorial spotted owls is exhausted. Because we intend to terminate the experiment once we have statistically significant data, we could miss the actual population decline altogether. Additionally, the alternatives that include occupancy studies generally provide data and conclusions with a lower ability to detect differences between the treatment and control areas (strength of inference) than the demographic approach because few occupancy study areas have pretreatment data (See Appendix E of this Final EIS for more information). Finally, since most spotted owl monitoring has concentrated on demography studies few areas exist with current occupancy data that are not part of the ongoing spotted owl demography study areas.

2.1.3.3 Site-Specific Experimental Approach

Site-specific studies involve removing barred owls from around individual spotted owl sites in conjunction with monitoring comparable sites without barred owl removal. This can be conducted as either a demography or occupancy type of experiment, depending on the availability of banded birds or historical information. This approach involves testing the effect of barred owls at many individual spotted owl sites, and requires a sufficient sample size to measure an effect using pooled site data (Johnson *et al.* 2008, pp. 14, 18, 19). Sites need to have a history of occupancy by both spotted and barred owls, and distinguish between currently occupied sites and sites that have not been occupied for multiple years. If a large sample of color banded spotted owls were available, it might be possible to measure rates of adult turnover, though this is unlikely given that most of the large banded samples are part of the ongoing spotted owl demography study areas, or concentrated (not scattered sites), which are more conducive to other experimental formats. An effort to locate and band a sufficiently large number of spotted owls prior to initiation of barred owl removal would add one to several years to the total experiment duration.

Site-specific studies have some advantages. This approach can be applied in many areas, because it allows data collection in places with localized barred owl presence at spotted owl sites. Experimental sites can be selected in landscapes with low densities of barred owls, and where most spotted owls may be unaffected by barred owls, mimicking an invasion experiment (described below). If we attempted to conduct a demography or occupancy experiment in a location with low barred owl densities, the effects of barred owls on those few spotted owl sites where they are present might be swamped by the larger landscape-scale spotted owl demography. Thus, in areas with low barred owl densities, the effect of barred owls might be more easily observed around specifically affected sites.

Site-specific experimental approaches have several limitations. In most cases, they do not allow identification of the vital rates that influence inter-species competition. Response variables are usually limited to occupancy, abundance, and productivity (but not survival). These studies would have a relatively low ability to detect differences (low strength of inference) because of relatively small sample sizes. The influence of confounding biotic and abiotic factors would increase over landscape-level approaches due to the scattered nature of the sites. The large and scattered spatial scale greatly limits the ability to determine turnover rates for owls at individual territories and creates substantial logistical difficulties. Given that barred owls must be removed for some distance around each site for the duration of the removal period of the experiment, this would involve a much large removal effort in relation to the amount of information gained than the other three experimental approaches. Given the large surface-to-interior ratio of the small treatment areas around each site and the large number of barred owls surrounding the site, we would anticipate extensive and rapid recolonization by barred owls and great difficulty in maintaining any site free of barred owls for any substantial amount of time. Additionally, this approach would require substantial coordination to develop an adequate sample size.

Based on the limitations described above, we did not choose to carry this approach into the action alternatives. This approach is not an efficient method to measure barred owl effects, or to determine the effectiveness of barred owl removal, and has low ability to detect differences (strength of inference) that limits the application of results.

2.1.3.4 Invasion Experimental Approach

An invasion experiment is similar to a demography experiment conducted in an area where barred owls are just beginning to invade the landscape and affect spotted owl populations. It can only be carried out in study areas that are near the advancing edge of the barred owl invasion or where barred owl numbers are currently low because there has been insufficient time for population expansion. A key assumption in an invasion experiment is that barred owls have not had a measureable influence on spotted owls, but barred owl populations are assumed to quickly increase to a point where such influences can be estimated. In the invasion experiment, the area where barred owls are removed is considered the control (where barred owl populations are unchanged from current low levels) and the treatment area is the portion in which barred owl numbers are allowed to increase (Johnson *et al.* 2008, pp. 14–16).

One advantage of an invasion experiment is that, under ideal conditions, it may allow us to estimate the population density of barred owls above which spotted owl populations begin to decline. This assumes that the increase in barred owl populations and effects are not so rapid as to pass the threshold before they can be manifested in spotted owl population data and measured in the experiment.

The most obvious limitation of this approach is that it can only be carried out in study areas that are near the presumed advancing edge of the barred owl invasion, and assumes that within a relatively short period barred owl numbers would substantially increase. It relies on a natural increase in barred owl populations, which may not occur or occurs so slowly that the experiment becomes impractical. Invasion studies require a relatively long duration, since it may take several years for the barred owl population to increase to a level where statistically significant effects on spotted owl populations can be detected.

We did not include this approach in any action alternative because its application is limited to very specific conditions at the front of the barred owl invasion and very few areas meet this standard, even at the southern edge of the northern spotted owl's range. Because it is only applicable in a few areas, this approach has low ability to detect differences (low strength of inference) and limited application of results to most of the spotted owl range.

2.1.4 Availability of Pretreatment Data

The availability of pretreatment data allows comparison of spotted owl population trends before and after the treatment on the treatment area, strengthening the results by eliminating other potential differences between the control and treatment areas. The presence of pretreatment data on spotted owl populations, particularly of 10 or more years in duration, greatly improves the ability to detect differences (strength of inference) of the results and applicability of the conclusions.

For demography experimental approaches, the nine ongoing spotted owl demography study areas provide the best locations available due to the long term existing data. They have been monitored for over 15 to 20 years and have existing, long-term data on survival, reproduction and recruitment and population trends. These include the Cle Elum, Olympic Peninsula, Rainier, Oregon Coast Ranges, Tyee, HJ Andrews, Klamath, South Cascades, Hoopa, and Willow Creek Study Areas.

We were able to locate two study areas that are not part of the spotted owl demographic meta-analysis, but have current or recent, demography-type data that would allow us to calculate a pretreatment rate of population change, or develop an estimate of pretreatment population trends (and other vital rates), the Union/Myrtle and Veneta Study Areas. The Union/Myrtle Study Area continues to be monitored so this information remains up to date. The Veneta Study Area has not been fully monitored since 2009 and portions may no longer be usable for the experiment.

Few areas have current, ongoing, occupancy data for spotted owls. We were able to identify only three areas with pretreatment occupancy data, including the Union/Myrtle and Veneta Study Areas described above. In addition, the Cowlitz Study Area has a history of occupancy data, though the method of data collection is different than our proposed approach.

The remaining study areas have no current spotted owl banding or other data to estimate pretreatment rate of population growth or occupancy. Some of these areas were used as spotted owl demography study areas in the past but were discontinued several years ago. Therefore, we have only historical data on these areas. In two alternatives we use study areas without pretreatment data and consider two sub-alternatives. One sub-alternative includes the collection of baseline pretreatment data before starting removal and the other conducts the removal experiment without any pretreatment data. This allows us to compare the cost and effectiveness of both approaches.

2.1.5 Method of Removal

All experimental approaches would substantially reduce barred owl populations in portions of the proposed areas through the removal of territorial barred owls. All removal methods would avoid removing breeding barred owls with dependent young. There are two basic approaches to remove barred owls: lethal and nonlethal.

2.1.5.1 Lethal Removal

We selected a procedure for lethal removal that is as humane and efficient as possible. It is designed to minimize the risk of accidental removal of other species, particularly northern spotted owls and other listed species. The procedure is designed to maximize the potential for specimens to be collected and used for other scientific purposes, within the constraints of a quick and humane death. The general approach involves attracting territorial barred owls with recorded calls and shooting birds that respond when they approach closely. In Section 2.2.2.2 and Appendix D of this Final EIS, we provide more detail on the specific protocol for removal, and appropriate measures to ensure humane and ethical implementation of this method.

2.1.5.2 Nonlethal Removal

As with lethal removal, we designed a nonlethal removal method that is as humane as reasonably possible and reduces stress on the birds. To accomplish the experiment, any barred owls captured must be removed completely from the study area. To avoid undue stress and problems with inadequate housing, we require that we have a destination ready to take the birds before any capture is attempted. The procedure minimizes the risk to other species, though this is less of an issue with capture as non-target species can be removed from the capture apparatus and released in most cases. The approach involves attracting territorial barred owls with a recorded call, and catching the responding birds in nets or other trapping devices. Birds would be transported to temporary holding facilities, checked for injuries or other health concerns, stabilized, and transported to permanent facilities or release locations. Section 2.2.2.2 and Appendix D of this Final EIS provide more details on removal methods, and measures to ensure humane and ethical implementation.

2.1.5.3 Combined Removal

A combination of lethal and nonlethal removal may be applied on a single study area. In this instance, we would capture the number of barred owls needed to meet placement opportunities and remove the remaining birds lethally.

2.2 Alternative Descriptions

2.2.1 No Action Alternative

Under the No Action Alternative, a barred owl removal experiment would not be initiated, and we would not implement Recovery Action 29. In the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011, p.II-5), the Service stated "[t]his [study] is needed to experimentally determine the effects of barred owls on spotted owls and to incorporate this information into management to reduce negative effects to a level that would promote spotted owl recovery." We also state that "[b]ecause the abundance of barred owls continues to increase, the effectiveness in addressing this threat depends on action as soon as possible" (USFWS 2011, p III-62).

Under the No Action Alternative, no experimental removal would be conducted by the Service at this time. This would not prevent others from proposing such studies and seeking the necessary permits, but there is no guarantee that any such efforts would occur.

The No Action Alternative would not provide the important information for developing and implementing barred owl management strategies, potentially delaying or limiting future management decisions. While this would not fully preclude a future decision to use removal as a management tool, it would make such decisions more difficult due to lack of information on the effects of removal on barred owls and spotted owls, as well as costs and applicability. The lack of information on feasibility, logistics, and costs could result in decisions that are not based on realistic expectations, leading to ineffective, or possibly no, barred owl management. If we do not implement experimental removals of barred owls, their populations would continue to increase, and any adverse effects they have on spotted owls would also continue to increase. Given the weight of current evidence, it is likely that spotted owl populations would continue to decline in most areas, and may become extirpated in some areas as spotted owl populations decline to unsustainable levels in the near future. Any delay in future decisions on the management of barred owls could actually lead to the eventual removal of even more barred owls if removal is implemented in the future. The longer we wait to make a decision on management, the fewer spotted owl would be available to respond to the management and the more barred owls would be present that may have to be removed.

2.2.2 Elements Common to All Action Alternatives

All experimental approaches in the action alternatives include the following three basic components:

- Survey spotted owls—survey the entire study area using spotted owl recorded calls and current spotted owl demography survey protocols. The data collected varies by experimental approach. In areas where spotted owls surveys are currently being conducted as part of demography studies, we would use the information from these based on the established experimental protocol.
- Survey barred owls—survey the entire study area using barred owl recorded calls to define barred owl density and locate barred owl sites.
- Remove barred owls—using the process described below; remove all barred owls from the treatment area.

2.2.2.1 Type of Experimental

The action alternatives focus on the two most effective types of studies: demography and occupancy.

Demography studies focus on measuring changes in annual rate of population growth resulting from barred owl removal. This method is described in Section 2.1.3.1 above and Appendix E of this Final EIS. The steps involved in implementing a demography experiment include:

- Survey the entire study area to locate barred and spotted owls.
- Band all spotted owls within the study area.
- Survey the entire area annually to relocate and check for banded spotted owls. Record whether each individual spotted owl was found each year.
- Track changes in population based on the fate of individual banded spotted owls. This information is used to calculate survival and recruitment rates, which in turn can be used to estimate population trends.

We estimate it would take a minimum of 4 years to acquire sufficient data to allow us to detect differences in population trends between treatment (removal) and control (non-removal) areas for spotted owl demography study areas with multiple years of pretreatment data, and longer if we lack long-term pretreatment data.

Occupancy studies focus on determining the occupancy status of spotted owl sites. They do not involve tracking individual spotted owls and so do not require banding. Details of occupancy experimental design are presented in Section 2.1.3.2 and Appendix E of this Final EIS. The steps in implementing an occupancy experiment include:

- Survey the entire study area to locate barred and spotted owls.
- Record the presence of spotted owl sites based on their vocal responses.
- Track changes in rates of spotted owl site occupancy.

- Track reproduction, though this would require additional survey effort to locate and check whether spotted owls are nesting, and count the number of young produced.

This approach would likely require a minimum of 3 to 5 years to detect differences in spotted owl site occupancy between treatment and control areas, depending on whether we attempt to measure reproductive success. Measuring reproductive success would require additional years of survey.

2.2.2.2 Methods of Removal

All removal methods are designed to:

- Reduce the number of territorial barred owls on the treatment area to a minimum. While we do not anticipate that we will be able to remove the entire population, we do anticipate reducing and maintaining the population of barred owls at a low level. This experiment would help determine what level of removal is feasible.
- Be as humane and quick as possible within the confines of the method.
- Pose little to no risk of mortality or injury to nontarget species, including the spotted owl.
- Avoid removing breeding barred owls with dependent young. This can be accomplished by:
    - Restricting the timing of removal. Because it is difficult to determine if barred owls are breeding, we can use the timing of removal to avoid orphaning dependent young. Removals that start after young become independent and before the next year's eggs have hatched would not result in any orphaned young. This limits removal efforts to the period from early fall through late winter. Actual dates would be developed based on the timing of barred owl reproduction in the specific study area or region. Restricting removal to this period would limit our efficiency, and in some cases ability, to remove barred owls in areas where winter access is difficult.
    - If protocols are developed that would allow researchers to determine if barred owls are nesting or have young, removal could occur during the nesting season. This would require approval from the Service before implementing removal during the breeding season.

LETHAL REMOVAL. This method involves removal by killing barred owls in the field. We created a removal protocol designed to provide the most humane, quick death as possible (See Appendix D of this Final EIS). Any experiment conducted under this EIS would be required to follow this protocol or future revisions to this protocol approved by the Service. We would continue to consider new information.

Lethal removal is accomplished by attracting the barred owls with recorded calls and shooting birds that respond by approaching closely. This is usually a very quick process and therefore leaves little opportunity for barred owls to learn avoidance. Our protocol includes the requirement to recover the carcasses for scientific research to the extent safely possible. This allows us to gather the greatest amount of scientific information as we can for each barred owl we remove

NONLETHAL REMOVAL. This method involves capture and transport of barred owls out of the study area. We designed a nonlethal removal protocol to provide the most humane capture and captivity possible (see Appendix D of this Final EIS for more detail). Any experiment conducted under this EIS would be required to follow this protocol or future revisions to this protocol approved by the Service. We would continue to consider new information to ensure any capture and transport is accomplished as humanely as possible.

Nonlethal removal begins much like lethal removal, attracting the barred owls with recorded calls. However, with this approach birds are also attracted with a decoy and captured in mist nets or other capture devices. Birds are transported to a temporary holding facility, checked and stabilized, and transported to a permanent facility or release location.

Nonlethal removal is only possible to the extent we have permanent locations ready to accept the captured birds. In looking for placement opportunities, we considered two general approaches: translocation and release to the wild, or captivity (See Appendix C of this Final EIS).

Translocation, the movement of captured barred owls to new areas for release in the wild, does not ensure that the individual birds would survive. If individuals are relocated to areas where barred owls already saturate the habitat, leaving no empty territories, translocated individuals are more likely to die or displace an individual already established in that area that would then face increased risk of death. Translocated birds are often at a disadvantage, as they do not know the local habitat and food as well as local owls. Thus, a likely outcome of translocation of barred owls into saturated habitat is the death of a barred owl. This death is not necessarily humane, if resulting from starvation, injury, or other trauma. Therefore, we would only consider release areas where barred owl populations do not saturate the available habitat.

Because the expansion of barred owl populations is a concern for the conservation of spotted owls and other native species in the west, we are not considering release of barred owls within their expanded range. We do not want, as part of this experiment, to increase the rate of barred owl population growth where they are not currently saturated, as this would exacerbate their current effect on spotted owls. We also do not want to spread the effects of predation to other species that did not evolve with barred owl. See Section 3.5 of this Final EIS for more discussion of the effects on other wildlife species. Additionally, we are concerned that barred owls translocated within the northwest could return to their territories, reducing the effectiveness of the experiment.

We considered translocation of captured birds to their pre-1900 historical range. We contacted states in the historical range of the northern barred owl, the subspecies of barred owls found in the northwest, to determine if they were interested in receiving barred owls for relocation. None of the responding states expressed interest in receiving captured barred owls. The primary reasons included: (1) lack of empty habitat; (2) concern about the potential of transmission of disease; and (3) likely differences in local genetic adaptation after 100 years of different selective pressures in the west, coupled with the desire to avoid diluting native gene pools.

Finally, we considered the option of captive holding, both temporary and permanent. Temporary captivity would require developing a holding facility for a large number of barred owls. The owls would have to be maintained for the duration of the barred owl removal portion of the experiment, 3 to 10 years depending on the alternative selected. Once the experiment was complete, these owls would be released back into the wild. Not all birds adjust to captivity, and some would undoubtedly die from stress or disease. Birds maintained in captivity for several years lose their wildness and are not suitable for release back into the wild. Release of long-captive birds could result in many deaths from prolonged starvation or disease, as a result of reduced ability to forage and shelter in the wild. Therefore, we do not consider temporary captivity a viable option.

Permanent captivity is the only remaining option for placement of birds captured and removed from the study areas. Maintaining owls in captivity is not an easy proposition. It is both difficult and expensive. We would only consider placing barred owls with organizations that have adequate facilities and resources to provide a good quality of life. In addition, any facility receiving barred owls would need to have all required State or Federal permits in possession before birds were captured. We would require that any facility make a long-term commitment to maintain the captured barred owl for its lifetime, and not release it to the wild or breed the bird.

We conducted a preliminary check of zoos, zoological parks, and related facilities through the internet to judge the level of interest. In this initial attempt, we found interest and a potential placement commitment at locations with appropriate facilities for only five individual barred owls. We will continue to solicit interest in captive birds and anticipate finding opportunities for more birds, but given the expense and commitment required, we do not anticipate finding adequate facilities for over 100 barred owls.

Each of the action alternatives requires the removal of more than 100 barred owls. Since we would not capture barred owls without a location ready to accept them, none of the alternatives could be implemented if limited to nonlethal removal. Because of the limitations placed on using nonlethal removal methods for the experiment, the limited options for placement of captured birds, the stress on the birds, and the likely outcome if released elsewhere, use of nonlethal removal as the sole removal method is not included in the action alternatives.

COMBINED REMOVAL. This approach would involve applying both lethal and nonlethal methods in a single study area. Barred owls would be captured to fill any identified captive placement opportunities, focusing on the easiest and safest locations for capture (e.g., closest to available holding facilities and care to reduce stress on captured owls). We would make one capture attempt per site before switching to lethal removal methods to avoid owls becoming wary of the researchers. Remaining barred owls would be removed using lethal methods. Given the difficulties in locating interested institutions with adequate facilities and resources to provide for captive barred owls, we anticipate nonlethal removal will be a relatively small portion of the removal in combined removal methods.

2.2.2.3 Duration of the Experiment

The duration of the experiment is driven by the circumstances and methods of each action alternative. For each action alternative, we provide an estimate of the duration of barred owl removal needed to reach a scientifically supported conclusion based primarily on the type of study, level of existing spotted owl data, size of the study area(s), and potential spotted owl population. This is only an estimate; the experiment may be completed earlier or continue longer, if needed, to detect statistically significant results for the effects of removal on spotted owl populations, to a maximum of 10 years of barred owl removal. Because spotted owl and barred owl surveys will need to proceed the first year of removal as well as following the final removal, and the final report will require some time to prepare, the total duration of each alternative is actually 6 months to one year longer than the removal duration. Information gained during each year of the experiment would be analyzed and presented annually to the Service. Depending on the strength of the response, information may be deemed adequate to begin a discussion of management opportunities prior to completing the experiment.

Within the same type of study, smaller study areas and areas with less habitat, and therefore fewer spotted owl sites, would generally take more time to detect a statistically significant result than larger or more densely populated sites (see Appendix H of this Final EIS). The presence of historical data, particularly in spotted owl demography study areas, generally reduces the time required to detect a statistically significant result. The type of approach also affects the time required to achieve results. Demography studies involve more intensive work (e.g., banding spotted owls), and therefore generally take longer than similar basic occupancy studies. However, there is little difference in total duration between demography and occupancy approaches that include tracking reproductive success.

The basis for estimating duration of alternatives involving demography experiments on ongoing spotted owl demography study areas or areas with demographic-quality data (e.g., banded spotted owls and annual surveys) is the power analysis described in Appendix H of this Final EIS. In general, we anticipate it would take a minimum of 4 years of barred owl removal to detect a 0.05 change in the spotted owl population trend (lambda).

For Alternatives 1 and 2, the first year will be devoted to locating and removing a large proportion of the barred owls present on the treatment area. Surveys in the following 2 years would provide an estimate of the change in population trend, but lack information on annual variability. Given the variability and other factors that may affect the rate of population growth (lambda), we added 1 additional year. Therefore, we consider 4 years of barred owl removal as the minimum time needed to reach a solid evaluation of the effect of removing spotted owls on the population trend of spotted owls in the treatment area. For study areas with lower power to detect change, additional years of barred owl removal were added to achieve a statistically significant result. This applies to the Preferred Alternative and Alternatives 1, 2, and 3. It also applies to some study areas in Alternative 7.

For Alternative 4, a demography experiment on areas without ongoing spotted owl demography studies, we lack a population of banded spotted owls to follow. To establish a banded spotted owl population to follow, identify survey routes, and establish the experiment will require 2 years of survey work before we can begin removal of barred owls and accumulating data on population trend.

For sub-Alternative 4a, we estimate it will take at least 3 years to establish the pre-treatment spotted owl population trend. Once treatment begins, it will require 4 years of barred owl removal to acquire estimates of the change in population trend, as described for ongoing spotted owl demography studies above. However, since the strength of the data is driven strongly by size of the spotted owl population, we added 1 year for alternative with less than 150 sites, 2 years for alternatives with less than 100 sites. For sub-Alternative 4a, this adds to 10 years total work, 2 years to band spotted owls, 3 years pre-treatment data, and 5 years of treatment (removal).

For sub-Alternative 4b, where we begin treatment removal as soon as possible and do not wait to establish a pre-treatment spotted owl population trend, we anticipate the experimental results will require more than the 4 years of barred owl removal described above for ongoing spotted owl demography studies. Without the history of surveys and data in the analyses, we anticipate a much larger variability in trend results which will delay our ability to detect the effect of barred owls on spotted owl populations. We added an additional 2 years to the estimated duration of barred owl removal to compensate for this delay. Thus the experiment would require 2 years to establish the base approach and 6 years to collect information, for a total of 8 years.

A simple occupancy study approach does not require banded spotted owl populations to follow, so results can be calculated more quickly. As in a demography study, the first year will be devoted to locating, and then removing, a large portion of the barred owls present on the treatment area. The following 2 years of barred owl removal will provide estimates on the occupancy for comparison between draft and final. If we chose to track information on reproductive success, the experiment will take longer given the potential natural variation in reproduction from year to year. Therefore, adding reproductive success to an occupancy-based alternative adds 2 years of barred owl removal to the duration.

For Alternative 5, an occupancy experiment with pre-treatment data available on the proposed study areas, the duration is the same as described above, 3 years of barred owl removal for simple occupancy, 5 years of barred owl removal for occupancy and reproduction.

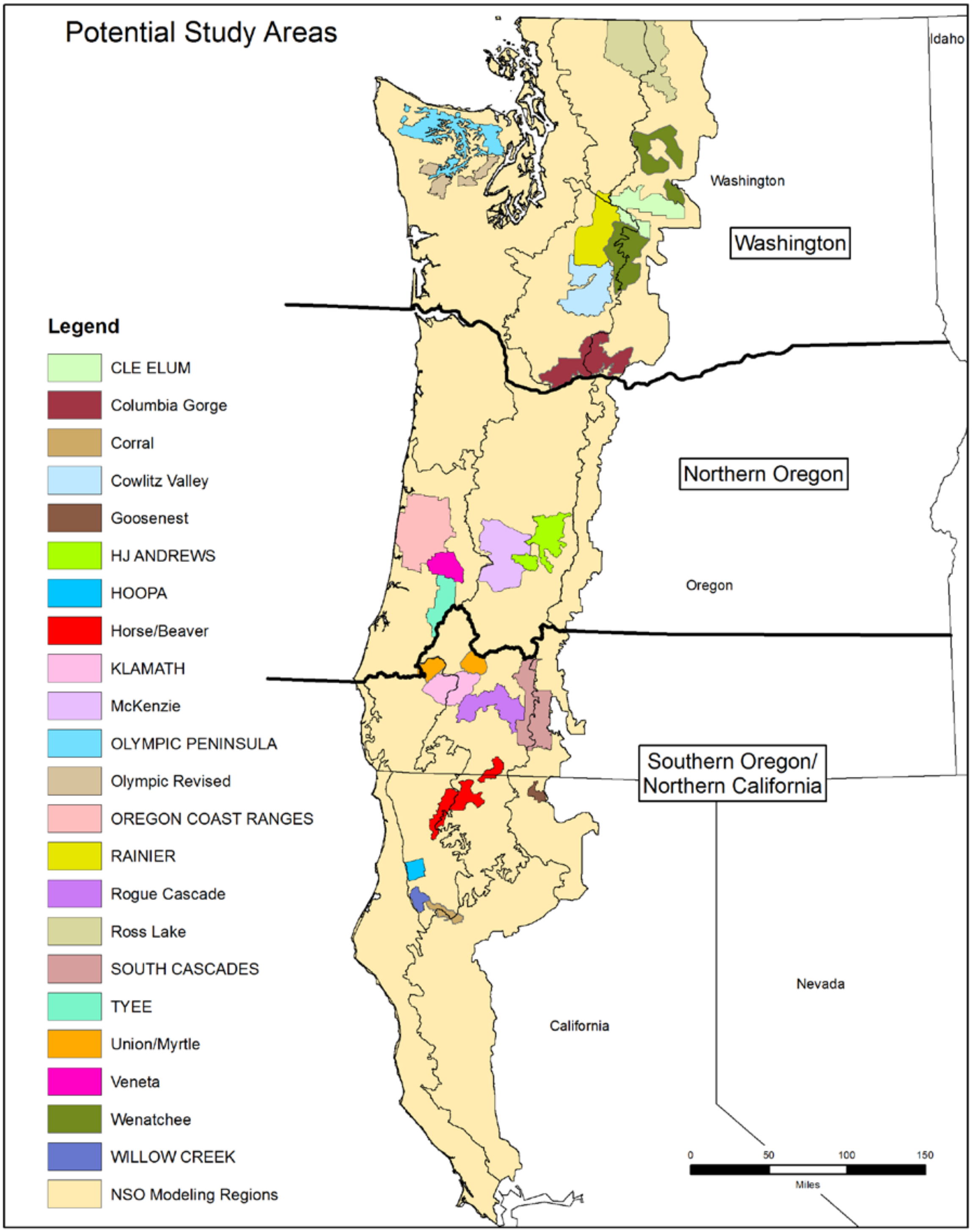
For Alternative 6, an occupancy experiment without pre-treatment data, the surveys will require an initial year to establish the sites and identify survey routes. For sub-Alternative 6a, we will need 2 years to establish the pre-treatment population trend and 3 years of barred owl removal to estimate the effect on spotted owl populations for simple occupancy, 5 years of barred owl removal for occupancy and reproduction. This results in a total duration estimate of 6 to 8 years. For sub-Alternative 6b, treatment and surveys begin simultaneously after the initial year of establishment. These basic surveys will require 3 years of barred owl removal, 5 years for occupancy and reproduction. This leads to an estimated total duration of 4 to 6 years.

For Alternative 7, we calculated the duration for each study area, assuming each would run until results were adequate for that study area, with the exception of the three study areas where we would conduct a 10 year barred owl removal to determine potential longer-term effects. See Section 2.2.3.8 in this Final EIS for the duration for each study area.

2.2.3 Action Alternatives

The action alternatives vary by location and number of study areas, type of study, and removal method. In the full range of action alternatives, we consider a total of 21 potential study areas (Figure 2-1) including ongoing spotted owl demography study areas, inactive spotted owl demography study areas, existing areas used for other studies, and new study areas with limited data. Five study areas are actually a combination of portions of more than one existing study area. For example, the Hoopa Study Area has been combined with the nearby Willow Creek Study Area to form the Hoopa (Willow Creek) Study Area. Both study areas are fairly small and individually would have little power to detect differences between treatment (removal) and control (non-removal) areas. Each study area is described in Section 3.1 of this Final EIS.

Figure 2-1. Potential study areas within which experimental removal of barred owls were considered. The number and combination of study areas used depended on the alternative selected. Study areas labeled in all capital letters represent the ongoing spotted owl demography study areas (See Forsman *et al.* 2011a, pp. 6-7).



2.2.3.1 Preferred Alternative

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Demography	Combined	4	Yes	4	5

The Preferred Alternative includes four study areas, representing a combination of study areas and methods from Alternatives 2 and 3 of the Draft EIS (Figure 2-2).

In developing a Preferred Alternative, we used the information described above, the effects analysis from the Draft EIS, and information from public comments to design an alternative that meets the purpose and need in an effective and efficient manner. We chose elements that would provide for a scientifically credible experiment with a high power to detect the effect of the barred owl removal on spotted owl populations, and that would provide results applicable across the range of the northern spotted owl in a timely manner.

NUMBER OF STUDY AREAS. We chose four study areas: Cle Elum, Oregon Coast Ranges/Veneta (half), Union/Myrtle (Klamath), and Hoopa (Willow Creek). Using multiple study areas provides for some internal validation of experimental results and provides for a reasonable safeguard and experimental redundancy should one study area be adversely impacted by an unanticipated event (e.g., large fire) without compromising the results. Inclusion of a fourth study area also increases the total number of spotted owls being studied, which increases the strength of the results. However, to reduce the impact on barred owls and costs, we reduced the size of the largest study area to a level that will still provide strong results.

DISTRIBUTION OF STUDY AREAS. To ensure that this experiment represents the various conditions across the northern spotted owl's range, at least one study area is included from each of the three regions described in Section 2.1.2 of this Final EIS. In the southern Oregon/northwestern California region, an area of more recent barred owl invasion, we included two study areas. Each of the four study areas included in this alternative is described in Section 3.1 of this Final EIS.

> Washington is represented by the Cle Elum Study Area, which was included in Alternatives 1 and 2 of the Draft EIS. This study area represents areas in Washington with a long history of barred owl presence, and habitat conditions typical of the higher Cascades and eastside forest types. In the Cle Elum Study Area, barred owl removal would occur on up to one-half of the ongoing spotted owl demography study area. The remaining portion of the Cle Elum Study Area would function as the experimental control.

Northern Oregon is represented by the combination of the Oregon Coast Ranges Study Area and Veneta Study Area. These study areas were also included under Alternatives 2 and 3 of Draft EIS. Since the combined study area is larger than necessary for this experiment, we have limited the experiment to one-half of this combined area. Removal would occur on up to one-half of this smaller study area, resulting in removal of up to one-quarter of the total combined study area. The actual portion of the area to be included in the treatment will be determined during the development of the detailed study plan prior to implementation of the experiment. For the purposes of this analysis, the removal may occur anywhere on the study area, including the ongoing spotted owl demography study area.

The southern Oregon/California area is represented by two study areas, the Union/Myrtle (Klamath) and the Hoopa (Willow Creek). This large area has the more recent invasion of barred owls and larger differences in barred owl densities; therefore we included two study areas representing the north and south portions of the region.

The Union/Myrtle (Klamath) Study Area lies near the transition zone between the flying squirrel and red tree vole prey base typical of the more northern portion of the northern spotted owl's range, and the woodrat-dominated prey base typical of the Klamath zone. The Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area includes long-term monitoring data that is adequate to model past spotted owl demographic performance for most sites and includes a population of banded spotted owls. Union/Myrtle will be used as the treatment (removal) portion of the study area, paired with experimental control (non-removal) areas on the Klamath Spotted Owl Demography Study Area. This study area was also included in Alternative 3 of the Draft EIS.

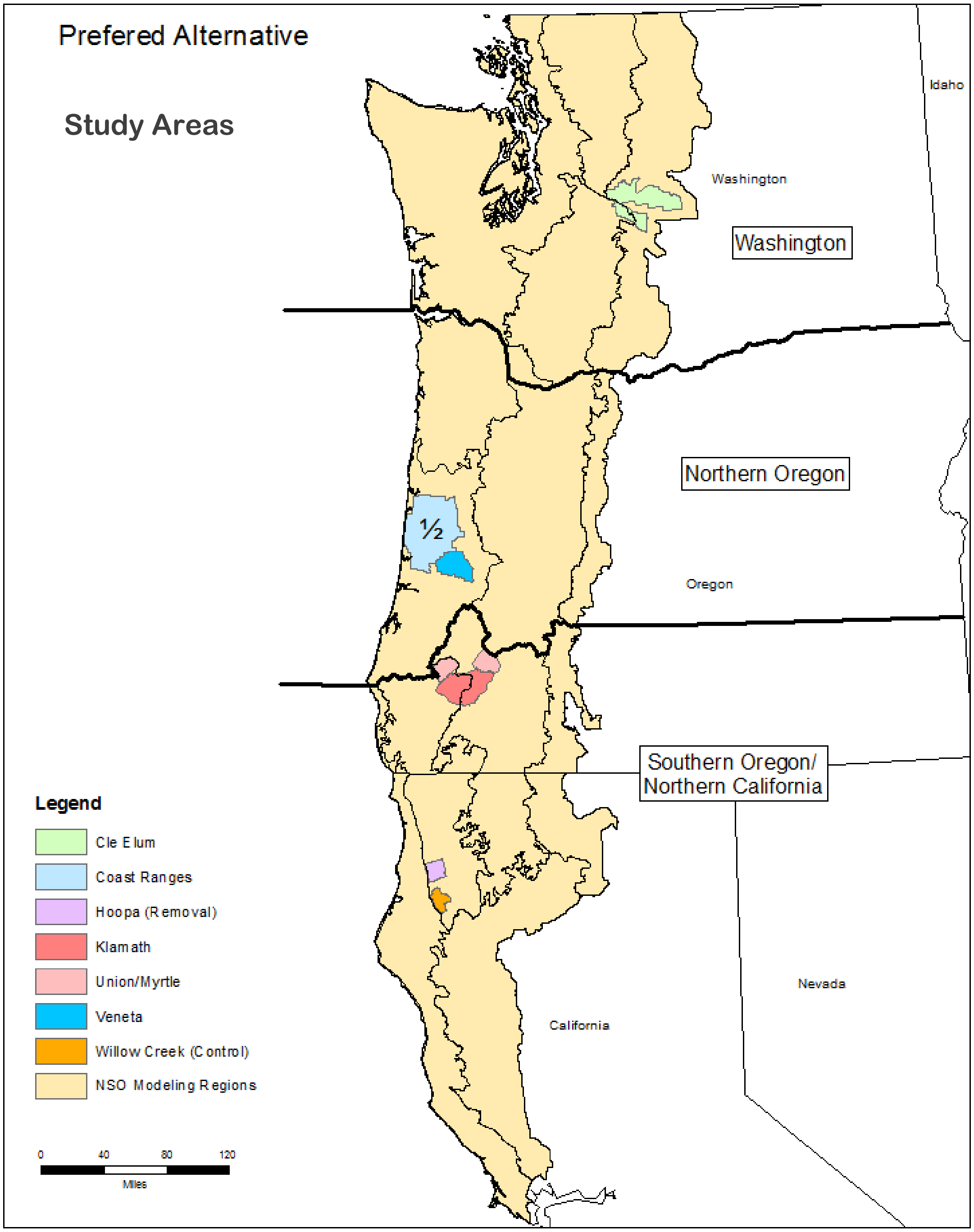
The Hoopa (Willow Creek) Study Area represents the southernmost portions of the Klamath Province, and has a long history of well-documented demographic data for the spotted owl. While barred owl populations are relatively lower than in areas where the invasion has a longer history, this area has seen a rapid increase in number of barred owls, and potential impacts on spotted owls, in recent years. The experiment would involve treatment (removal) on the Hoopa Spotted Owl Demography Study Area paired with experimental control (non-removal) on the Willow Creek Spotted Owl Demography Study Area. This study area was also included in Alternative 2 of the Draft EIS.

TYPE OF STUDY. The experiment will utilize a demography study approach. We chose to do a demography experiment in the Preferred Alternative because it best meets our needs to quantify effects of barred owl removal on spotted owl conservation, and it provides the most extensive information on the spotted owl parameters that may affect their decline. Demography studies provide the most detailed information, including estimates of annual survival, reproduction (fecundity), and population growth rates, potentially allowing us to identify the mechanisms of the inter-specific competition. Because we mark and follow individual spotted owls, a demography approach also allows us to detect if the removal area is acting as a sink for spotted owls from neighboring areas.

PRE-TREATMENT DATA. We included only study areas with pre-treatment data to provide the greatest power to detect an effect of barred owl removal on spotted owl populations in a reasonable period of time, and at lower cost than for similar areas with no pretreatment data. However, in an effort to reduce the number of barred owls removed on the ongoing spotted owl demography studies, we selected the Union/Myrtle and Veneta Study Areas described above. These areas are not part of the spotted owl demographic meta-analysis, but have current or recent, demography-type data that would allow us to calculate a pretreatment rate of population change, or develop an estimate of pretreatment population trends (and other vital rates).

TYPE OF REMOVAL. We will use a combined removal method that necessarily relies primarily on lethal removal. This will involve capture of barred owls where we have an interested organization that has adequate facilities and resources to provide a good quality of life for the barred owl. Since we have few opportunities for such placement, most removal will be by lethal methods. Using four study areas with pre-treatment data on spotted owl demographic performance provides a strong test of the effects of removal (see Appendix H of this Final EIS). Given the number of spotted owl sites in the combined study areas, this alternative would require an estimated duration of 4 years of barred owl removal to secure scientifically credible results.

Figure 2-2. Study areas for the Preferred Alternative.



2.2.3.2 Alternative 1

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Demography	Lethal	1	Yes	4 to 7 years, depending on study area	5 to 8 years, depending on study area

This alternative involves a demography study using lethal removal methods. This would be conducted on a single study area, one of the nine ongoing spotted owl demography study areas (Figure 2-3). We are considering the use of any one of these nine areas and are analyzing the effects for each area. This alternative may include the use of lethal removal in Olympic or Mount Rainier National Parks (but not both). This would provide decision makers with the information to select the best option in the Final EIS.

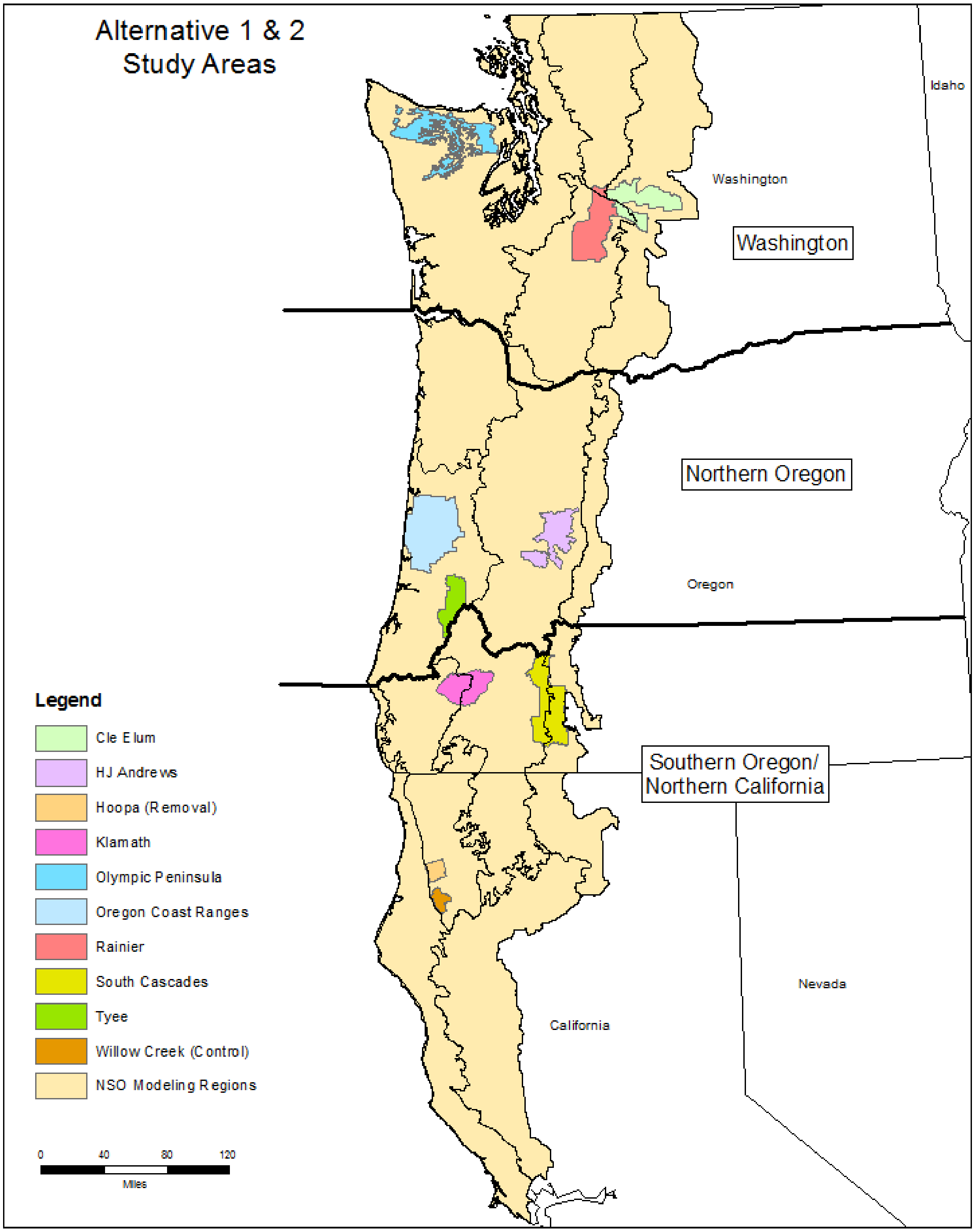
Using an ongoing spotted owl demography study area provides the strongest test of effects of the removal experiment (see Appendix H of this Final EIS). However, using a single study area limits the applicability of the results; results would be most pertinent to only a portion of the range of spotted owl and extrapolating results to the entire spotted owl range would be difficult.

The estimated duration of barred owl removal for this alternative varies by study area, due primarily to the size of the study area and the number of spotted owl sites (Table 2-1). Smaller study areas or areas with fewer spotted owl sites would take longer to detect statistically significant results.

Table 2-1. Duration of removal study by study area choices in Alternative 1.

Study Area	Duration of Barred Owl Removal (years)
Cle Elum	7
Olympic Peninsula	5
Rainier	6
Oregon Coast Ranges	4
Tyee	4
HJ Andrews	4
Klamath	4
South Cascades	4
Hoopa (Willow Creek)	5

Figure 2-3. Study areas for Alternatives 1 and 2.



2.2.3.3 Alternative 2

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Demography	Combined	3	Yes	4	5

This alternative involves a demography study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on three study areas spread across the range of the northern spotted owl. To ensure that this represents the various conditions across the range of the northern spotted owl, the three study areas would be distributed such that one is in each of three regions described above in Section 2.1.2 of this Final EIS.

We are considering the use of any three of the nine ongoing spotted owl demography study areas that fit the distribution (Figure 2-3). This alternative may include the use of both lethal and nonlethal removal in Olympic or Mount Rainier National Parks (but not both). We already evaluated the individual study areas under Alternative 1. The effects of removal activities on these study areas are independent of one another; each acts and reacts independently. That is, demography research activity on one ongoing spotted owl demography study area would not change the effects on other areas. Therefore we can simply add the effects described for the individual study areas. Using three ongoing spotted owl demography study areas provides the strongest test of the effects of removal (see Appendix H of this Final EIS).

While we are considering all possible combinations of study areas to provide decision makers with the best options for the Final EIS, we would evaluate and describe effects based on three combinations of study areas—those with the largest effect in each category (e.g., barred owl, economic), the smallest effect, and the three study area approach developed by the Barred Owl Work Group. All combinations would fall within these values.

Given the size and number of spotted owl sites in the combined study areas, this alternative would require an estimated duration of 4 years of barred owl removal to secure statistically significant results.

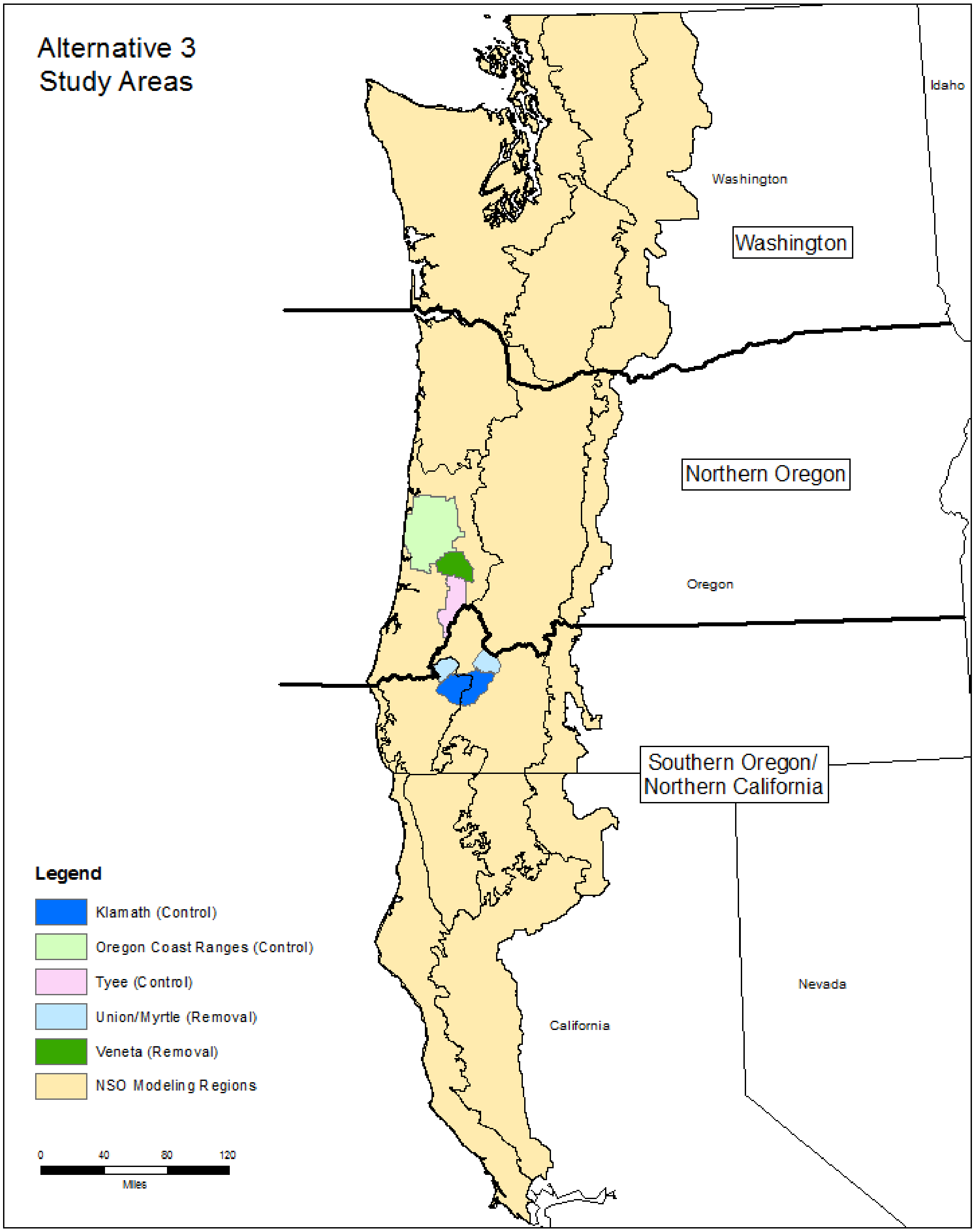
2.2.3.4 Alternative 3

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Demography	Combined	2	Yes	4	5

This alternative involves a demography study approach using a combination of lethal and nonlethal removal methods. Portions of this experiment would be conducted on two study areas that are not ongoing or are inactive spotted owl demography study areas, but that have data to allow an estimate of pretreatment spotted owl population trends (Figure 2-4). We were able to identify two locations that have the required background information to develop these estimates—Veneta and Union/Myrtle. The Union/Myrtle area has long-term monitoring data that are adequate to model past spotted owl demographic performance. The Veneta area has research and monitoring data that, with information from the adjacent Oregon Coast Ranges and Tyee Spotted Owl Demography Study Areas, would allow us to estimate pretreatment spotted owl population trends and survival rates. Both have current or recent data on most spotted owl sites and banded spotted owls. However, given the relatively small size of the areas, they would not provide a strong experiment by themselves. Therefore, Veneta and Union/Myrtle would be the treatment (removal) portion of the study area, paired with control (non-removal) areas on adjacent ongoing spotted owl demography study areas. The Union/Myrtle area would be paired with the Klamath Spotted Owl Demography Study Area. The Veneta area would be paired with comparable portion of Tyee and/or Oregon Coast Ranges Spotted Owl Demography Study Areas. The location of the control area for Veneta would be determined in the final research plan.

Given the size and number of spotted owl sites in the two study areas, this alternative would require an estimated duration of 4 years of barred owl removal to secure statistically significant results.

Figure 2-4. Study areas for Alternative 3.



2.2.3.5 Alternative 4

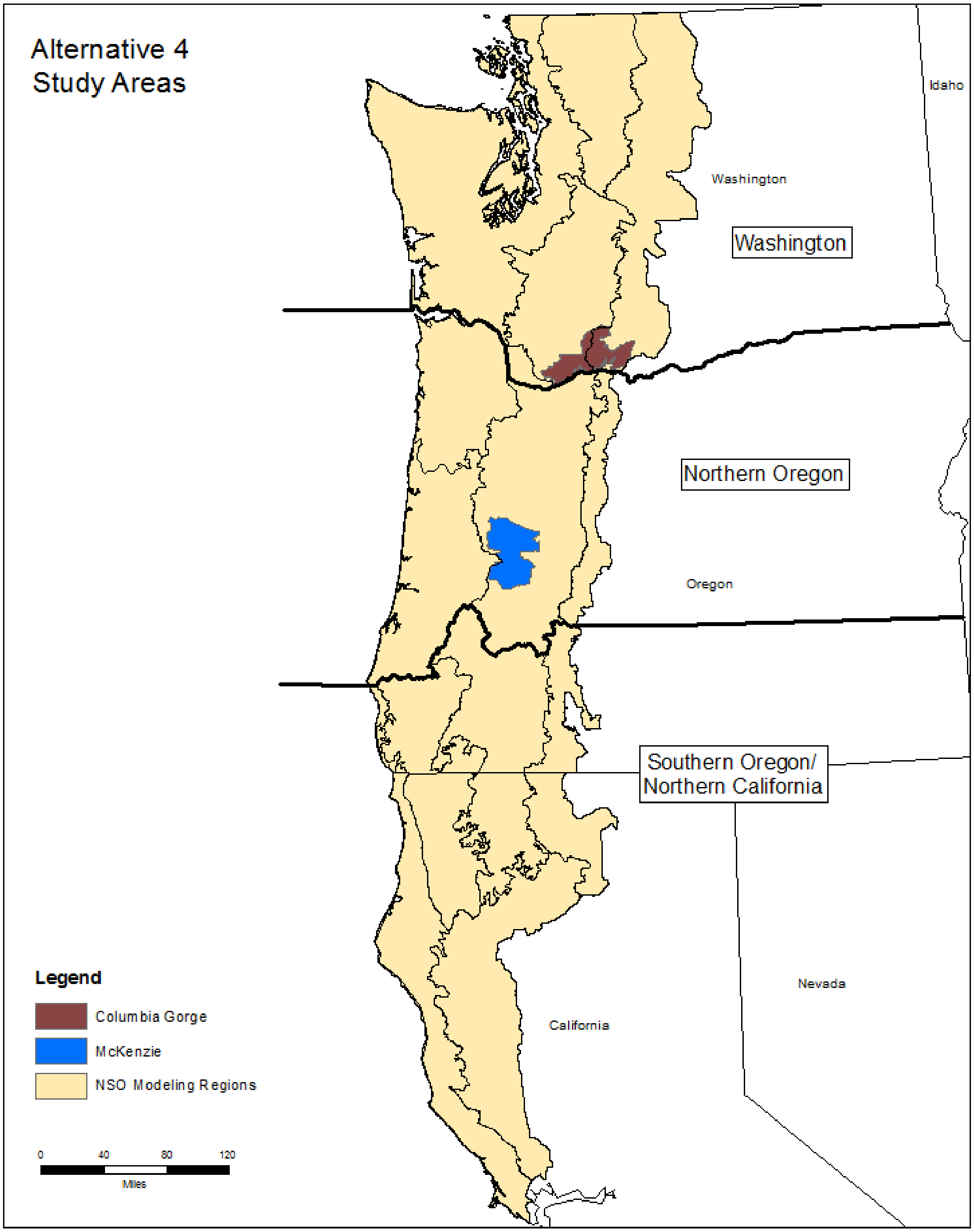
Sub-Alternative	Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
a	Demography	Combined	2	No	5	10
b	Demography	Combined	2	No	6	8

This alternative involves a demography study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on two study areas that lack current demographic data—Columbia Gorge in Washington and McKenzie in Oregon (Figure 2-5). This would cover two of the three regions described in Section 2.1.2 of this Final EIS. These two study areas have some past and current spotted owl survey data. The Columbia Gorge Study Area has no banded spotted owls. The McKenzie Study Area has current banded spotted owls on a portion of the study area.

Alternative 4 includes two sub-alternatives. Under sub-Alternative 4a, we would take time to gather pretreatment demographic data before beginning the removal portion of the experiment. Under sub-Alternative 4b, we would start removal on the treatment portion of the study area in year 3, immediately after establishing a population of banded spotted owls, and rely on differences between the control and treatment areas to determine the effects of removal. Lack of pretreatment data reduces the strength of the experimental approach.

Sub-Alternative 4a would require 5 years of pre-removal data collection to establish demographic values (population trend, survival, recruitment), and 5 years of barred owl removal to establish changes in these demographic measures between the control and treatment areas. Sub-Alternative 4b would require approximately 8 years; 2 years to develop a population of banded spotted owls for analysis, and 6 years of barred owl removal to develop the demographic measurements and detect differences between the control and treatment areas.

Figure 2-5. Study areas for Alternative 4.



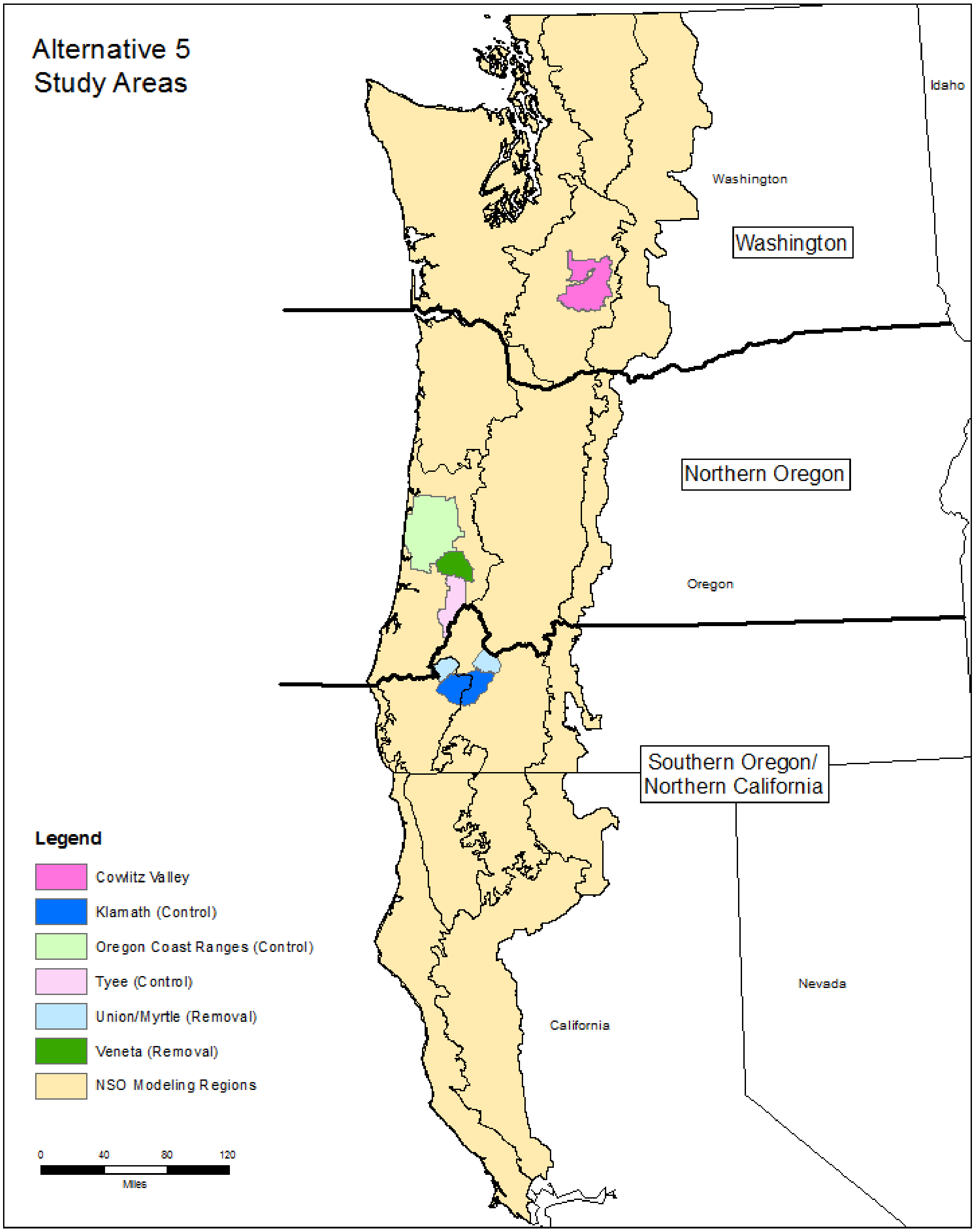
2.2.3.6 Alternative 5

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Occupancy	Lethal	3	No	3 to 5	4 to 6

This alternative involves an occupancy study approach using lethal removal methods. There are two options for collecting occupancy data. Option 1 is a simple occupancy experiment looking only at presence or absence of spotted owls on each site. Option 2 includes the simple occupancy data along with additional information on reproductive success. This experiment would be conducted on three study areas with existing and recent occupancy data distributed across the range of the northern spotted owl (Figure 2-6). We chose not to use ongoing spotted owl demography study areas to avoid conflicts with the ongoing research on those areas. This approach does not require banded birds and demographic data. The need for current occupancy data limits our options. Few areas are surveyed consistently except for ongoing spotted owl demography study areas. We were able to select the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas for this alternative. Fortunately, these cover the three regions of the spotted owl range. As described in Alternative 3, the Veneta and Union/Myrtle areas would be treatment (removal) areas paired with control (non-removal) areas on adjacent ongoing spotted owl demography study areas (Oregon Coast Ranges and/or Tyee paired with Veneta, and Klamath paired with Union/Myrtle).

Given the size and number of spotted owl sites on the three study areas, a simple presence/absence occupancy experiment would require 3 years of barred owl removal to detect differences between the control and treatment areas. If we add reproductive success to the experiment, it would require an additional 2 years, bringing the duration of barred owl removal to 5 years.

Figure 2-6. Study areas for Alternative 5.



2.2.3.7 Alternative 6

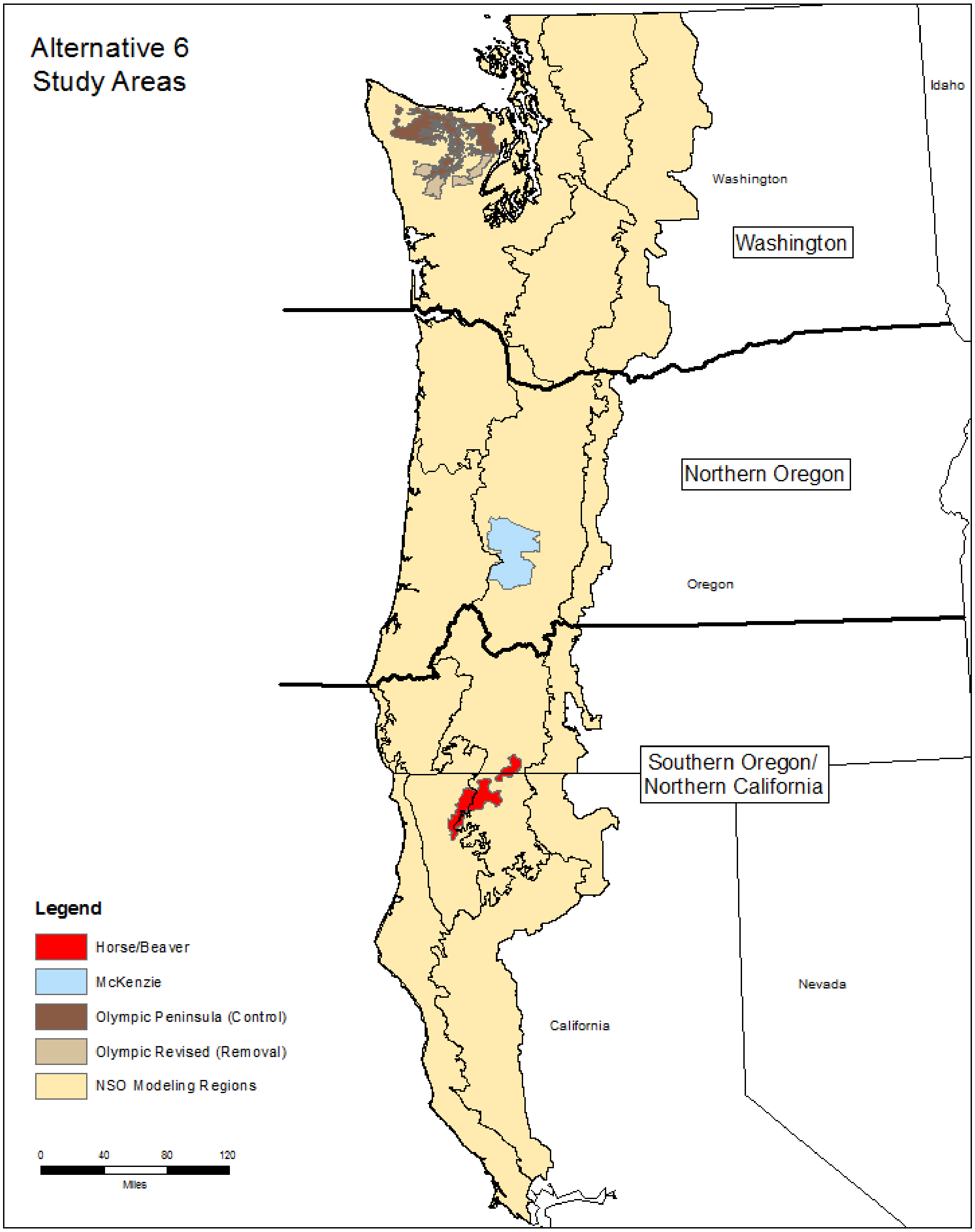
Sub-Alternative	Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
a	Occupancy	Combined	3	No	3 to 5	6 to 8
b	Occupancy	Combined	3	No	4 to 6	5 to 7

This alternative involves an occupancy study approach using a combination of lethal and nonlethal removal methods. This experiment would be conducted on three study areas that do not have current occupancy data (Figure 2-7). Barred owls would be removed from the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area, with a control (non-removal) area on the Olympic Peninsula Spotted Owl Demography Study Area. The McKenzie and Horse/Beaver Study Areas include both treatment (removal) and control areas. This alternative may include surveys, but no removal in Olympic National Park. These study areas cover the three regions of the spotted owl range.

Alternative 6 includes two sub-alternatives. Under sub-Alternative 6a, we would take time to gather pretreatment occupancy data before beginning the removal portion of the experiment. Under sub-Alternative 6b, we would start removal on the treatment portion of the study area immediately and rely on differences between the control and treatment areas to determine the effects of the removal. Lack of pretreatment data reduces the strength of the experimental approach and potential variability.

Sub-Alternative 6a would require 3 years of pre-removal data collection to establish occupancy values and 3 years of barred owl removal to establish changes in occupancy between the control and treatment areas, for a total of 6 years for simple occupancy data, and 2 additional years of barred owl removal if we add reproductive success measurements. Sub-Alternative 6b would require approximately 4 years of barred owl removal for simple occupancy, and 2 additional years of barred owl removal if we add reproductive success measurements.

Figure 2-7. Study areas for Alternative 6.



2.2.3.8 Alternative 7

Study Type	Control Type	Number of Study Areas	Existing Pretreatment Data?	Duration of Barred Owl Removal (years)	Total Experiment Duration (years)
Occupancy and Demography	Combined	11	Yes for ongoing spotted owl demography study areas and some occupancy study areas	Varies by study area. From 3 to 10 years	Varies by study area. From 4 to 11 years

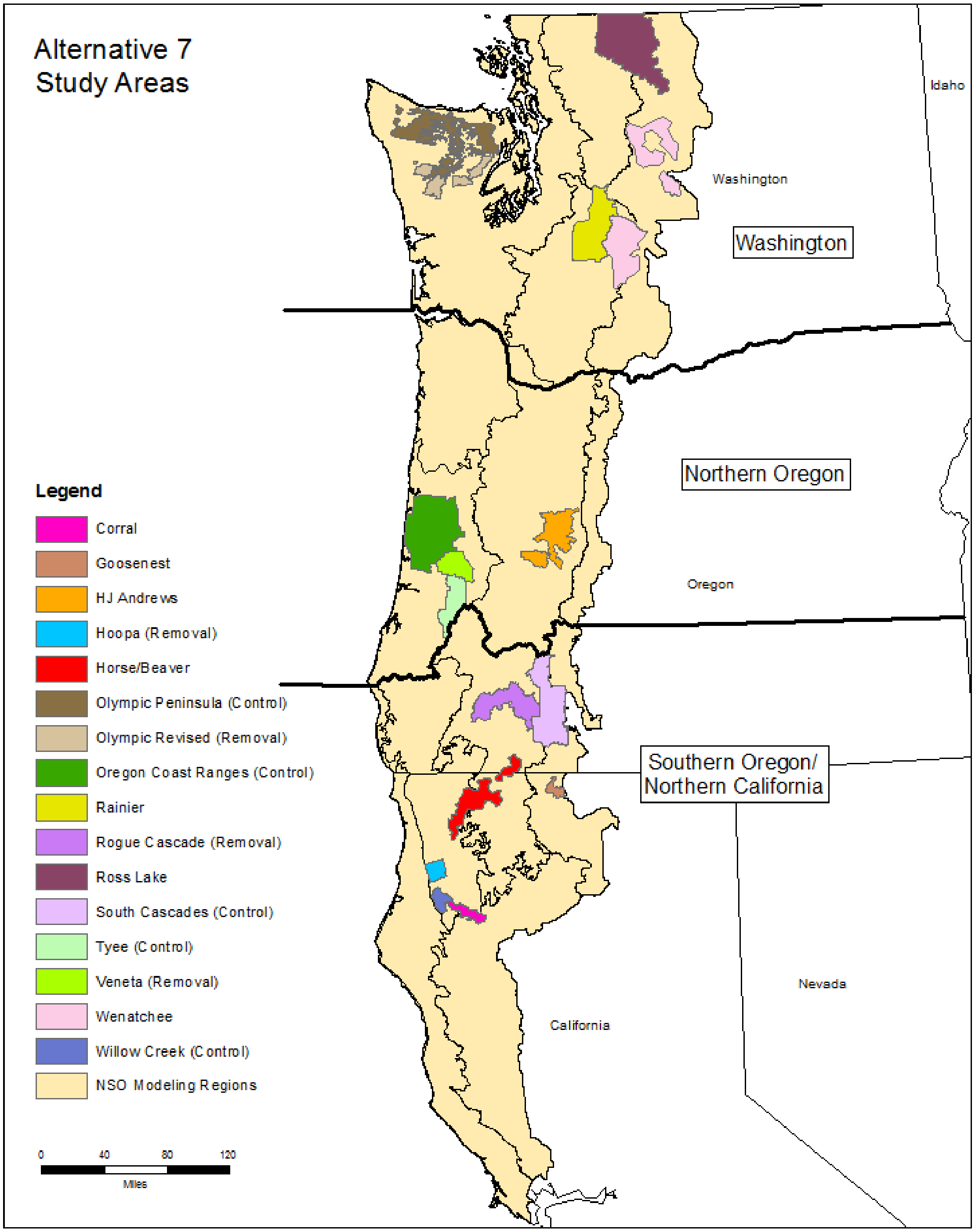
This alternative involves both demography and occupancy approaches, depending on the study area, using a combination of lethal and nonlethal removal methods. For this alternative, we selected a total of 11 study areas (Figure 2-8). We attempted to select one from each physiographic province to provide stronger information from across the range of the northern spotted owl. In some cases, where study areas have few potential spotted owl sites, more than one was selected within a province to provide sufficient sample size. In very large provinces, additional study areas were included to provide better distribution of results. This alternative may include the use of lethal and nonlethal removal methods in Mount Rainier and North Cascades National Parks. It may also include surveys, but no removal in Olympic National Park.

For most study areas we estimated the duration based on the time required to detect statistically significant results relative to the effects of removal on spotted owls (Table 2-2). For four study areas spread across the range of the spotted owl we would continue barred owl removal for 10 years to determine the long-term effects of removal. For example, whether observed changes in spotted owl populations continue past the initial phase, taper off, or even reverse after the initial years of the experiment.

Table 2-2. Summary of study type and duration of the experiment by study area for Alternative 7.

Study Areas	Study Type	Duration of Barred Owl Removal (years)
Ross Lake	Occupancy	10
Wenatchee	Occupancy	3
Olympic Revised (Olympic Peninsula)	Occupancy and reproduction	4
Rainier	Demography	6
Veneta (Oregon Coast Ranges/Tyee)	Demography	10
HJ Andrews	Demography	4
Rogue-Cascades (South Cascades)	Occupancy	4
Horse Beaver	Occupancy	4
Goosenest	Occupancy and reproduction	10
Hoopa (Willow Creek)	Demography	10
Corral	Occupancy	10[1]
[1] Due to the small sample size, the experiment on the Corral Study Area are estimated to require 10 years to detect a statistically significant result. This is not one of the areas designed to measure long-term effects.		

Figure 2-8. Study areas for Alternative 7.



2.2.3.9 Summary of Action Alternatives

Table 2-3. Summary description of action alternatives.

Alternative or Sub-Alternative	Type of Study	Type of Control	Number of Study Areas	Pretreatment Data	Duration of Barred owl Removal (years)	Total Experiment Duration (years)
Preferred	Demography	Combined	4	Existing	4	5
1	Demography	Lethal	1	Existing	4 to 7	5 to 8
2	Demography	Combined	3	Existing	4	5
3	Demography	Combined	2	Data available to calculate	4	5
4a	Demography	Combined	2	None—collect pretreatment data before starting treatment	5	10
4b	Demography	Combined	2	None—start treatment immediately without pretreatment data	6	8
5	Occupancy	Lethal	3	Existing data on site occupancy and other historical data	3 to 5	4 to 6
6a	Occupancy	Combined	3	None—collect pretreatment data before starting treatment	3 to 5	6 to 8
6b	Occupancy	Combined	3	None—start treatment immediately without pretreatment data	4 to 6	5 to 7

7	Demography and Occupancy	Combined	11	Yes for five study areas	3 to 10	4 to 11

2.3 Alternatives Considered and Dismissed from Detailed Analysis

Several additional alternatives were considered and dismissed from detailed analysis.

2.3.1 Site-Specific Study Approach

This approach (Johnson *et al.* 2008, pp. 14, 18, 19) removes barred owls around individual spotted owl sites, and evaluates barred owl effects at the multiple but individual spotted owl sites. With a sufficient sample size, data from individual sites may be pooled.

This experimental approach was dismissed from detailed consideration because:

- It does not allow identification of vital rates that are influenced by competition. Response variables are limited to occupancy, abundance, productivity, etc., but not survival. Survival data provides information on the mechanism by which barred owls are influencing spotted owl population change.
- The influence of confounding biotic and abiotic factors is greater than other approaches due to the scattered nature of the sites. The large and scattered spatial scale used greatly limits interpretation of turnover rates and provides a low ability to detect differences (strength of inference) which limits likely success of this approach.
- There are substantial logistic limitations:
  - Most barred owls must be removed from a large area around each spotted owl site and maintained for the years of the experiment to determine the effect of removal. This requires a very large removal effort in relation to the information gained.
  - The large surface-to-interior ratio of the relatively small treatment areas around each site allow for extensive and rapid recolonization by barred owls. This makes it more difficult to maintain any areas free of barred owls for any substantial period of time.
- This approach does not provide information that could not be gathered in a more effective and efficient manner by any of the other action alternatives. The data collected are similar to occupancy studies (Alternatives 5 and 6). The number of barred owls removed and the effort required to follow spotted owls is higher overall and per site than the other action alternatives.

2.3.2 Invasion Study

This demography-type study (Johnson *et al.* 2008, pp. 14–16) can only be conducted in areas where barred owls are just beginning to expand. It involves maintaining barred owl numbers at low levels on treatment (removal) areas and following changes in spotted owl populations as barred owls increase on control (non-removal) areas.

This study approach was dismissed from detailed consideration because:

- It is limited to very specific conditions at the leading edge of the barred owl range expansion, or other locations where barred owl populations are currently very low but are anticipated to substantially increase within a few years.
- Few, if any, areas with spotted owl populations large enough to track changes are currently in this condition and, given the continuing expansion of barred owl populations, even fewer are likely to be in the early invasion stage by the time this study is implemented.
- Any potential study areas are limited to the very southern end of the spotted owl range, making the information of limited application to most of the spotted owl's range;
- This approach has the potential to take a long time to yield results that would meet our purpose and need, which is evaluating the effects of barred owls on spotted owl populations.
- There is no guarantee that we would be able to detect the effects early in the expansion, which would further delay results.

2.3.3 Targeted Partial Removal of Barred Owls

Under this approach, rather than remove all barred owls within the treatment area, we would remove a set proportion of barred owls or reduce barred owl populations to a specific density and track the effects on spotted owl populations. If enough experiments were conducted with different levels of barred owl removal, we might be able to determine the threshold level at which barred owl populations begin to adversely affect spotted owl populations. To ensure addressing the purpose and need, at least one study site would have to include complete removal.

This experimental approach was dismissed from detailed consideration because:

- This approach would require a large number of experimental sites at various levels of barred owl removal to determine if a threshold exists, resulting in very high costs both in financial expense and barred owls removed. Replication of results would require even more study areas.
- Even with many study areas, it is highly unlikely we would be able to detect the threshold at which barred owls densities affect spotted owl populations.
- Maintaining barred owl density at a specific level would be very difficult and costly, requiring ongoing, intensive monitoring of barred owl populations on each treatment area to determine the number and locations of all barred owls not targeted for removal. Variations in density would make it even more difficult to detect the threshold density.
- For study areas where too few barred owls are removed to affect spotted owl populations, the cost in time, money, and barred owls removed would result in little information to inform any future decision processes, and therefore an experiment of this type. This approach would not meet the purpose and need.

2.3.4 Reproductive Interference

This approach is aimed at reducing the productivity of territorial barred owls by removing eggs from nests, rendering eggs unviable (e.g., oiling eggs), surgical sterilization, or immuno-contraceptive vaccines.

This study approach was dismissed from detailed consideration because:

- This approach may eventually cause the territorial barred owl population to decline, but only after the existing territorial birds die and external sources of recruits dry up, which could take well over a decade given the lifespan of barred owls.
- It is highly unlikely that we would be able to reduce reproduction by barred owls over an area large enough that dispersers (which may come from many miles away) would not be able to successfully replace those barred owls dying of natural causes. We would therefore never effectively eliminate the barred owl conflicts with spotted owls and never answer our primary question as to whether barred owls affect spotted owl populations.
- Finding nests and removing or destroying eggs would require that we find nests early in the nesting season every year and track any renesting efforts, something we do not have the ability to do at this time. Finding barred owl nests is difficult, and missing even a few would provide replacements for older barred owls that die, resulting in few or no empty sites for spotted owls to colonize. It would be nearly impossible to completely eliminate barred owl influence on enough spotted owl pairs to adequately test our hypothesis.
- The costs of conducting sterilization work likely would equal or exceed costs of even nonlethal removal, at least on a site-by-site basis. Sterilization would require capture and handling every barred owl encountered; egg oiling would require finding and entering nest trees at least once a year (or more often, as barred owls have been shown to renest following nest failure).

Based on these limitations, this approach would not address our purpose and need.

2.3.5 Studies of Species Interaction without Removal

This approach focuses on observational studies of barred owl and spotted owl ecology, and the interactions between the two species. Limitations of this approach include:

- While observations may provide information on potential underlying mechanisms, such an experiment would not directly test the impact of barred owls on spotted owl populations.
- This study approach would not test the effects of barred owl removal on spotted owl populations or provide information on the effectiveness of removals in stemming spotted owl population declines.
- Some studies and monitoring efforts already have shown declines of spotted owls where barred owls invade, and the public has indicated they want data from designed studies where a clear cause and effect relationship can be demonstrated. While observational studies can establish an association between barred owl presence and spotted owl

declines, they cannot clearly identify barred owls as the cause of the declines; this is because other factors such as weather or habitat differences are not accounted for.
- We anticipate the cost of observational studies to be exceedingly high, resulting from the need to have numerous trained individuals available to conduct such observations, in light of the difficulties in locating such potential encounters.

Therefore, this approach does not meet our purpose and need.

2.3.6 Remove Food Competition with Supplemental Feeding

Two potential methods have been proposed: (1) feed spotted owls to reduce food stress or (2) feed barred owls to reduce competition for native prey. Limitations of this approach include:

- This approach assumes that food competition is the sole or primary mechanism by which barred owls affect spotted owl populations, rather than competition for space (territory) or aggressive encounters, and that treatment of food competition would allow the two species to coexist in the same areas.
- While competition for food probably occurs, current information indicates that competition for space and aggressive interactions are more likely causes of the effects on spotted owls and their populations.
- If the assumption that food is the limiting factor is incorrect, this approach would provide little or no information to inform future barred owl management decisions and discussions regarding other potential competitive factors.
- The costs and operational difficulties of daily supplemental feeding of hundreds of spotted owls and/or barred owls would be logistically infeasible and economically extremely costly.
- Influences on the wildness of artificially fed spotted owls could have consequences that would reduce spotted owl overall survival and fitness.

This approach would not directly address questions on the effects of barred owls on spotted owls or meet the purpose and need.

2.3.7 Forest or Habitat Management to Favor Spotted Owls and Hinder Barred Owls

This approach combines observational assessments of spotted owl habitat use and their responses to specific forest management actions. Limitations of this approach include:

- This approach assumes that there are forest conditions under which spotted owls have a competitive advantage over barred owl and that we can manage for these conditions.
    - To date, barred owls have been shown capable of occupying all types of habitat used by spotted owls, despite attempts in demography studies to examine potential differentiation between the two species habitat use.

  - While barred owls have not displaced spotted owls as rapidly in some areas and under some conditions, there are no substantial areas where barred owls are not present, or will not be present within the next few years.
- Managing habitat to be favorable and beneficial to spotted owls and simultaneously unfavorable to barred owls would require a very long time to test, with limited potential for success.
- During the time required to manage forests for changed habitat conditions and then detect a response from spotted owls, barred owl populations would continue to increase and expand, not meeting the urgent need for information to help us determine feasible options to respond to the barred owl threat in a timely manner.

This approach would not directly address questions on the effects of barred owls on spotted owls or meet the purpose and need.

2.3.8 Northern Spotted Owl Captive Propagation

This approach uses captive propagation of northern spotted owls for release into the wild to bolster wild spotted owl populations. Limitations of this approach include:

- This assumes that released spotted owls would survive, despite the fact that there are no changes to the conditions that resulted in current population levels.
- Unless factors resulting in the current decline of spotted owl populations are removed or modified, placing new spotted owls into the current habitat under current conditions is highly unlikely to boost spotted owl populations and would likely result in the death of the released individuals. In the worst case, these additional spotted owls could put greater pressure on the remaining spotted owls by competing for limited food or space resources.
- If captive propagation proved successful, and spotted owls could be successfully released into the wild, it would not result in recovery of the spotted owl, or be an effective long-term management tool.
- This would require intensive, perpetual management that would only be practicable if it were determined that interspecific interactions between barred and spotted owls are not causing a negative effect on spotted owl recovery.

This approach would not address the underlying issue of determining whether barred owl competition is causing negative effects to northern spotted owl recovery and, therefore, would not meet the purpose and need.

2.3.9 Nonlethal Removal Method

This method involves capture and transport of barred owls out of the study area. Nonlethal removal is only possible to the extent we have permanent locations ready to accept the captured birds. We examined several placement options based on two general approaches: translocation and release to the wild or permanent captivity.

To avoid spreading the barred owls more quickly in the west, we limited considering translocation to the historical (pre-1900) range of the northern barred owl, the subspecies we now have in the west. Translocations are most likely to be successful and not result in the death of the animal where barred owl populations do not already saturate the available habitat. We contacted states in the historical range of the northern barred owl to determine if they were interested in receiving barred owls for relocation. None of the responding states expressed interest in receiving captured barred owls; the primary reason being lack of empty habitat. Therefore translocation is not a viable option.

We considered the option of captive holding, both temporary and permanent. Temporary captivity would require maintaining captured barred owls for the duration of the removal portion of the experimental (3 to 10 years) by which time any surviving birds would lose their wildness and are not suitable for release back into the wild. Therefore, we do not consider temporary captivity a viable option.

Permanent captivity is the only remaining option for placement of birds captured and removed from the study areas. Based on a preliminary survey of zoos, zoological parks, and related facilities, we found interest and potential placement for only five individual birds. Even with additional efforts, we do not anticipate finding adequate facilities for over 100 barred owls.

All the action alternatives require the removal of more than 100 barred owls. Since we would not capture barred owls without a location ready to accept them, none of the alternatives could be implemented if limited to nonlethal removal. Therefore, an alternative based solely on a nonlethal removal method would not meet our purpose and need.

Chapter 3
Affected Environment, Environmental Consequences, and Cumulative Effects

This chapter provides a description of the action areas and the current conditions within each action area (affected environment), and an analysis of the potential effects to the human environment (environmental consequences and cumulative effects). For the purposes of this Final EIS, "effect" is synonymous with "consequences" and "impact," and effects may be positive or negative. We identified potential effects for the following areas: barred owls, northern spotted owls, other species, values (social and ethical considerations), economic, cultural resources, and recreation and visitor use. We determined that there was no potential for effects to resource areas such as air, water, and wetlands.

3.1 Description of the Affected Environment

3.1.0 Changes between Draft and Final EIS

- Updated the estimated number of barred owl sites anticipated to occur within each of the Oregon/California study areas. These revisions resulted from updated survey data for the Hoopa (Willow Creek) Study Area, including focused survey data through the 2012 field season (see Section 3.2 of this Final EIS for details of estimation method).

3.1.1 Introduction

For this experiment, the environmental effects would occur within the identified study areas. Temporary and very limited effects on non-territorial barred owl populations may occur within a few miles of the study area boundary; no other effects beyond the boundaries of the study areas are anticipated. We have also considered effects in context of the entire range of the species. Thus, for the purposes of this EIS, the affected environment is made up of the study areas (Figure 2-1), and the affected environment for each alternative is made up of a combination of study areas. One study area may occur in more than one alternative, and alternatives may have more than one study area in the action area.

In most cases, each study area is independent—actions on one study area do not affect those on other study areas. This is due to the distance between study areas and the lack of substantial effects of the experiment beyond the study area boundary. We describe each study area below.

3.1.2 Washington

3.1.2.1 Ross Lake Study Area

DESCRIPTION. The Ross Lake Study Area (Figure 3-1) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 884,400 total acres, barred owl removal would occur on up to 442,200 acres, or up to one-half of the total study area. Portions of the study area are immediately south of a location where the Government of British Columbia is conducting barred owl removal as part of a recovery action for northern spotted owls.

The Ross Lake Study Area is located in Washington State, northeast of Seattle and adjacent to the Canadian border in Whatcom, Skagit, and Chelan Counties. The area lies within two physiographic provinces: 542,400 acres are in the Western Cascades Physiographic Province and 342,000 acres are in the Eastern Cascades Physiographic Province.

The Ross Lake Study Area includes areas on the east and west slope of the Cascade Range. It is an area with extremely high relief and deep, steep-sided valleys. Elevation ranges from 350 to 9,130 feet. The area's lower elevation forests are dominated by Douglas-fir and western hemlock. Mid- and high-elevation sites are dominated by Pacific silver fir and subalpine fir, alpine vegetation, ice, and rock. Forests on the east slope of the Cascades are dominated by mixed-conifer and ponderosa pine forests at lower elevations, and true fir and mountain hemlock at higher elevations. The primary spotted owl prey species in the area is the northern flying squirrel though other small mammals are also taken. The study area contains approximately 170,000 acres of spotted owl nesting and roosting habitat.

The Ross Lake Study Area includes a mixture of Federal and privately owned lands (Table 3-1). The U.S. Forest Service (Forest Service) administers approximately 23 percent of the study area, of which 5 percent is designated Late-Successional Reserve (Table 3-2). The Okanogan and Mount Baker National Forest lands include portions of the Pasayten, Noisy-Diobsud, Lake Chelan-Sawtooth, and Glacier Peak Wilderness Areas. The National Park Service administers 75 percent of the study area, including the Ross Lake and Lake Chelan National Recreational Areas, the North Cascades National Park, and the Stephen Mather Wilderness.

Table 3-1. Ross Lake Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	865,300	98
Forest Service	*201,100*	*(23)*
National Park Service	*664,200*	*(75)*
North Cascades National Park	*(484,800)*	
Lake Chelan National Recreation Area	*(62,600)*	
Ross Lake National Recreation Area	*(116,800)*	
Private Total	19,100	2
Total	**884,400**	**100**

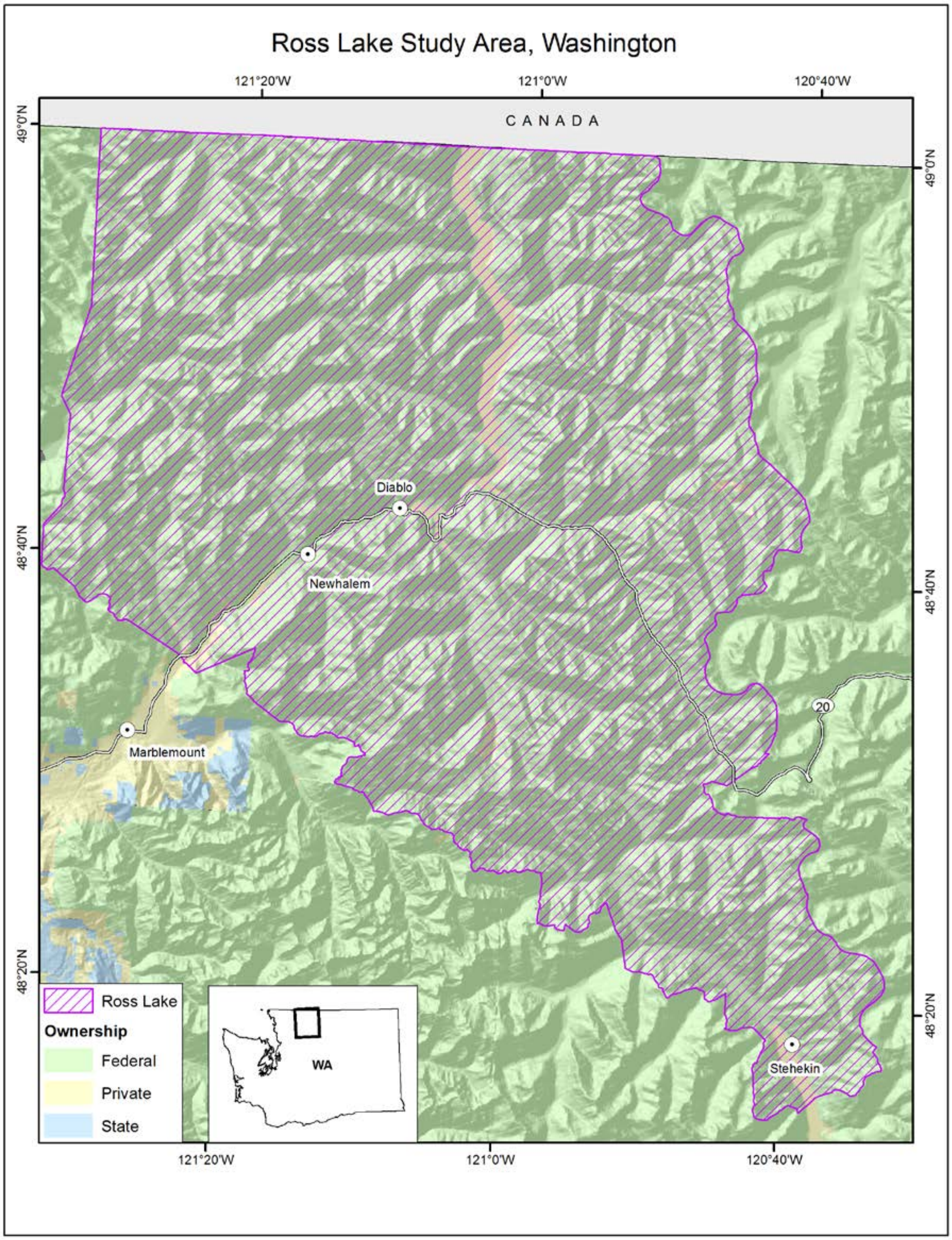
Table 3-2. Ross Lake Study Area Northwest Forest Plan land use allocations

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	92
Late-Successional Reserves	2
Administratively Withdrawn areas	6
Matrix and Riparian Reserves	less than 1
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. Within the lands administered by the National Park Service, the first systematic spotted owl survey for the North Cascades complex occurred in 1993 on the east side of the complex and in 1994 to 1996 on the west side. Numerous spotted owl surveys for project compliance occurred in subsequent years. From 2007 through 2010, researchers were able to resurvey most of the transects included in the 1993 to 1996 surveys and monitor all historical activity sites. The Ross Lake Study Area currently has 26 surveyed or known spotted owl sites. Based on habitat available, the study area has an estimated 78 potential spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. The first barred owl detection in the Ross Lake Study Area was recorded in 1972, with breeding barred owls first recorded in 1977. Within the areas administered by the National Park Service, numerous individual barred owls were detected during the 1993 to 1996 spotted owl surveys and even more were reported during the 2007 through 2010 surveys. Comparison of transect surveys clearly shows an increase in the number of barred owls in the area. Twenty-seven barred owl activity sites were identified on the west side transects in surveys from 1994 to 1996. Surveys of the same transects in 2009 and 2010 identified 34 barred owl activity sites. On the east side transects, 6 barred owl activity sites were identified in 1993, and 10 sites were identified in survey years 2007 and 2008. Based on the density of barred owls on a portion of the Cowlitz Study Area, we estimate that there are likely to be approximately 304 barred owl sites in the Ross Lake Study Area.

Figure 3-1. Ross Lake Study Area.



3.1.2.2 Wenatchee Study Area

DESCRIPTION. The Wenatchee Study Area (Figure 3-2) would include both treatment (removal) and control (non-removal) areas. Three separate sites make up this inactive spotted owl demography study area (Leavenworth, Naches, and Entiat). All were originally part of an independent demography study and were analyzed in 2003 as part of a rangewide northern spotted owl study, referred to as a demographic meta-analysis. Of the study area's approximately 905,100 total acres, barred owl removal would occur on up to 452,600 acres, or up to one-half of the total study area.

The Wenatchee Study Area is located in central Washington State, northeast of Seattle. It is mainly in Chelan County, with a small portion of Snohomish County. The area lies within two physiographic provinces: the Eastern Cascades and the Western Cascades.

The study area lies primarily on the east slope of the Cascade Range, an area with extremely high relief and deep, steep-sided valleys. Elevation ranges from 1,300 to 7,985 feet. The east slope forests are dominated by mixed-conifer and ponderosa pine forests at lower elevations, and true fir and mountain hemlock at higher elevations. The primary prey species for spotted owl in the area is northern flying squirrel, though other small mammals are also taken. The study area includes approximately 267,600 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, other government, and privately owned lands occurs in the Wenatchee Study Area (Table 3-3). The Wenatchee and Okanogan National Forests comprise approximately 93 percent of the study area, of which 42 percent is designated Late-Successional Reserve or Managed Late-Successional Areas (Table 3-4). The National Forests in the study area includes portions or all of the Alpine Lakes, Glacier Peak, Goat Rocks, Norse Peak, and William O. Douglas Wilderness areas.

Table 3-3. Wenatchee Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	837,700	93
State Total	9,000	less than 1
Private Total	58,400	7
Total	**905,100**	**100**

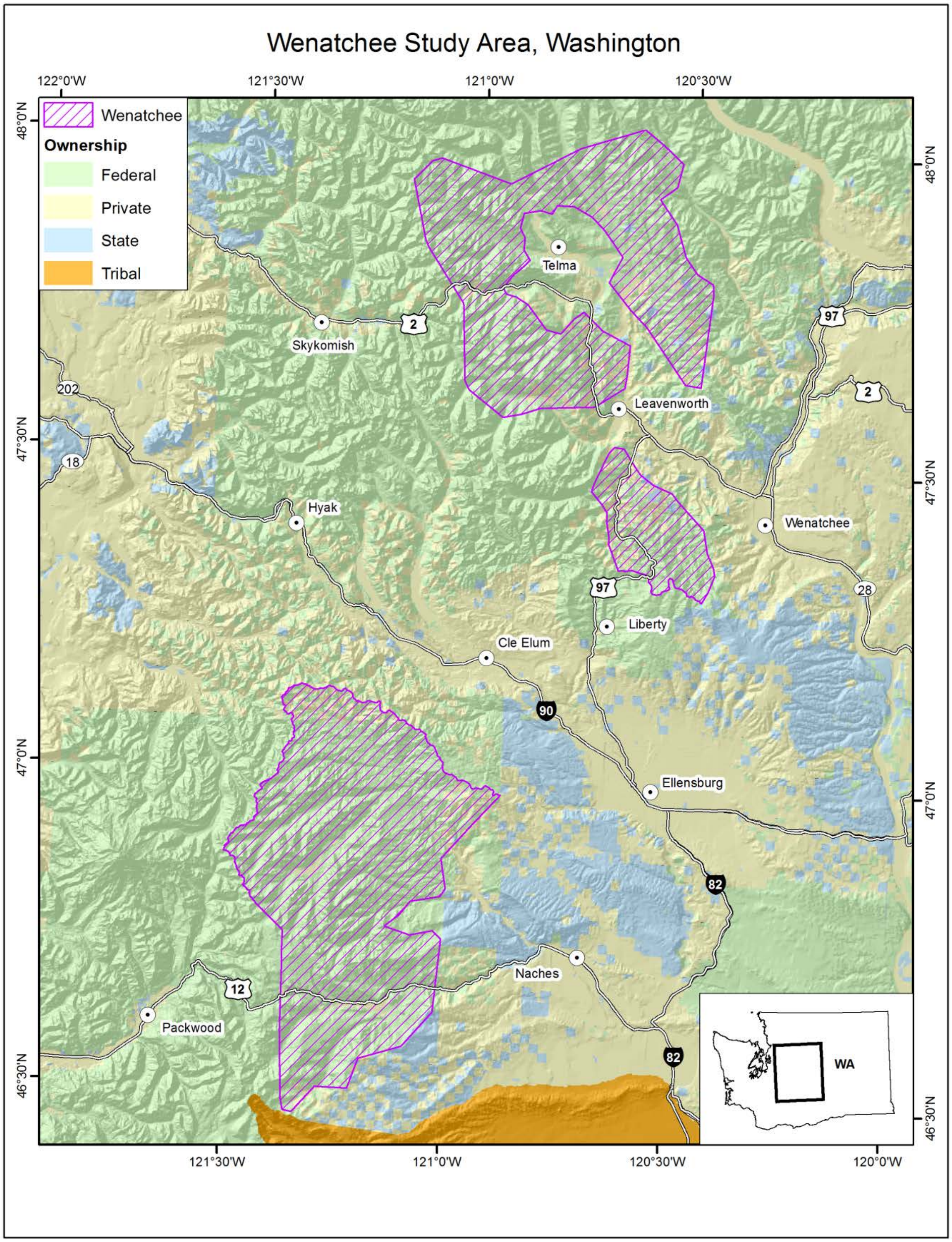
Table 3-4. Wenatchee Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	38
Late-Successional Reserves	42
Administratively Withdrawn areas	5
Matrix (includes embedded Riparian Reserves)	15
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. This area has been included in past rangewide northern spotted owl demographic analyses, but is not part of the Northwest Forest Plan Effectiveness Monitoring Program. The Wenatchee study began in 1990 with approximately 106 owl sites known from prior surveys. The study area expanded in 1992 by approximately 30 percent, including additional owl sites that had been detected in prior surveys. Sites in this area were surveyed annually from 1990 to 2003, at which time field researchers reduced the effort by half due to funding constraints. The field crews randomly selected 50 percent of sites for continued monitoring. The Wenatchee Study Area currently has 161 surveyed or known spotted owl sites. Based on habitat available, the area has the potential for an estimated 188 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the study area in 1991. The proportion of spotted owl sites with barred owl detections increased from over 10 percent in 1991 to 35 percent in 2003. Based on the density of barred owls on a portion of the Cowlitz Study Area, we estimate that there are likely to be approximately 479 barred owl sites in the Wenatchee Study Area.

Figure 3-2. Wenatchee Study Area.



3.1.2.3 Cle Elum Study Area

DESCRIPTION. The Cle Elum Study Area (Figure 3-3) would include both treatment (removal) and control (non-removal) areas. This area is one of the eight long-term, ongoing spotted owl demography study areas selected as part of the Effectiveness Monitoring Program of the Northwest Forest Plan. Of the study area's approximately 440,800 total acres, barred owl removal would occur on up to approximately 220,400 acres, or up to one-half of the total study area.

The Cle Elum Study Area is located in central Washington State, east of Seattle in Kittitas County.

This study area lies on relatively gentle slopes on the east side of the Cascade Mountains, with elevation ranging from 1,945 to 6,835 feet. The area is characterized by warm, dry summers and cold winters, with most precipitation occurring as snow during winter. The dominant forest vegetation is eastside mixed-conifer. Forest vegetation generally extends from the lowest valleys to the highest ridges, dominated by mixed-conifer stands of Douglas-fir, grand fir, and ponderosa pine. The primary spotted owl prey species in the area is northern flying squirrel, though other small mammals are also taken. The study area contains approximately 143,700 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Cle Elum Study Area (Table 3-5). The Wenatchee and Snoqualmie National Forests comprise approximately 61 percent of the study area, of which 54 percent is designated Late-Successional Reserve (Table 3-6). A small portion of the Alpine Lakes Wilderness lies within the study area to the north.

Table 3-5. Cle Elum Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	271,200	61
State Total	30,300	7
Private Total	139,300	32
Total	**440,800**	**100**

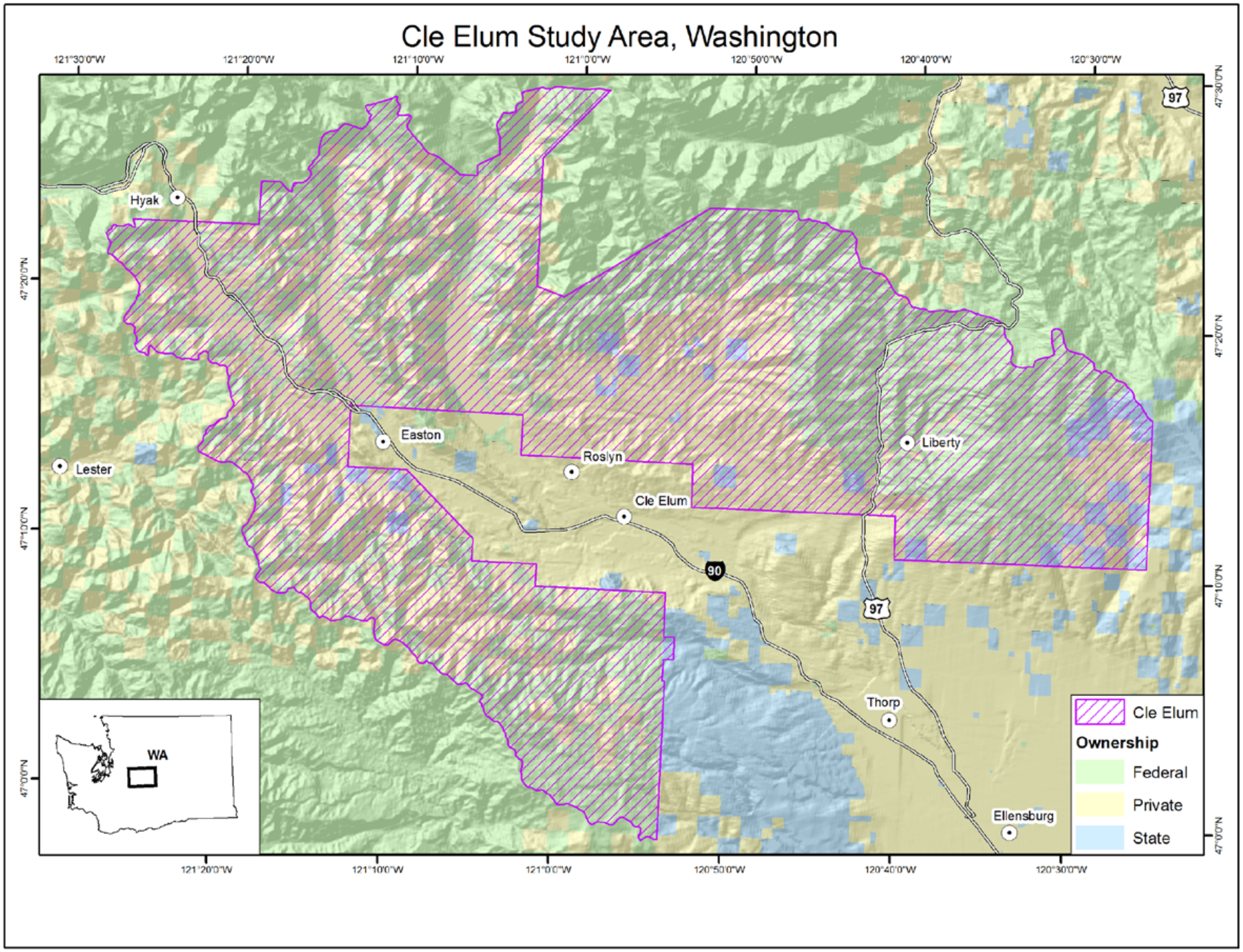
Table 3-6. Cle Elum Study Area Northwest Forest Plan land use allocations

Northwest Forest Plan Land Use Allocations	Percent of Federal Lands
Congressional Reserves	less than 1
Late-Successional Reserves	55
Adaptive Management Area	37
Administratively Withdrawn	2
Matrix (included embedded Riparian Reserves)	6
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. A study was initiated in 1989 to determine demographic trends in spotted owls on the east slope of the Cascade Range, including age- and sex-specific survival rates, reproductive rates, and overall population trends. Surveys were done yearly from 1989 to 1993. In 1994, this area became part of the Northwest Forest Plan Effectiveness Monitoring Program. Spotted owl surveys continue to be conducted annually. The Cle Elum Study Area has 87 known historical sites, 75 of which are surveyed annually. Based on habitat available, the area has an estimated potential for 99 spotted owl sites, though it is unknown if those are or ever have been occupied.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Cle Elum Study Area in 1989. The proportion of spotted owl territories with barred owl responses increased from 1989 to 2002, after which time the proportion varied among years but did not increase above the 2002 level. In the current study area, 35 percent of spotted owl sites had at least one barred owl response in surveys for spotted owl. Based on barred owl density on a portion of the Cowlitz Study Area, we estimate that there are approximately 257 barred owl sites in the Cle Elum Study Area.

Figure 3-3. Cle Elum Study Area.



3.1.2.4 Olympic Peninsula Study Area

DESCRIPTION. The Olympic Peninsula Study Area (Figure 3-4) would include both treatment (removal) and control (non-removal) areas. This area is one of the eight long-term, ongoing spotted owl demography study areas selected as part of the Northwest Forest Plan Effectiveness Monitoring Program. For some alternatives, barred owl removal in the Olympic Peninsula Study Area would be up to one-half of the total study area, or approximately 317,200 acres of the total 634,400 acres.

The Olympic Peninsula Study Area is located in Washington State on the Olympic Peninsula west of Puget Sound and the city of Seattle. The area lies within Jefferson, Grays Harbor, and Clallam Counties and is entirely within the Olympic Peninsula Physiographic Province.

The Olympic Peninsula Study Area is mountainous with a wet, relatively warm maritime climate and elevation ranging from 95 to 7,655 feet. Numerous deep, large river valleys radiate out from the Olympic Mountain Range in the center of the peninsula. Precipitation occurs mainly as rain, and is especially heavy on the western slopes of the mountains. Vegetation is dominated by a mixture of coniferous rain forests on the west slopes and relatively dry Douglas-fir forests on the east side in the rain shadow. The primary spotted owl prey species is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 384,700 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Olympic Peninsula Study Area (Table 3-7). The Olympic National Forest comprises approximately 33 percent of the study area, of which 74 percent is designated Late-Successional Reserve (Table 3-8). The study area includes sections of the Buckhorn, Brothers, and Colonel Bob Wilderness Areas. The National Park Service manages the Olympic National Park and the Olympic Wilderness, which comprise 61 percent of the study area.

Table 3-7. Olympic Peninsula Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	599,400	94
Forest Service	*210,400*	
National Park Service	*389,000*	
State Total	16,700	3
Private Total	18,300	3
Total	**634,500**	**100**

Table 3-8. Olympic Peninsula Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	73
Late-Successional Reserves	27
Total Federal Land	**100**

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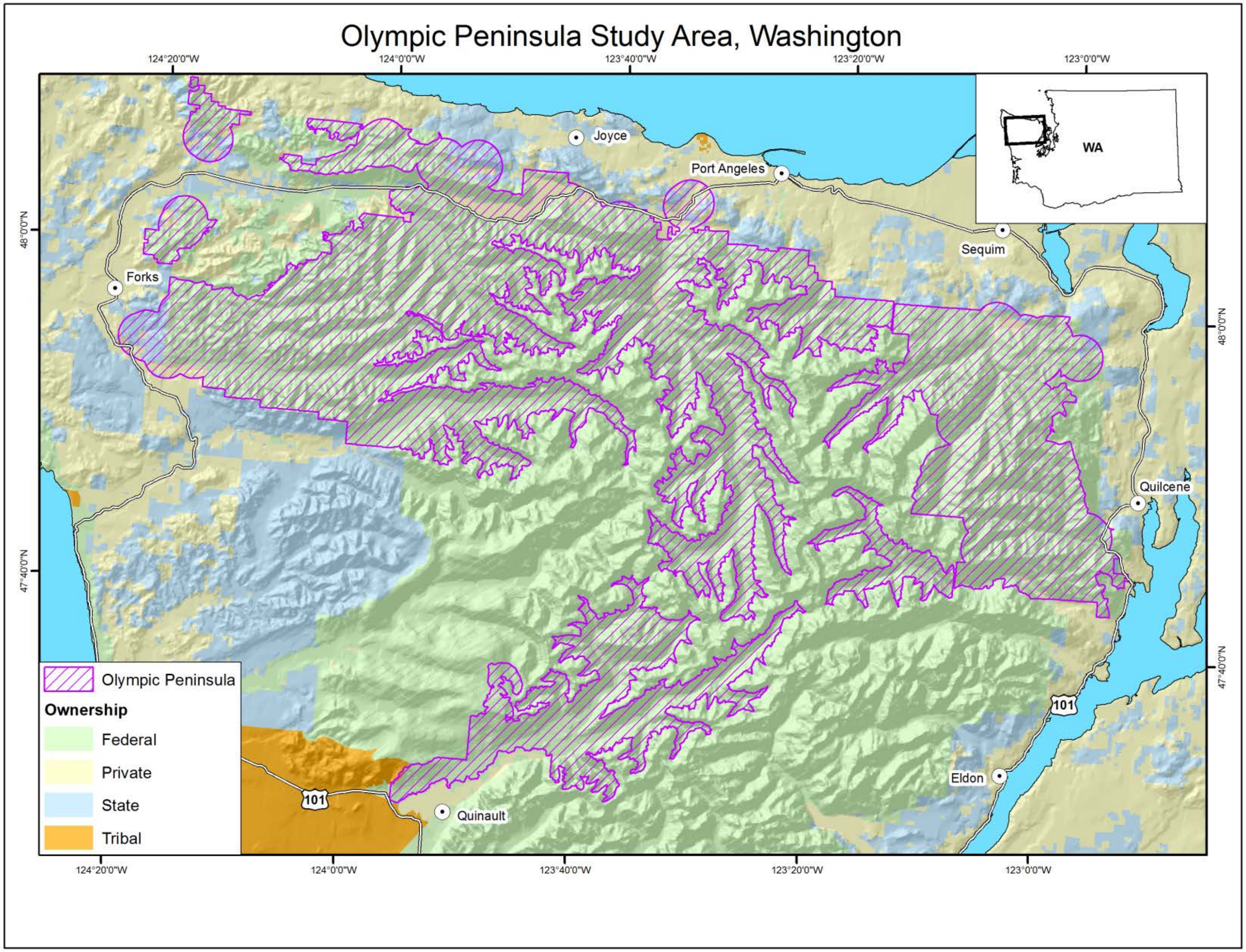
SPOTTED OWL POPULATION INFORMATION. A long-term spotted owl demography study was initiated in the Olympic Peninsula Study Area in 1987, and in 1994 the study area became part of the Northwest Forest Plan Effectiveness Monitoring Program. Portions of the study area are monitored by the Forest Service and portions by the National Park Service. The purpose of the demography study was to clarify population ecology of northern spotted owls by collecting data on survival, reproduction, population age structure, and population trends. Surveys are conducted yearly. As of 2010, 45 spotted owl sites were monitored on the National Forest (Forsman *et al.* 2011b, p. 3) and 54 spotted owl sites were monitored in the Olympic National Park (Gremel 2010, p. 2). There are 114 surveyed or known spotted owl sites on the Olympic Peninsula Study Area, some of which were dropped from monitoring with budget cuts in 2006 (Forsman *et al.* 2011b, p. 2). Based on habitat available, the study area has an estimated potential for 126 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. The first detection of barred owls in the Olympic Peninsula Study Area occurred in 1987 (Anthony *et al.* 2006, p. 39). The percentage of spotted owl sites with at least one barred owl detection have increased steadily from less than 5 percent to 50 percent between 1990 and 2008 (Forsman *et al.* 2011b, p. 17). Based on barred owl density on a well-surveyed portion of the nearby Cowlitz Valley Study Area, we estimate there are approximately 689 barred owl sites in the Olympic Peninsula Study Area.

Figure 3-4. Olympic Peninsula Study Area.



3.1.2.5 Olympic Revised (Olympic Peninsula) Study Area

DESCRIPTION. The Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area was originally part of the Olympic Peninsula Spotted Owl Demography Study Area, one of the eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program. Between 1998 and 2004, nonfederal lands were excluded from this study area (Anthony *et al.* 2006, pp. 6-7), and the remaining Federal lands surveyed were reduced as a result of budget cuts between 2004 and 2009 (Forsman *et al.* 2011b, p. 2). The Olympic Revised portion of this study area includes the Federal lands removed from the larger Olympic Peninsula Spotted Owl Demography Study Area (Forsman *et al.* 2011a, p. 5). Barred owl removal (treatment areas) could occur on up to approximately 227,000 acres of the Olympic Revised portion of this study area, with a control (non-removal) area on the Olympic Peninsula Spotted Owl Demography Study Area.

The Olympic Revised (Olympic Peninsula) Study Area (Figure 3-5) is located in Washington State on the Olympic Peninsula, west of Puget Sound and the city of Seattle. The area lies within Jefferson, Grays Harbor, and Clallam Counties and is entirely within the Olympic Peninsula Physiographic Province.

The Olympic Revised portion of this study area is mountainous with a wet, relatively warm maritime climate and elevation ranging from 135 to 6,790 feet. Numerous deep, large river valleys radiate out from the Olympic Mountain Range in the center of the peninsula. Precipitation occurs mainly as rain, and is especially heavy on the western slopes of the mountains. Vegetation is dominated by a mixture of coniferous rain forests on the west slopes and relatively dry Douglas-fir forests in the rain shadow. The primary northern spotted owl prey species is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 127,300 acres of spotted owl nesting and roosting habitat.

A mixture of Federal and privately owned lands occurs in the Olympic Revised portion of this study area (Table 3-9). The Olympic National Forest comprises 99 percent of the study area, of which 86 percent is designated Late-Successional Reserve (Table 3-10). The study area includes portions of the Mount Skokomish, Colonel Bob, Brothers, and Wonder Mountain Wilderness areas.

Table 3-9. Land ownership in the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	225,900	99
Private Total	1,100	less than 1
Total	**227,000**	**100**

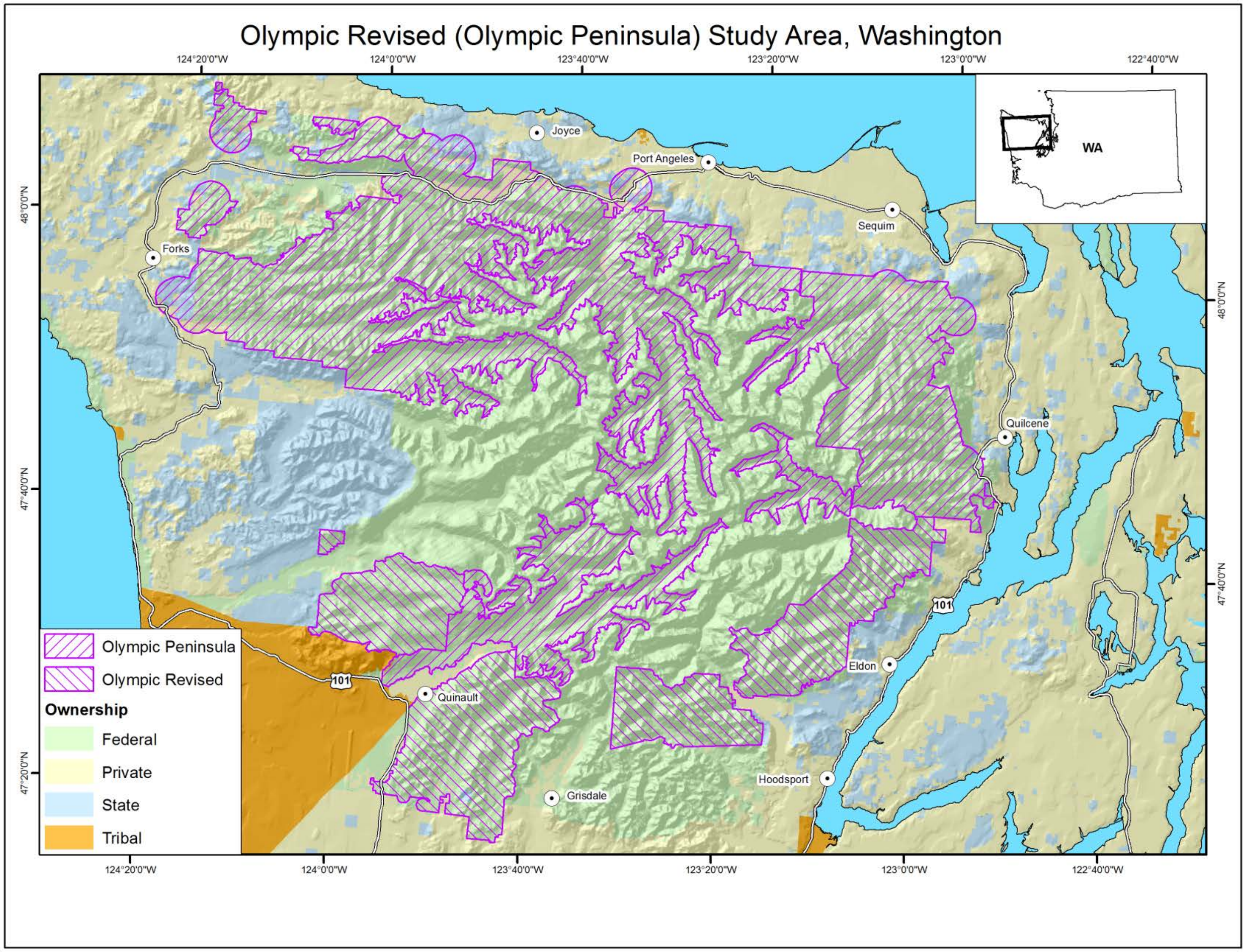
Table 3-10. Northwest Forest Plan land use allocations in the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	14
Late-Successional Reserves	86
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. A spotted owl demography study was initiated on the Olympic Peninsula in 1987 (Anthony *et al.* 2006, p. 7, Table 1). This area was included in the long-term northern spotted owl Northwest Forest Plan Effectiveness Monitoring Program (Lint *et al.* 1999, p. 17). Due to budget cuts, surveys were discontinued in the Olympic Revised portion of this study area after 2005 (Forsman *et al.* 2011b, p. 2), but demographic monitoring has continued annually on the larger Olympic Peninsula Spotted Owl Demography Study Area (Forsman *et al.* 2011a, pp. 5-7, Table 1). The Olympic Revised portion of this study area currently has 53 surveyed or known spotted owl sites. Based on habitat available, these are all the sites we anticipate in this area.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Olympic Revised portion of this study area in 1987 (Anthony *et al.* 2006, p. 39). The percentage of spotted owl sites with at least one barred owl detection have increased steadily from less than 5 percent to 50 percent between 1990 and 2008 (Forsman *et al.* 2011a, Appendix B). Based on barred owl density on a well-surveyed portion of the Cowlitz Valley Study Area, we estimate that there is a potential for approximately 228 barred owl sites in the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area.

Figure 3-5. Olympic Revised (Olympic Peninsula) Study Area.



3.1.2.6 Rainier Study Area

DESCRIPTION. The Rainier Study Area (Figure 3-6) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 527,000 total acres, barred owl removal would occur on up to 263,500 acres, or up to one-half of the total study area. This area is one of the long-term ongoing spotted owl demography study areas and, though not part of the Northwest Forest Plan Effectiveness Monitoring Program, it has been included in the rangewide demographic analysis. Funding for continued implementation of the demography study for this area is currently uncertain.

The Rainier Study Area is located in Washington State, in the areas surrounding Mount Rainier southeast of Seattle in King, Pierce, and a small portion of Lewis Counties. The area is primarily within the Western Cascades Physiographic Province, but a small portion is within the Eastern Cascades Physiographic Province.

The Rainier Study Area lies along the western slope of the Cascade Range in elevations ranging from 1,275 to 14,365 feet. The area's lower elevation forests consist primarily of Douglas-fir and western hemlock, while Pacific silver fir dominates the middle elevations and the higher elevations are dominated by mountain hemlock. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 148,500 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, other government, and privately owned lands occurs in the Rainier Study Area (Table 3-11). The National Park Service manages Mount Rainier National Park and the Mount Rainier Wilderness, which together comprise 44 percent of the study area. Mount Rainier Wilderness is 97 percent of Mount Rainier National Park. The Snoqualmie National Forest comprises approximately 34 percent of the study area, of which 50 percent is designated Late-Successional Reserve (Table 3-12). The study area includes portions of the Clearwater, William O. Douglas, Tatoosh, and Norse Peak Wilderness Areas.

Table 3-11. Rainier Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	409,900	78
Forest Service	*178,000*	
National Park Service	*231,900*	
State Total	11,800	2
Other Government	42,300	8
Private Total	63,000	12
Total	**527,000**	**100**

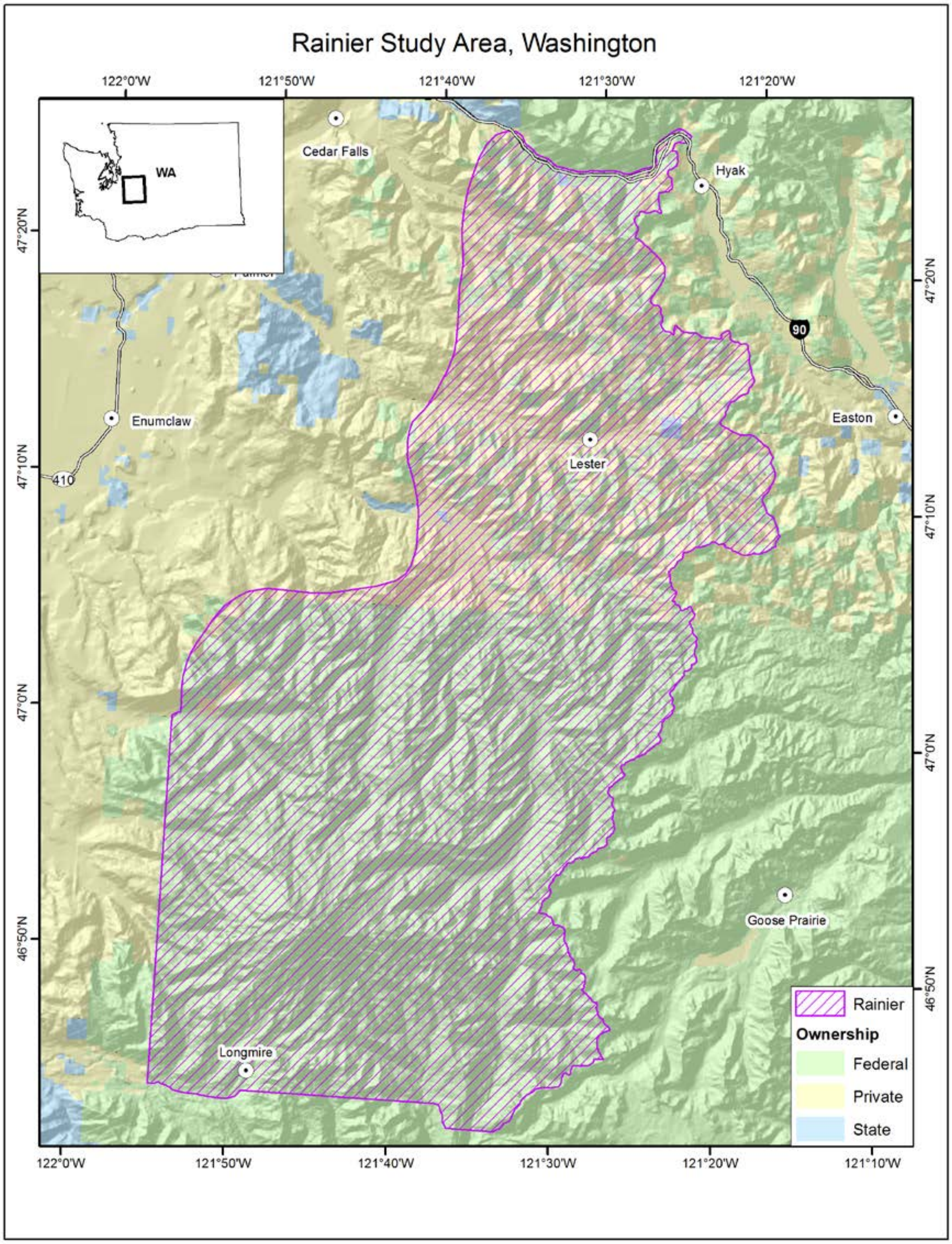
Table 3-12. Rainier Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	68
Late-Successional Reserves	23
Administratively Withdrawn	3
Matrix (includes embedded Riparian Reserves)	6
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. In 1992, a study was initiated in the Rainier Study Area to collect additional demographic information on spotted owls. Surveys were, and continue to be, conducted annually. In 2008, 66 spotted owl sites were surveyed. The Rainier Study Area currently has 68 surveyed or known spotted owl sites. Based on habitat available, there is an estimated potential for 77 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Rainier Study Area in 1993. From 1993 to 2003, the percent of spotted owl sites with at least one barred owl detection has increased from approximately 18 to 28 percent (Forsman *et al.* 2011a, Appendix B). However, there was some year-to-year variation in barred owl encounter rates during this time. Based on barred owl density on a well-surveyed portion of the adjacent Cowlitz Valley Study Area, we estimate that there are approximately 266 potential barred owl sites at the Rainier Study Area.

Figure 3-6. Rainier Study Area.



3.1.2.7 Cowlitz Valley Study Area

DESCRIPTION. The Cowlitz Valley Study Area (Figure 3-7) would include both treatment (removal) and control (non-removal) areas. Of the area's approximately 535,200 total acres, barred owl removal would occur on up to approximately 267,600 acres, or up to one-half of the total study area. The area has been surveyed for spotted owls for years, and has historical and current survey data for both spotted owl and barred owl sites.

The Cowlitz Valley Study Area is located in Washington State southeast of Seattle, occupying portions of Lewis, Skamania, Yakima, and Pierce Counties. The area is almost entirely within the Western Cascades Physiographic Province.

The Cowlitz Valley Study Area lies along the western slope of the Cascade Range where elevation ranges from 890 to 2,800 feet. Lower elevation forests consist primarily of Douglas-fir and western hemlock, while Pacific silver fir dominates the middle elevations and the higher elevations are dominated by mountain hemlock. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 221,000 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State and privately owned lands occurs in the Cowlitz Valley Study Area (Table 3-13). The Gifford Pinchot and Snoqualmie National Forests comprise approximately 99 percent of the study area, of which 34 percent is designated Late-Successional Reserve (Table 3-14). The study area contains portions of the Rainier, Mount Adams, Goat Rocks, Glacier View, Tatoosh, and William O Douglas Wilderness Areas.

Table 3-13. Cowlitz Valley Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (National Forest)	528,100	99
State Total	700	less than 1
Private Total	4,400	less than 1
TOTAL	**533,200**	**100**

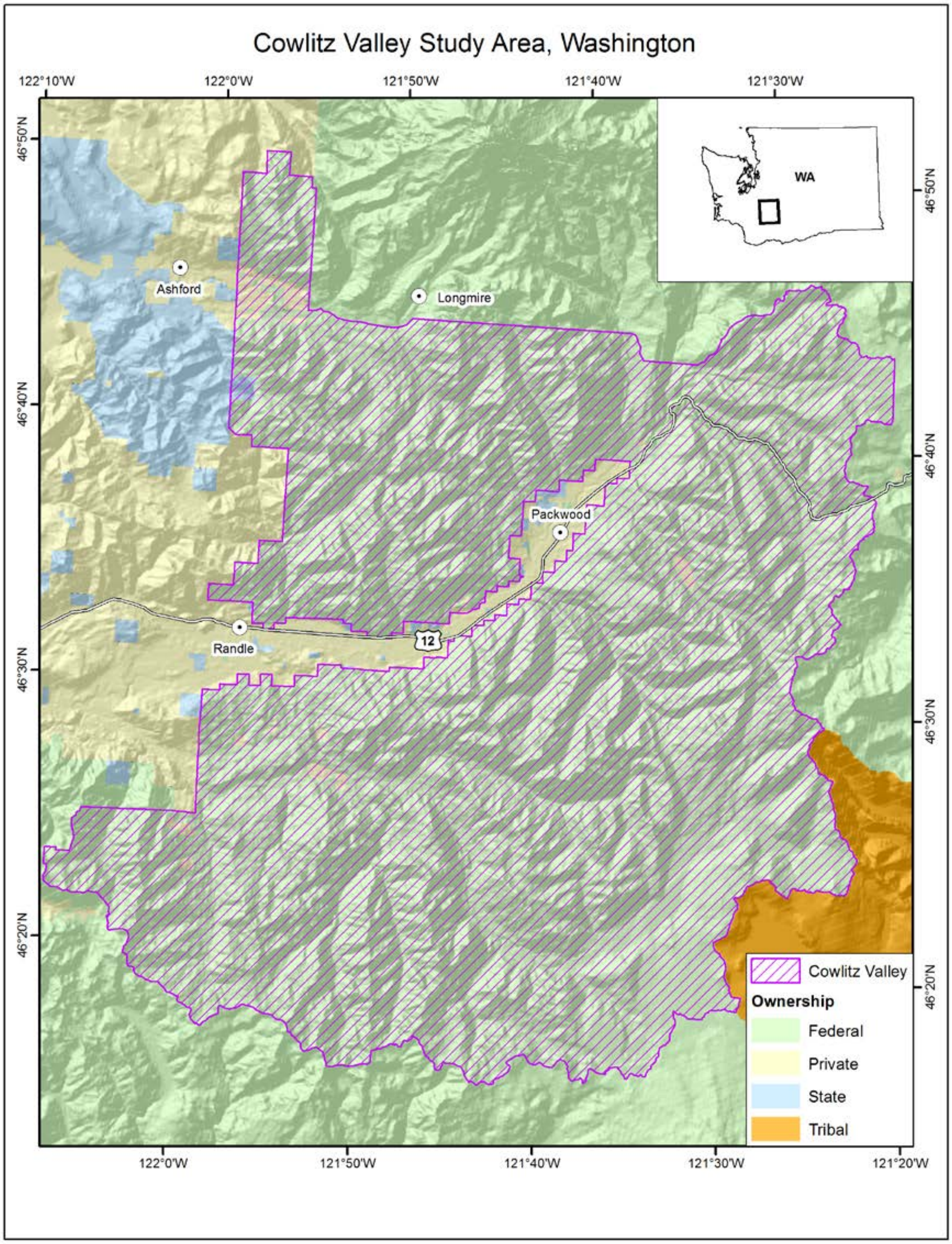
Table 3-14. Cowlitz Valley Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Administratively Withdrawn areas	7
Congressional Reserves	28
Late-Successional Reserves	34
Matrix (includes embedded Riparian Reserves)	31
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. The Forest Service began spotted owl surveys in the Cowlitz Valley Study Area in 1978 and 1979, though these surveys were mainly exploratory and the coverage was incomplete. Informal surveys continued until 1986 when the agency developed a more structured project and began to conduct complete area surveys. Most of the area had been surveyed to some degree by 1991. Robert Pearson started a small survey effort in 1991, and began a comprehensive effort in 1992. Currently he surveys about 149 sites in the area, with some areas surveyed every year, 120 sites surveyed every 2 to 3 years, and the remaining sites are surveyed irregularly. The Cowlitz Valley Study Area has 149 known spotted owl sites. Based on habitat available, the study area has a potential estimated 159 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Cowlitz Valley Study Area in 1978. Fewer than 20 barred owl sites were identified in 1991, but by 2008 that number had increased to 178 sites. Currently we can identify 348 barred owl sites in the Cowlitz Valley Study Area and estimate a potential for up to 396 barred owl sites.

Figure 3-7. Cowlitz Valley Study Area.



3.1.2.8 Columbia Gorge Study Area

DESCRIPTION. The Columbia Gorge Study Area (Figure 3-8) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 559,600 total acres, barred owl removal would occur on up to approximately 279,800 acres, or up to one-half of the total study area.

The Columbia Gorge Study Area is located in Washington State on the northeast side of the Columbia River, slightly northeast of Portland, Oregon. The area is mainly in Klickitat and Skamania Counties, though small portions are within Clark and Yakima Counties. The study area is within both the Western Cascades and Eastern Cascades Physiographic Provinces.

The Columbia Gorge Study Area lies along the western slope of the Cascade Range where elevation ranges from 15 to 5,825 feet. Lower elevation forests consist primarily of Douglas-fir and western hemlock, while Pacific silver fir dominates the middle elevations and the higher elevations are dominated by mountain hemlock. The portion of the study area to the east of the Cascade crest is extremely high relief and dominated by mixed-conifer forests and ponderosa pine forests at higher elevations. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 210,900 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, state, other, and privately owned lands occurs in the Columbia Gorge Study Area (Table 3-15). The Gifford Pinchot National Forest comprises approximately 41 percent of the study area, of which 37 percent is designated Late-Successional Reserve (Table 3-16). A portion of the study area is designated Columbia Gorge Wild and Scenic River. Portions of the Indian Heaven and Mount Adams Wilderness Areas lie within the boundaries of the study area.

Table 3-15. Columbia Gorge Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (National Forest)	227,600	41
State Total	134,100	24
Other Government	1,700	less than 1
Private Total	196,200	35
Total	**559,600**	**100**

Table 3-16. Columbia Gorge Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	4
Late-Successional Reserves	41
Administratively Withdrawn	18
Matrix (includes embedded Riparian Reserves)	37
Total Federal Lands	**100**

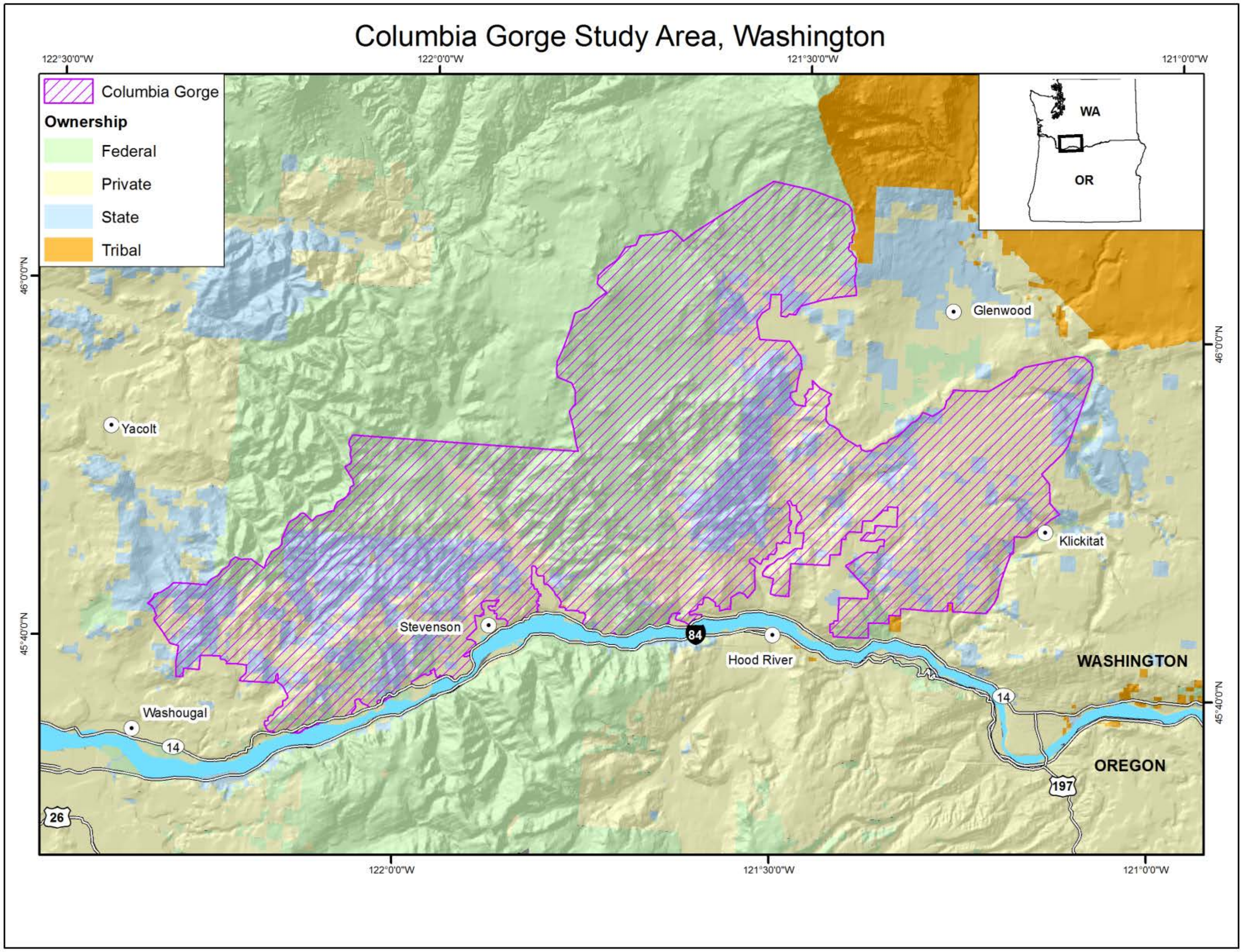
SPOTTED OWL POPULATION INFORMATION. The Washington Department of Natural Resources and Forest Service conducted extensive general spotted owl surveys from the 1980s to the mid-1990s. The western portion of the study area has not seen consistent or complete surveys since the mid-1990s. Some surveys have been conducted around timber sale and other projects such as pipelines. On the eastern portion of the study area has been surveyed most years through 2010. This portion of the study area was part of an early demography study area. About 40 to 50 percent of the study area has been surveyed in recent years. No spotted owls are banded at this time.

The Columbia Gorge Study Area currently has 75 surveyed or known spotted owl sites. Based on habitat available, the area has a potential estimated 102 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. The first barred owl was detected on the study area in 1978. There is no consistent data with which to estimate the growth of barred owl populations for the entire study area. However, on the Trout Lake block to the east, 7 percent of the spotted owl sites had at least one barred owl detection in 1992. By 2007 this rose to 78 percent.

Based on barred owl density on a well-surveyed portion of the adjacent Cowlitz Valley Study Area, we estimate that there are currently approximately 378 barred owl sites in Columbia Gorge Study Area.

Figure 3-8. Columbia Gorge Study Area.



3.1.3 Oregon

3.1.3.1 Oregon Coast Ranges Study Area

DESCRIPTION. The Oregon Coast Ranges Study Area (Figure 3-9) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 839,000 total acres, barred owl removal would occur on up to approximately 419,500 acres, or up to one-half of the total study area. This area is one of the eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program.

The Oregon Coast Ranges Study Area is located along the western coast of Oregon, west of Eugene and south of Highway 20 in Lincoln, Benton, Douglas, and Lane Counties. The study area is mainly within the Oregon Coast Range Physiographic Province, but a small portion is within the Willamette Valley Physiographic Province.

The Oregon Coast Ranges Study Area has a moderate maritime climate with most precipitation falling as rain from October through May and snow during the winter months at the higher elevations, but with no permanent snowpack. The interior portions have a more Mediterranean climate. The forests are highly productive, and dominated by western hemlock, Douglas-fir, and western redcedar. Red alder and bigleaf maple are common and may occur in stands or intermixed with conifers. Sitka spruce may occur in low-lying areas along the coast. Elevation in the area ranges from 0 to 4,000 feet. The primary spotted owl prey species is the northern flying squirrel, though other small mammals, including red tree voles, are also taken. The study area contains approximately 307,200 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Oregon Coast Ranges Study Area (Table 3-17). The Siuslaw National Forest and Salem and Eugene Districts of the BLM comprise approximately 61 percent of the study area, of which 81 percent is designated Late-Successional Reserve (Table 3-18). The study area encompasses Rock Creek, Cummins Creek, and Drift Creek Wilderness Areas.

Table 3-17. Coast Ranges Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	509,700	61
Forest Service	*366,000*	
Bureau of Land Management	*143,700*	
State Total	3,400	less than 1
Private Total	325,900	39
Total	**839,000**	**100**

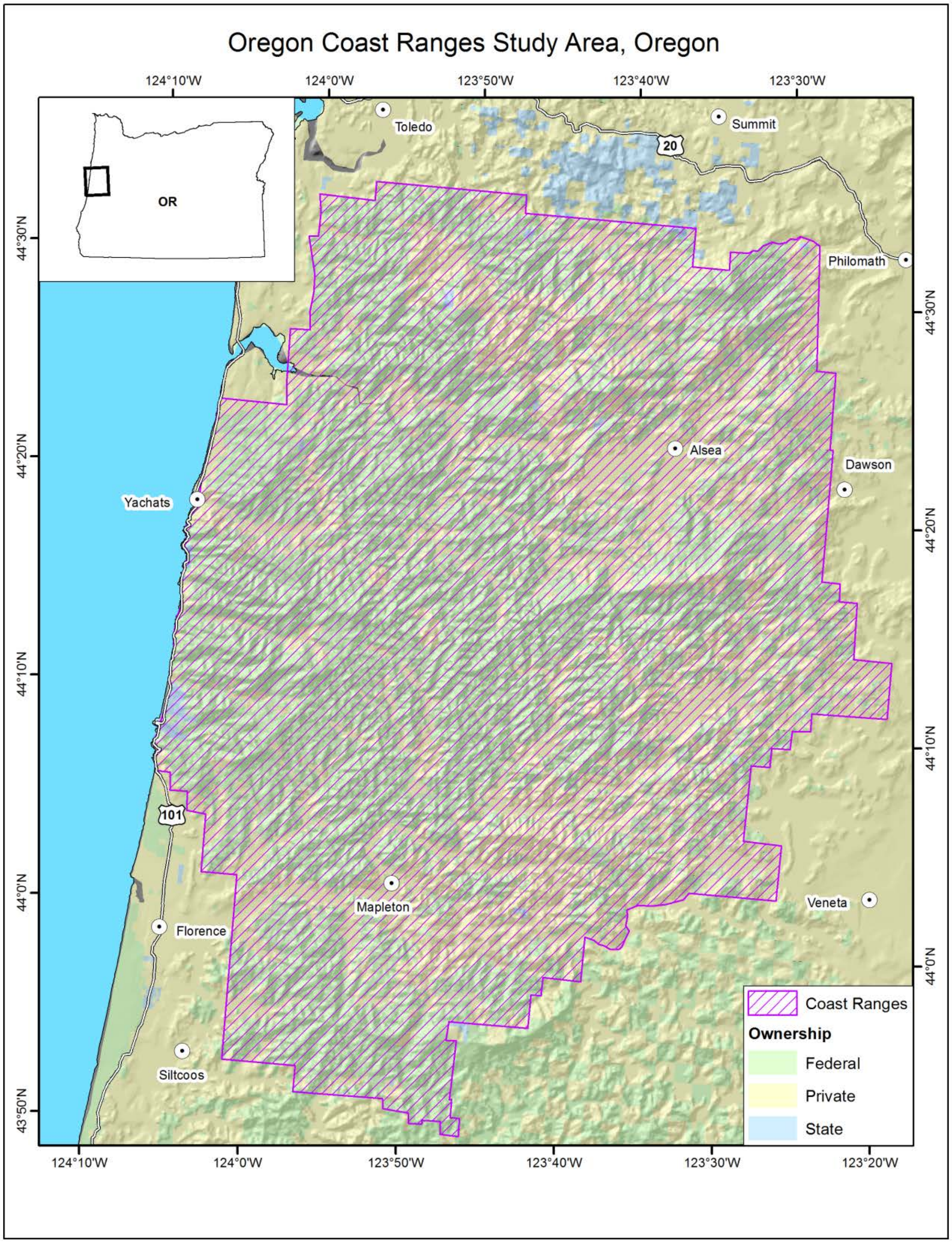
Table 3-18. Coast Ranges Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Congressional Reserves	4
Late-Successional Reserves	75
Administratively Withdrawn	less than 1
Matrix (includes embedded Riparian Reserves)	21
Total	**100**

SPOTTED OWL POPULATION INFORMATION. Demography studies were initiated in the Oregon Coast Ranges Study Area in 1990 to provide demographic data, including age-specific birth and death rates, fecundity, and population trend estimates (Forsman *et al.* 1996b, p. 47). This became part of the Northwest Forest Plan Effectiveness Monitoring Program in 1994 (Lint *et al.* 1999, p. 16). Surveys were conducted yearly from 1990 to relocate previously banded spotted owls and band any new spotted owls (Forsman *et al.* 2011a, pp. 7-8, Table 1). Originally, these surveys were conducted on the western portion of the Oregon Coast Ranges Study Area. Over time the area surveyed was expanded to include lands outside of what we are considering as the study area. The area being considered for this Final EIS has been surveyed consistently for spotted owls since 1990 (Forsman *et al.* 2011a, pp. 7-8, Table 1). From 1990 to 2009, between 123 and 203 spotted owl sites were surveyed annually. The study areas defined for the removal study include most, but not all, of the ongoing demography study area. Within the area we are considering for this Final EIS, there are 198 known spotted owl sites. Based on the available habitat we estimate the Oregon Coast Ranges Study Area has 275 potential spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Oregon Coast Ranges Study Area in 1990 incidental to a spotted owl survey. The proportion of spotted owl sites with at least one barred owl detection has steadily increased since 1990. As of the last analyzed available data in 2010, 70 percent of the surveyed spotted owl sites in the study area have at least one barred owl detection (Forsman *et al.* 2011a, Appendix B). Based on barred owl density at the nearby Veneta area, we estimate that there is a potential for approximately 909 barred owl sites in the Oregon Coast Ranges Study Area.

Figure 3-9. Oregon Coast Ranges Study Area.



3.1.3.2 Veneta (Oregon Coast Ranges/Tyee) Study Area

DESCRIPTION. The Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) Study Area (Figure 3-10) has been surveyed for spotted owls for various reasons since the 1980s, and substantial data exist on the area's spotted owl sites because the area was used for a barred owl/spotted owl interaction study between 2007 and 2009 (Wiens *et al.* 2011, entire). Barred owl removal (treatment areas) would take place on all of the approximately 193,500 acres of the Veneta portion of this study area. A similar control (non-removal) area would be chosen from comparable portions of the Tyee and/or Coast Ranges Spotted Owl Demography Study Areas.

The Veneta portion of this study area is located in central western Oregon, west of Eugene; the study area is in Benton, Lane and Douglas Counties, and lies primarily within the Coast Range Physiographic Province.

The Veneta portion of this study area has a moderate maritime climate with most precipitation falling as rain from October through May. Some snow may fall during the winter months but it does not last. The forests here are highly productive, and dominated by western hemlock, Douglas-fir, and western redcedar. Hardwood species such as red alder and bigleaf maple are common and may occur in stands or intermixed with conifers. Elevation in the area ranges from 105 to 664 feet. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 39,200 acres of spotted owl nesting and roosting habitat.

A mixture of Federal and privately owned lands occurs in the Veneta portion of this study area (Table 3-19). The Eugene District of the Bureau of Land Management administers approximately 41 percent of the Veneta portion, of which 79 percent is designated Late-Successional Reserve (Table 3-20).

Table 3-19. Land ownership in the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) Study Area.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Bureau of Land Management)	79,800	41
Private Total	113,600	59
Total	**193,500**	**100**

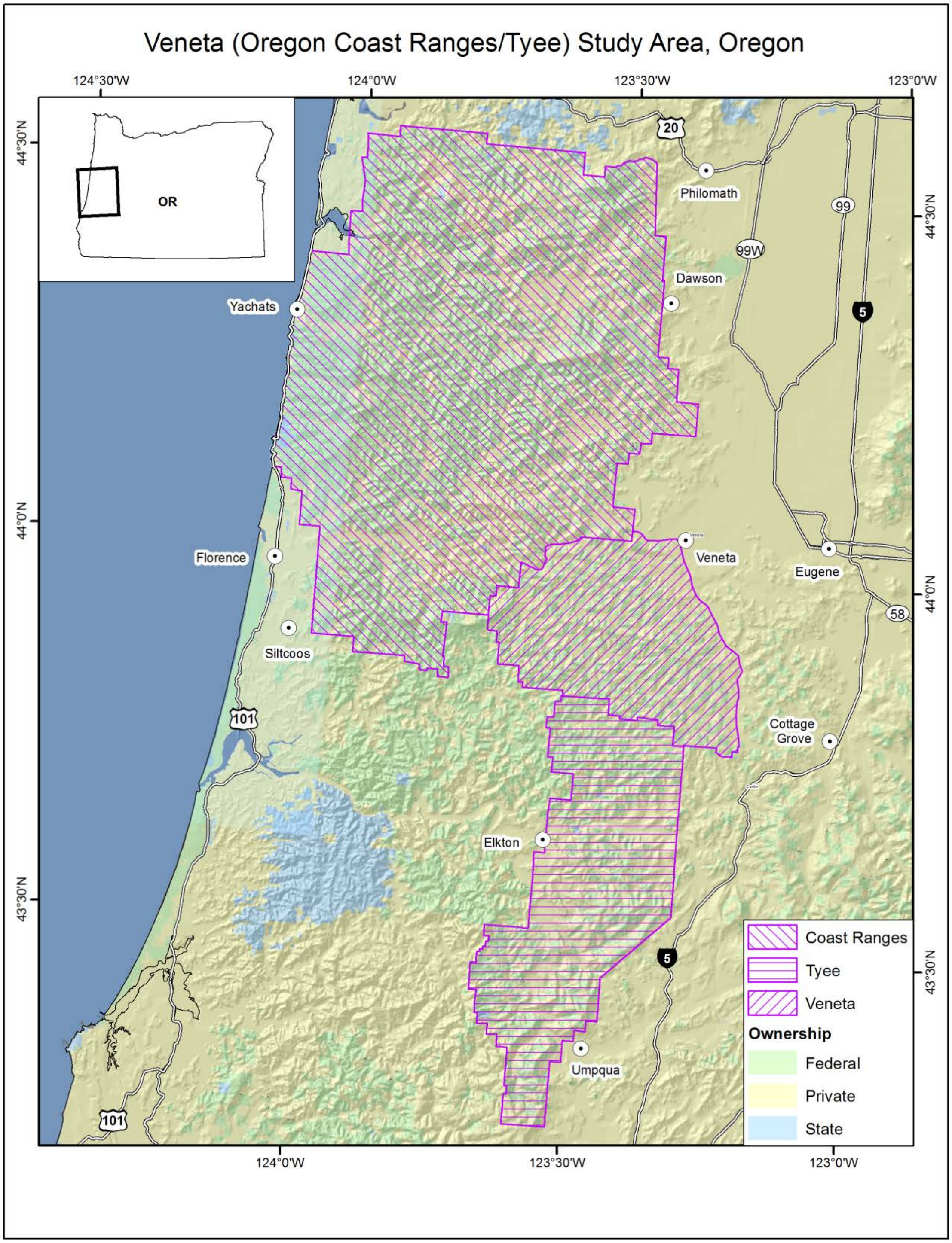
Table 3-20. Northwest Forest Plan land use allocations in the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) Study Area

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Late-Successional Reserves	79
Matrix (with embedded Riparian Reserves)	21
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. Demography studies of spotted owls on Eugene BLM lands (including the Veneta area) were initiated in 1990. Sites were surveyed annually from 1990 to 1995 (Thrailkill *et al*. 1998, pp. I-8 to I-9). The Eugene BLM study area was larger than (and completely encompassed) the Veneta area. A barred owl/ spotted owl interaction study was conducted on the Veneta portion of the Eugene BLM area from 2007-2009 (Wiens *et al.* 2011, entire). This study used the same area we are considering as the Veneta area for this Final EIS. In 2007 to 2009, 12 to 14 pairs of spotted owls were detected at the study area (Wiens *et al.* 2010, unpubl. data, p. 2). As of 2009, the Veneta area has 44 known historical, or surveyed spotted owl sites (Wiens *et al.* 2010, unpubl. data, p. 2). Based on habitat available, this is the total number of potential spotted owl sites at the study area.

BARRED OWL POPULATION INFORMATION. From 2007 to 2009, 18 to 30 pairs of barred owls were detected at the Veneta area (Wiens *et al.* 2010, unpubl. data, p. 2). Based on barred owl surveys in this study area, we estimate the potential for 116 current barred owl sites on the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) Study Area.

Figure 3-10. Veneta (Oregon Coast Ranges/Tyee) Study Area.



3.1.3.3 Tyee Study Area

DESCRIPTION. The Tyee Study Area (Figure 3-11) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 253,200 total acres, barred owl removal would occur on up to approximately 126,600 acres, or up to one-half of the total study area. This area is one of the eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program.

The Tyee Study Area is located in south-central Oregon, southwest of Eugene and to the west of Interstate 5, entirely within Douglas County. The area is in the Coast Range Physiographic Province.

The Tyee Study Area has a moderate maritime climate with most precipitation falling as rain from October to May. Some snow may fall at the higher elevations in winter, but rarely lasts. The forests here are highly productive, and dominated by western hemlock, Douglas-fir, and western redcedar. Hardwood species such as red alder and bigleaf maple are common and may occur in stands or intermixed with conifers. Elevation in the area ranges from 160 to 2,800 feet. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals, including red tree voles, are also taken. The study area contains approximately 74,100 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Tyee Study Area (Table 3-21). The Roseburg District of BLM administers approximately 43 percent of the study area, of which 66 percent is designated Late-Successional Reserve (Table.3-22).

Table 3-21 Tyee Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Bureau of Land Management)	108,000	43
State Total	700	less than 1
Private Total	144,500	57
Total	**253,200**	**100**

Table 3-22 Tyee Study Area Northwest Forest Plan land use allocations.

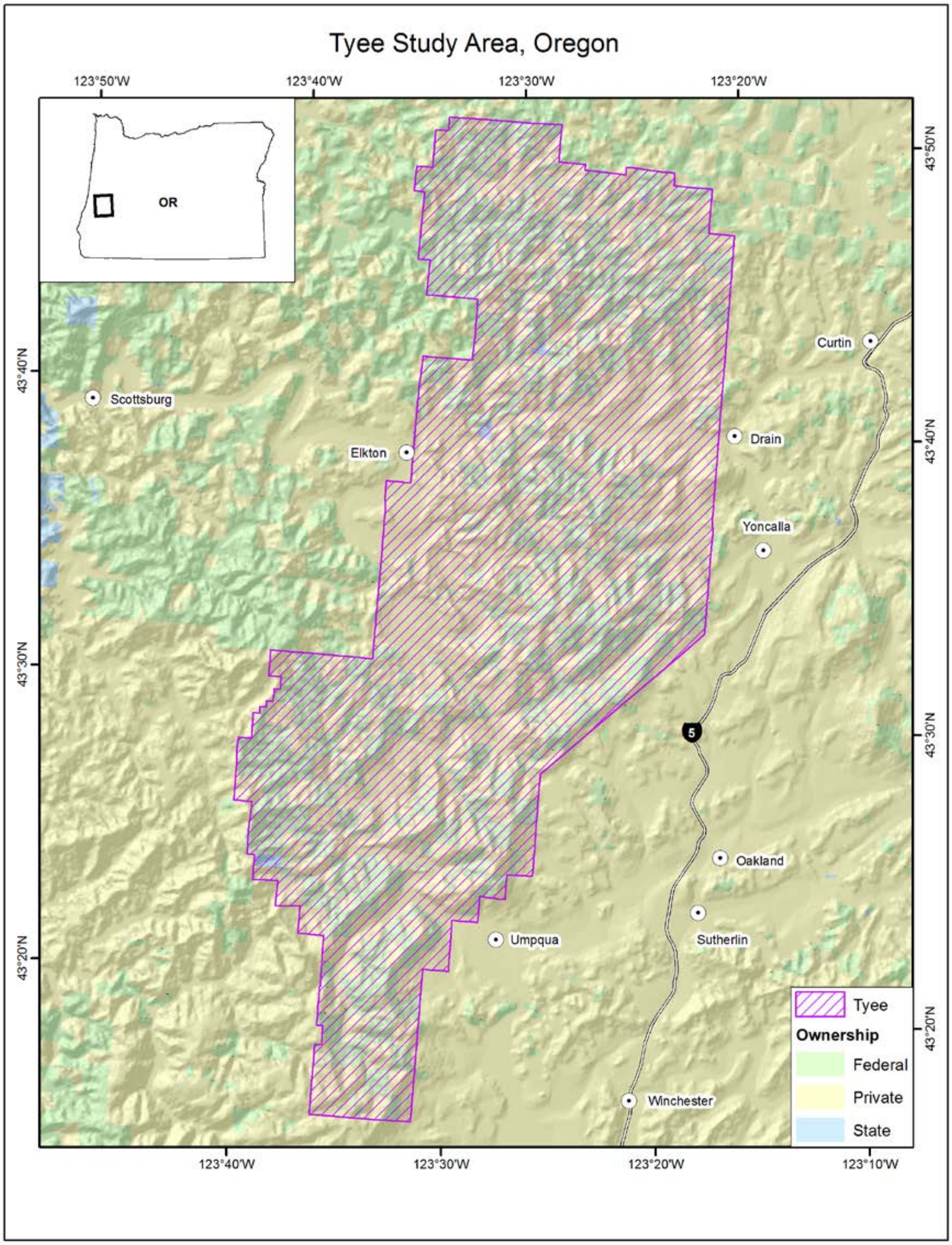
Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Congressional Reserves	less than 1
Late-Successional Reserves	66
Administratively Withdrawn	less than 1
Matrix (includes embedded Riparian Reserves)	33
Total Federal Lands	**100**

SPOTTED OWL POPULATION INFORMATION. Surveys for spotted owls on the Tyee Study Area began with scattered surveys in the 1970s. More consistent surveys of specific sites began in the 1980s, with the first banding in 1983 and increased effort in

1985. Survey efforts continued to increase until 1990 when a spotted owl density study was initiated resulting in a survey of the entire area each year. In 1994 the study became part of the Northwest Forest Plan Effectiveness Monitoring Program. The purpose of the study was to clarify population ecology of spotted owls by collecting survival, reproduction, population age structure, and population trends; surveys were conducted annually. The Tyee Study Area currently has 133 active or historical spotted owl sites and, based on available habitat, the study area has 141 potential spotted owl sites, though not all are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Tyee Study Area in 1989. The percentage of spotted owl sites with at least one barred owl detection have increased steadily from approximately 5 percent in 1990 to approximately 55 percent in 2009. Based on barred owl density on the neighboring Veneta area, we estimate that there are approximately 219 potential barred owl sites on the study area.

Figure 3-11. Tyee Study Area.



3.1.3.4 McKenzie Study Area

DESCRIPTION. The McKenzie Study Area (Figure 3-12) would include both treatment (removal) and control (non-removal) areas. Of the approximately 663,000 total acres in the study area, barred owl removal would occur on up to approximately 331,500 acres, or up to one-half of the study area. Historical spotted owl surveys and study efforts have taken place on Federal and nonfederal lands throughout this study area, so varying levels of data are available for this area.

The McKenzie Study Area is located in central western Oregon to the east of Eugene, in Linn and Lane Counties. The study area is mostly within the Western Cascades Physiographic Province.

The McKenzie Study Area lies to the west of the crest of the Cascade Mountain Range, at elevations ranging from 345 to 4,840 feet. Forests consist primarily of Douglas-fir and western hemlock at low to mid elevations, with western redcedar, bigleaf maple, and red alder as minor components. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 131,800 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the McKenzie Study Area (Table 3-23). The Willamette National Forest and Eugene District BLM administer approximately 30 percent of the study area, of which 15 percent is designated Late-Successional Reserve (Table 3-24). There are no wilderness areas within the study area.

Table 3-23 McKenzie Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	200,000	30
Forest Service	*102,400*	
Bureau of Land Management	*97,600*	
State Total	1,300	less than 1
Private Total	461,700	69
Total	**663,000**	**100**

Table 3-24 McKenzie Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Late-Successional Reserves	15
Adaptive Management Areas	9
Administratively Withdrawn areas	5
Matrix (includes embedded Riparian Reserves)	71
Total	**100**

SPOTTED OWL POPULATION INFORMATION. About 80 percent of the McKenzie Resource Area has been surveyed extensively in the past, including the BLM McKenzie Resource Area and associated private lands. Spotted owl surveys began in earnest about

1988 and continue to the present. Telemetry studies occurred from 1990 to 1992. Large-scale surveys for a density-type demography study occurred from 1992 to 1996. In 1998, an adaptive management study tracked radio-marked birds to determine response to different types of forest thinning.

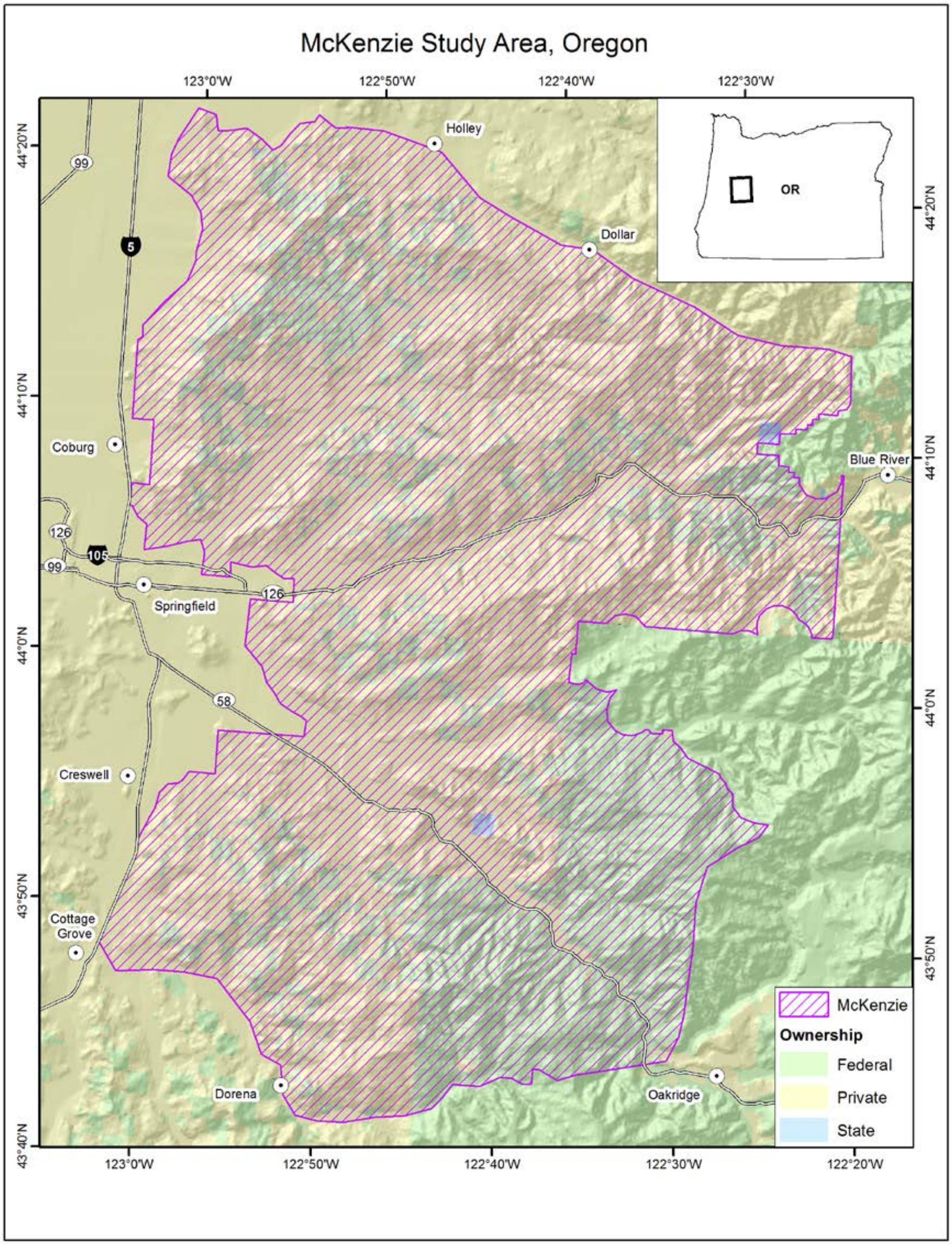
All known sites on this portion of the study area continued to be monitored, with varying intensity, from 1997 to the present. Banding of all spotted owls and some barred owls occurred during this time. In 2009, spotted owl protocol testing was conducted and some barred owls and all detectable spotted owls were radio-marked. This testing also included some barred owl calling.

Survey work has also been conducted on the remainder of the area (primarily Forest Service lands). Timber harvest-based surveys occurred in the 1980s and early 1990s. Some surveys took place along the edge of the Forest Service lands, from the BLM side. Other areas have not had any current or consistent surveys

In 1996 there were about 50 active spotted owl sites on the McKenzie Resource Area portion of the study area. This dropped to about six to eight active spotted owl sites in 2011. The McKenzie Study Area has 111 surveyed or known spotted owl sites. Based on habitat available, the area has an estimated potential 163 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were detected in the McKenzie Study Area in 1988 (two sites). By 1996 there were 3 to 4 active barred owl sites, and as of 2011 there were 70 to 75 active barred owl sites. Based on barred owl density on the neighboring Veneta area, we estimate that there are approximately 390 potential barred owl sites.

Figure 3-12. McKenzie Study Area.



3.1.3.5 HJ Andrews Study Area

DESCRIPTION. The HJ Andrews Study Area (Figure 3-13) would include both treatment (removal) and control (non-removal) areas. Of the approximately 396,100 total acres in the study area, barred owl removal would occur on up to approximately 198,000 acres or up to one-half of the total study area. This is one of eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program.

The HJ Andrews Study Area is located on the west slope of the Cascade Mountain Range in Western Oregon, west of Bend and northeast of Springfield. The study area is in Linn and Lane Counties, and entirely within the Western Cascades Physiographic Province.

The HJ Andrews Study Area is on mountainous terrain deeply dissected by rivers and streams, at elevations ranging from 1000 to 5,785 feet. The area has a maritime climate, with relatively dry summers and wet winters. Winter precipitation is often in the form of snow at higher elevations and rain at lower elevations. The area is in the western hemlock zone dominated by Douglas-fir, western hemlock, and western redcedar. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 224,400 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the HJ Andrews Study Area (Table 3-25). The Willamette National Forest administers approximately 93 percent of the study area, of which 33 percent is designated Late-Successional Reserve (Table 3-26). The study area is adjacent to, and includes, portions of the Mount Washington, Menagerie, Mount Jefferson, and Three Sisters Wilderness Areas.

Table 3-25. HJ Andrews Study Area Land Ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	367,500	93
Forest Service	*367,400*	
Bureau of Land Management	*100*	
State Total	100	less than 1
Private Total	28,500	7
Total	**396,100**	**100**

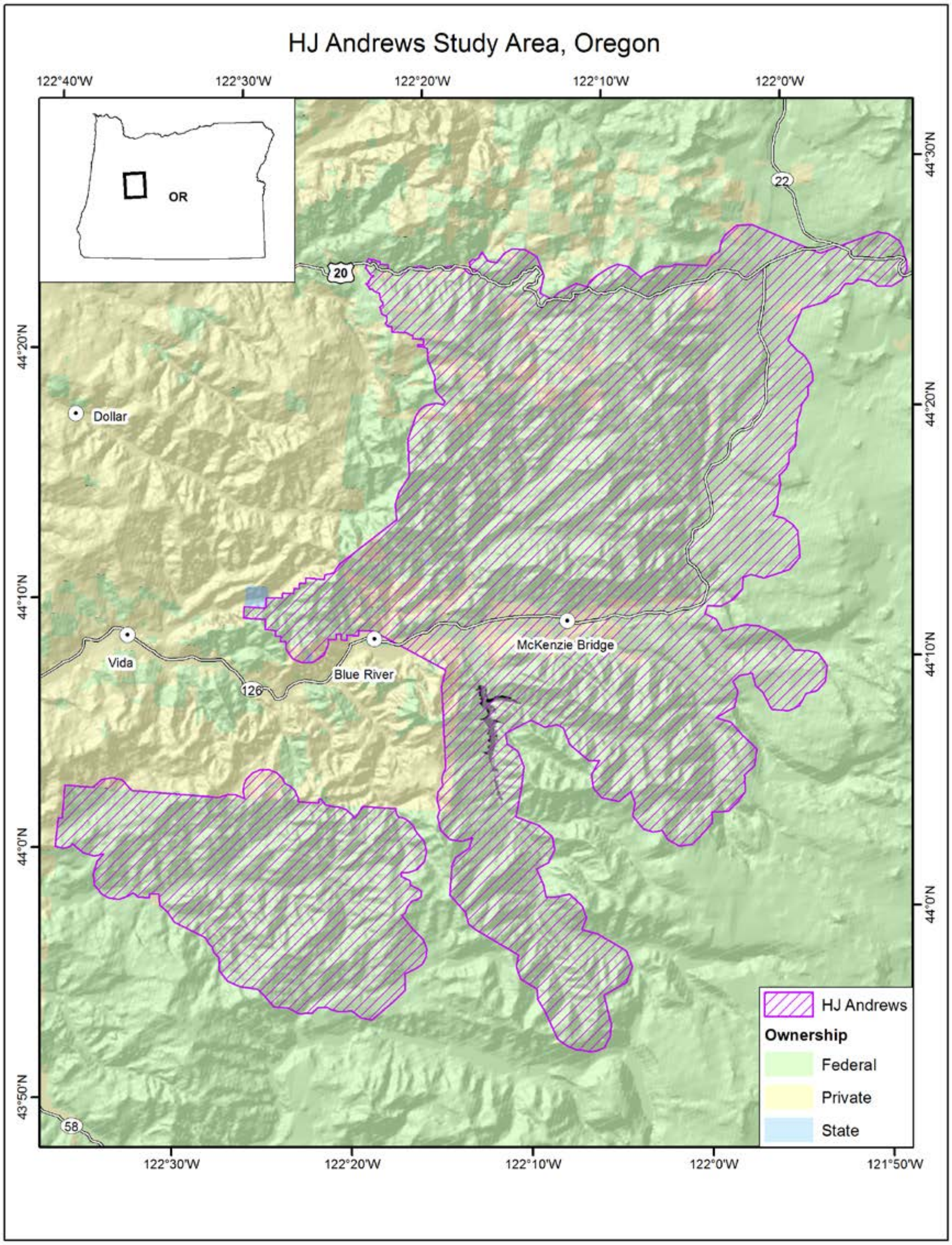
Table 3-26. HJ Andrews Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Congressional Reserves	6
Late-Successional Reserves	34
Adaptive Management Areas	28
Administratively Withdrawn areas	6
Matrix (with embedded Riparian Reserves)	26
Total	**100**

SPOTTED OWL POPULATION INFORMATION. The HJ Andrews Study Area has a long history of spotted owl research. The first intensive study of spotted owl ecology, including home range size and habitat use, occurred in the study area in early 1970s, and several spotted owl nest sites have been monitored periodically since that time. The first study of dispersal of juvenile spotted owls was also conducted here in 1989, as well as research on spotted owl prey species and influence of habitat fragmentation. A long-term spotted owl demography study was initiated in 1987; this was included in the Northwest Forest Plan Effectiveness Monitoring Program in 1994 (Lint *et al.* 1999, p. 17). The goal of this study was to gain understanding of the current status of the population by determining occupancy and reproduction, survival, age-specific fecundity, and rate of population change. The HJ Andrews Study Area currently has 146 surveyed or known spotted owl sites. Based on habitat available, the study area has an estimated potential for 189 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected at the HJ Andrews Study Area in 1988. The percentage of spotted owl sites with incidental detections of barred owl has increased steadily from 1988 to 2009, and was at 38 percent in 2009. As of 2011, 40 percent of the spotted owl sites have incidental detections of barred owl at the study area (Dugger *et al.* 2011, p. 23). Based on barred owl density on a well-surveyed portion of the Cowlitz Valley study area, we estimate that the HJ Andrews Study Area has approximately 402 potential barred owl sites. We used the Cowlitz Valley data because conditions on that study area are most similar to the HJ Andrews study area.

Figure 3-13. HJ Andrews Study Area.



3.1.3.6 Union/Myrtle (Klamath) Study Area

DESCRIPTION. The Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area (Figure 3-14) is the treatment (removal) area and would be paired with the Klamath Spotted Owl Demography Study Area as a control (non-removal) area. Barred owl removal would occur on all of the approximately 227,600 acres within the Union/Myrtle portion of this study area. The BLM has banded and monitored spotted owls in this area since 1989. This is not part of the current demographic analysis, though it has comparable levels of survey effort and results.

The Union/Myrtle portion of this study area has two sections located in southwest Oregon on either side of Interstate 5 near Canyonville in Douglas County. The Union/Myrtle portion of this study area is primarily in the Oregon Klamath and Oregon Western Cascades Physiographic Provinces.

The Oregon Klamath Physiographic Province, in which most of the Union/Myrtle portion of this study area is located, is a rugged and lightly populated area in southwest Oregon. The area is inland of the Siskiyou Mountains and Oregon Coast Ranges, in the rain shadow of the mountains at elevations ranging from 730 to 4,400 feet. The summers are warm and dry, and most winter precipitation is in the form of rain rather than snow. Vegetation is a mixed-conifer/mixed-hardwood type, dominated by Douglas-fir and incense-cedar and including several pine and fir species, Pacific madrone, golden chinquapin, and various other hardwoods.

A small portion of the northeast corner of the Union/Myrtle portion of this study area transitions into the Oregon Western Cascades Physiographic Province. The forests here are in the western hemlock zone dominated by Douglas-fir, western hemlock, and western redcedar. They generally have fewer hardwood species, are less arid in the summer, and have greater snowfall in the winter. The primary spotted owl prey species in the area is the dusky-footed woodrat, though flying squirrels and other small mammals are also taken. Woodrat populations phase out in the northeastern corner of the study area, where flying squirrels become the primary food source. This area contains approximately 98,100 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Union/Myrtle portion of this Study Area (Table 3-27). The Roseburg District of BLM and the Umpqua National Forest administers approximately 46 percent of this area, of which 24 percent is designated Late-Successional Reserve (Table 3-28).

Table 3-27 Land ownership within the Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	106,000	47
Forest Service	*4,400*	
Bureau of Land Management	*101,700*	
State Total	100	less than 1
Private Total	121,400	53
Total	**227,600**	**100**

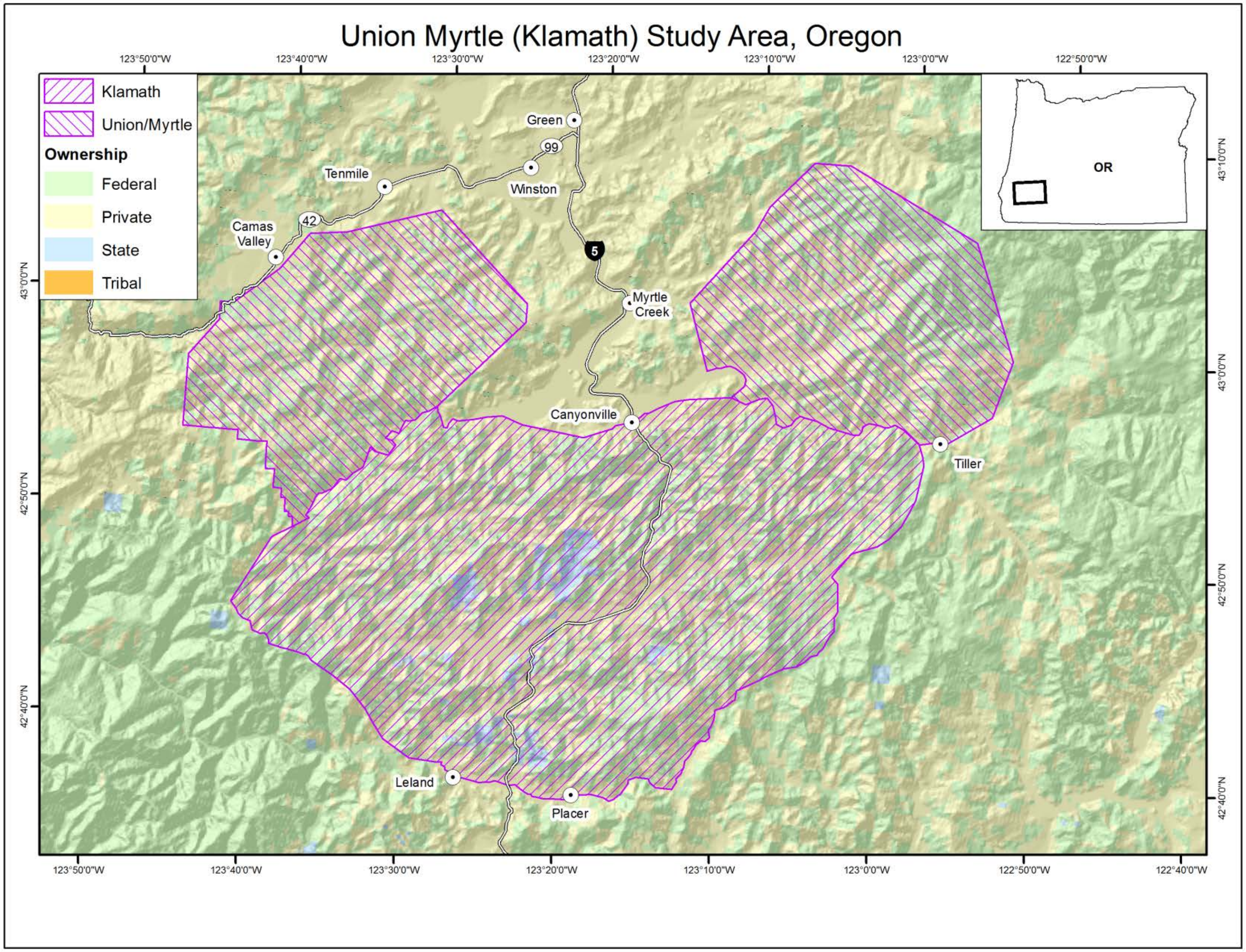
Table 3-28. Northwest Forest Plan land use allocations within the Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Late-Successional Reserves	24
Administratively Withdrawn areas	less than 1
Adaptive Management Areas	1
Matrix (with embedded Riparian Reserves)	75
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. In the Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area, spotted owl territories have been surveyed and all spotted owls banded since 1986. This area currently has 73 known or surveyed spotted owl sites and, based on available habitat, potentially has 87 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Union/Myrtle portion of this study area in 1983. Barred owls in the area surveyed have increased from approximately 38 in 1990 to 58 in 2010. Based on barred owl density on the Veneta area, we estimate that there are approximately 290 potential barred owl sites in the Union/Myrtle portion of this study area.

Figure 3-14. Union/Myrtle (Klamath) Study Area.



3.1.3.7 Klamath Study Area

DESCRIPTION. The Klamath Study Area (Figure 3-15) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 341,900 total acres, barred owl removal would occur on up to approximately 171,000 acres, or up to one-half of the total study area. This area is one of the eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program.

The Klamath Study Area is located in southwest Oregon between Roseburg and Grants Pass, in Douglas, Josephine, and Jackson Counties. The study area is entirely within the Oregon Klamath Physiographic Province.

The Klamath Study Area lies inland of the Siskiyou Mountains, in the rain shadow of the mountains at elevations ranging from 751 to 5,196 feet. The summers are warm and dry, and most winter precipitation is in the form of rain rather than snow. Vegetation is a mixed-conifer/mixed-hardwood type, dominated by Douglas-fir and incense-cedar, and including several pine and fir species, Pacific madrone, golden chinquapin, and various other hardwoods. The primary spotted owl prey species in the area is the dusky-footed woodrat, though flying squirrels and other small mammals are also taken. The study area contains approximately 132,300 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Klamath Study Area (Table 3-29). The Roseburg and Medford Districts of BLM administer approximately 46 percent of the study area, of which 43 percent is designated Late-Successional Reserve (Table 3-30). A small portion of the Umpqua National Forest is also included in the study area. There are no wilderness areas within the study area.

Table 3-29. Klamath Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	158,700	46
Forest Service	6,700	
Bureau of Land Management	152,000	
State Total	10,800	3
Private Total	172,400	51
Total	**341,900**	**100**

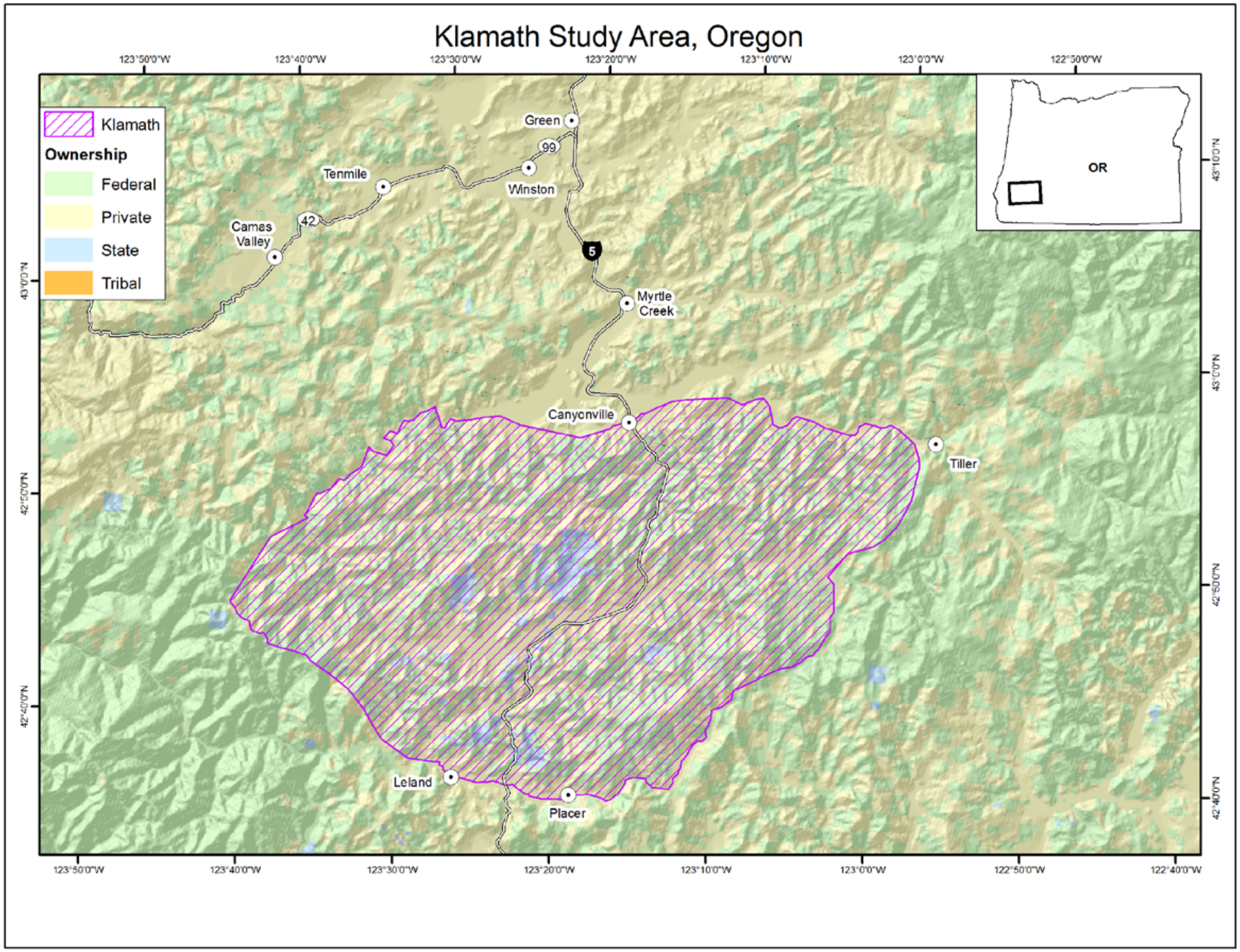
Table 3-30. Klamath Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Late-Successional Reserves	43
Matrix (with embedded Riparian Reserves)	57
Total	**100**

SPOTTED OWL POPULATION INFORMATION. Spotted owls have been surveyed in the Klamath Study Area since 1985. Initial surveys were focused on specific sites, but expanded into complete surveys by 1990. Beginning in 1994, this area was included in the Northwest Forest Plan Effectiveness Monitoring Program. Surveys continue to be conducted annually. The Klamath Study Area currently has 141 known or surveyed spotted owl sites. Based on habitat available, the study area has an estimated 151 spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. A barred owl was first detected in the Klamath Study Area in 1986, incidental to spotted owl surveys. The barred owl detected in this instance was paired with a spotted owl. In 2009, 58 barred owl sites were detected in the study area. The percentage of spotted owl territories with barred owl detections has increased over time, from 1.7 percent in 1998 to 25 percent in 2009. As of the last analyzed available data in 2008, 65 percent of the surveyed spotted owl sites in the Klamath Study Area had at least one barred owl detection (Forsman *et al.* 2011a, Appendix B). Based on barred owl density on the Veneta area, we estimate that there are approximately 392 potential barred owl sites in the Klamath Study Area.

Figure 3-15. Klamath Study Area.



3.1.3.8 South Cascades Study Area

DESCRIPTION. The South Cascades Study Area (Figure 3-16) would consist of treatment (removal) and control (non-removal) areas. Of the study area's approximately 584,400 total acres, barred owl removal would occur on up to 292,200 acres, or up to one-half of the total study area. This area is one of eight long-term ongoing spotted owl demography study areas selected as part of Northwest Forest Plan Effectiveness Monitoring Program.

The South Cascades Study Area is located in southwest Oregon north east of Medford, northwest of Klamath Falls and adjacent to and southwest of Crater Lake National Park. It lies within Jackson, Douglas and Klamath Counties. A majority of the study area is within the Oregon Western Cascades Physiographic Province but approximately one-third is in the Oregon Eastern Cascades Physiographic Province.

The South Cascades Study Area lies on the west and east of the crest of the Cascade Mountains in elevations ranging from 730 to 2,855 feet. Vegetation is dominated by dry, mixed-conifer and mixed-hardwood forest on the west, subalpine fir and mountain hemlock forests along the crest, and mixed-conifer forest at lower elevations, including lodgepole/ponderosa pine at the lowest elevations. The primary spotted owl prey species in the area are dusky-footed woodrats and northern flying squirrels, though other small mammals are also taken. The study area contains approximately 252,300 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the South Cascades Study Area (Table 3-31). The Rogue River-Siskiyou and Fremont-Winema National Forests administer approximately 94 percent of the study area, of which 37 percent is designated Late-Successional Reserve (Table 3-32). The study area includes portions of the Rogue-Umpqua Divide, Sky Lakes, and Mountain Lakes Wilderness Areas.

Table 3-31. South Cascades Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	549,600	94
State Total	900	less than 1
Private Total	33,900	5
Total	**584,400**	**100**

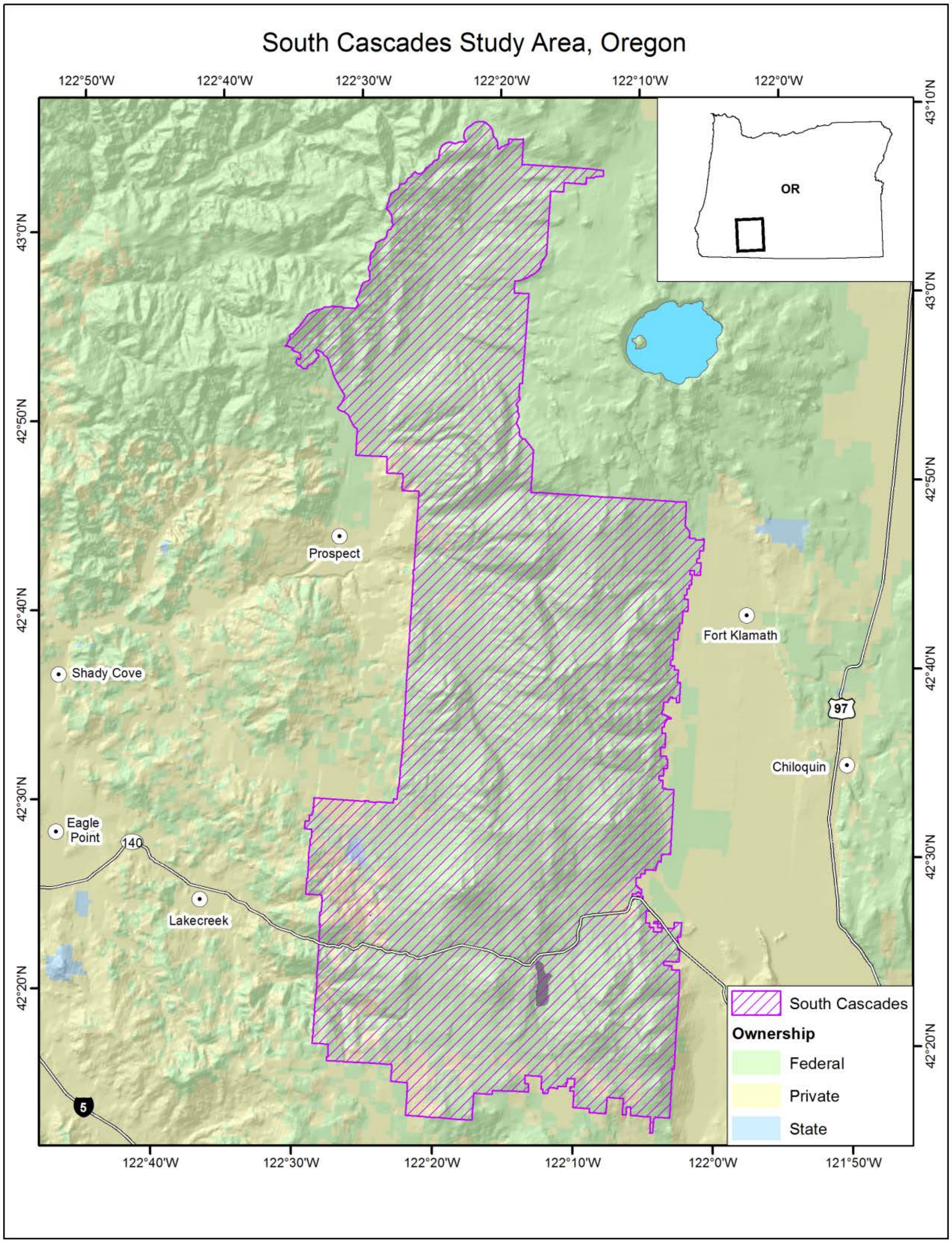
Table 3-32. South Cascades Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Congressional Reserves	26
Late-Successional Reserves	37
Administratively Withdrawn areas	3
Matrix (with embedded Riparian Reserves)	34
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. The South Cascades Spotted Owl Demography Study Area was established in 1990. In 1994 it was included as part of Northwest Forest Plan Effectiveness Monitoring Program (Lint *et al.* 1999, p. 17). The study gathered information on survival rates, reproductive rates, and the annual rate of population change on a collection of known owl sites within a bounded area. The sites were surveyed yearly from 1992 to present. The South Cascades Study Area currently has 156 surveyed or known spotted owl sites. Based on habitat available, the study area has an estimated 226 potential spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the South Cascades Study Area in 1981, incidental to spotted owl surveys. The percentage of historical spotted owl territories with barred owls present has increased from 4.1 in 1991 to 28.2 percent in 2010 (Dugger *et al.* 2010, p. 10). Based on barred owl density on the Veneta area, we estimate that there are approximately 747 potential barred owl sites in the South Cascades Study Area.

Figure 3-16. South Cascades Study Area.



3.1.3.9 Rogue Cascades (South Cascades) Study Area

DESCRIPTION. The Rogue Cascades portion of the Rogue Cascades (South Cascades) Study Area (Figure 3-17) would consist of treatment (removal), and would be paired with all or a portion of the South Cascades Spotted Owl Demography Study Area as a control (non-removal) area. Barred owl removal would occur on all of the approximately 391,100 acres of the Rogue Cascades portion of this study area. This area has had numerous historical spotted owl surveys and ongoing studies of spotted owl sites.

The Rogue Cascades portion of this study area is located in southwest Oregon, southeast of Roseburg, north of Medford, and northeast of Grants Pass. The area is mostly within Jackson County, with small portions in Josephine and Douglas Counties. The study area lies within the Western Cascades and Klamath Mountains Physiographic Provinces.

The Rogue Cascades portion of this study area is west of the crest of the Cascade Mountain Range at elevations ranging from 1,200 to 5,000 feet. Forests consist primarily of Douglas-fir and western hemlock at low to moderate elevations. The primary spotted owl prey species in the area is the dusky-footed woodrat, though flying squirrels and other small mammals are also taken. This area contains approximately 79,300 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Rogue Cascades portion of this study area (Table 3-33). The Medford District of BLM and portions of the Rogue River-Siskiyou and Fremont-Winema National Forests administer approximately 43 percent of this area, of which 16 percent is designated Late-Successional Reserve (Table 3-34). There are no wilderness areas within the Rogue Cascades portion of this study area, though the control area (South Cascades Spotted Owl Demography Study Area) includes portions of the Rogue-Umpqua Divide, Sky Lakes, and Mountain Lakes Wilderness Areas.

Table 3-33. Land ownership within the Rogue Cascades portion of the Rogue Cascades (South Cascades) Study Area.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	169,400	43
Forest Service	*15,000*	*4*
Bureau of Land Management	*154,400*	*39*
State Total	500	less than 1
Private Total	221,200	57
Total	**391,100**	**100**

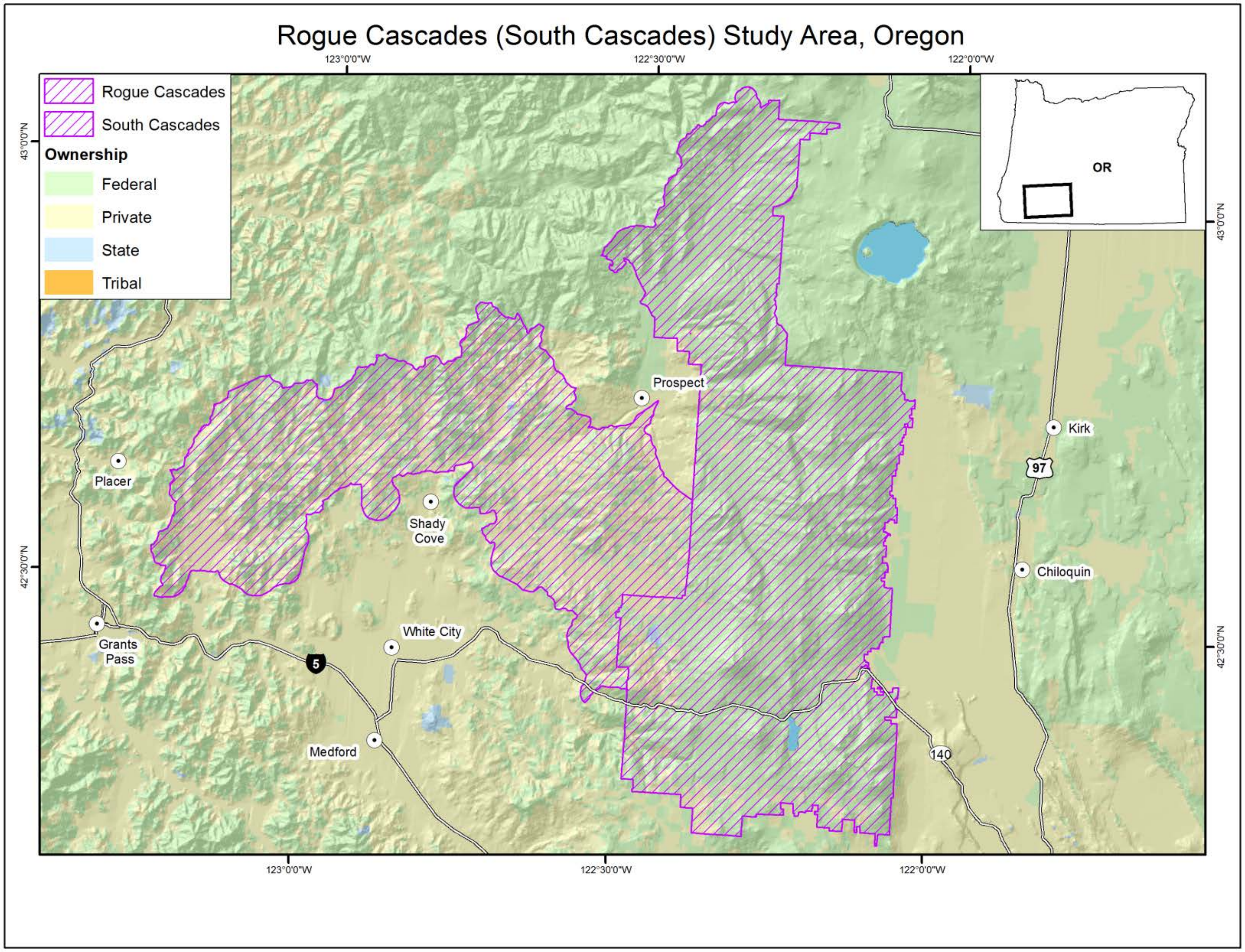
Table 3-34. Northwest Forest Plan land use allocations within the Rogue Cascades portion of the Rogue Cascades (South Cascades) Study Area.

Northwest Forest Plan Land Use Allocations	Percentage of Federal Land
Late-Successional Reserves	15
Administratively Withdrawn areas	less than 1
Matrix (with embedded Riparian Reserves)	85
Total	**100**

SPOTTED OWL POPULATION INFORMATION. Spotted owl surveys began in the Rogue Cascades portion of the Rogue Cascades (South Cascades) Study Area in the late 1970s with project-based surveys. Systematic surveys by Frank Wagner began on part of this area in 1988 and expanded over time. Surveys of about 100 sites are ongoing and provide fairly complete information of the area. The Rogue Cascades portion of this study area currently has 100 surveyed or known spotted owl sites. Based on habitat available, this area has an estimated 130 potential spotted owl sites, though not all of these sites are likely occupied at this time.

BARRED OWL POPULATION INFORMATION. A single barred owl was first detected in the Rogue Cascades portion of this study area in 1986. Although it remained a single bird for some time, more barred owls have been detected in recent years. However, not many are located in the area at this time. We know of six pair sites, but specific barred owl surveys have not been done. Based on barred owl density on the Veneta area, we estimate that there are approximately 235 potential barred owl sites in this portion of the study area.

Figure 3-17. Rogue Cascades (South Cascades) Study Area.



3.1.4 Oregon/California

3.1.4.1 Horse-Beaver Study Area

DESCRIPTION. The Horse-Beaver Study Area (Figure 3-18) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 359,900 total acres, barred owl removal would occur on up to approximately 179,100 acres, or up to one-half of the total study area. The area has a history of spotted owl surveys from the early 1990s to the present, although in some years no surveys were done.

The Horse-Beaver Study Area is located both in northern California and southern Oregon just to the west of Interstate 5. The study area is in Siskiyou County in California and Jackson County in Oregon. The area lies primarily within the Klamath and Klamath Mountains Physiographic Provinces, with a small portion in the Western Cascades Physiographic Province.

The Horse-Beaver Study Area is a mountainous region at elevations ranging from 510 to 4,658 feet in California and from 2,379 to 7,480 feet in Oregon. The area is dominated by mixed-conifer and mixed-conifer/hardwood forests. Mixed Douglas-fir forests are common at lower elevations, with Douglas-fir/true fir forests at higher elevations. Some of the study area has mixed forest stands. The primary spotted owl prey species in the area is the dusky-footed woodrat, though other small mammals are also taken. The study area contains approximately 117,400 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Horse-Beaver Study Area (Table 3-35). The Rogue River National Forest in Oregon and Klamath National Forest in California administer approximately 87 percent of the study area, of which 59 percent is designated Late-Successional Reserve (Table 3-36). A small portion of the Medford District BLM is also included. The study area overlaps a portion of the Marble Mountain Wilderness Area.

Table 3-35. Horse-Beaver Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total	314,700	87
Forest Service	*312,700*	87
Bureau of Land Management	*2,000*	less than 1
States Total	400	less than 1
Private Total	44,900	12
Total land	**359,900**	**100**

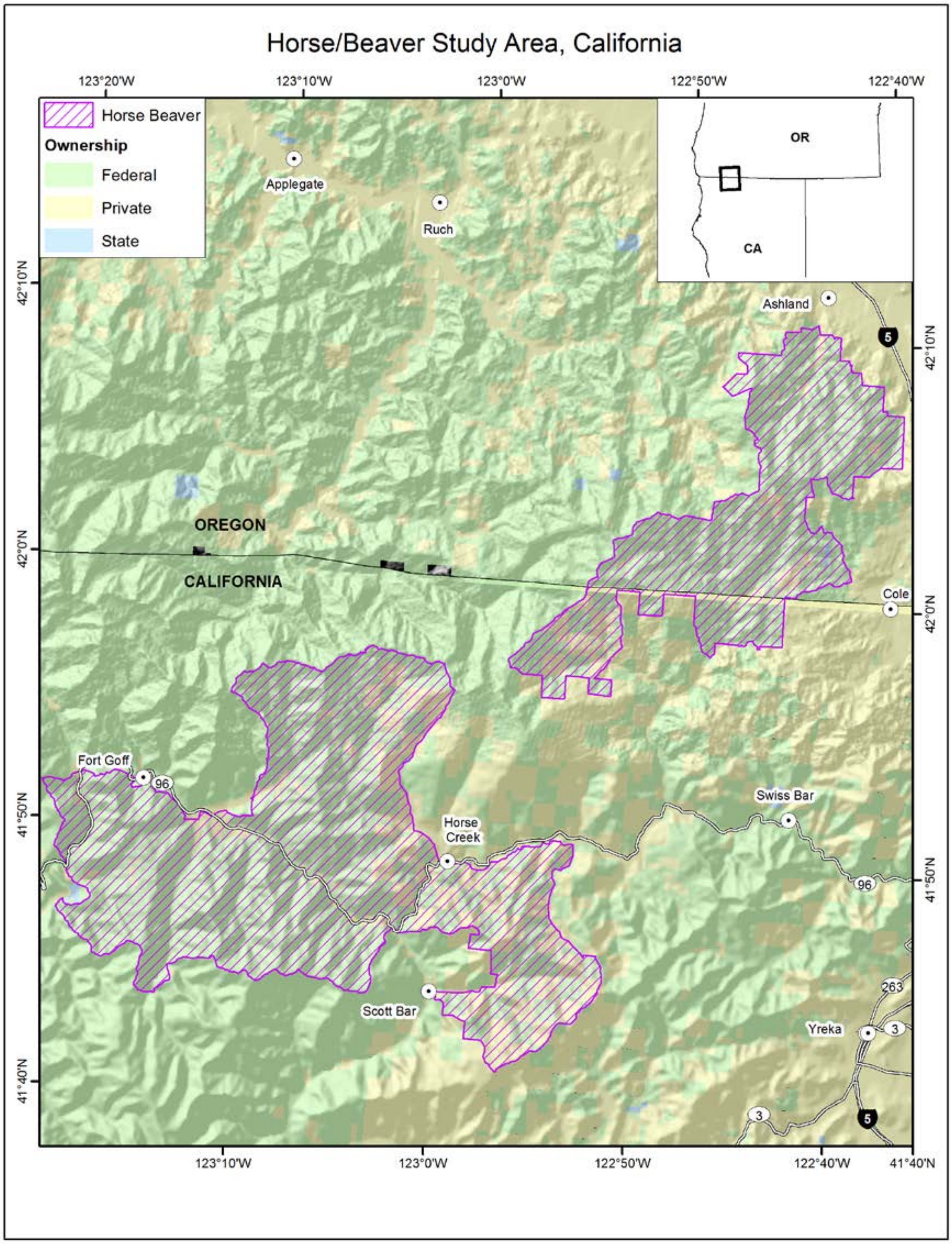
Table 3-36. Horse-Beaver Study Area Northwest Forest Plan land use allocations.

Northwest Forest Plan Land Use Allocations	Percent Federal Land
Congressional Reserves	5
Late-Successional Reserves	59
Adaptive Management Areas	less than 1
Administratively Withdrawn areas	5
Matrix (includes imbedded Riparian Reserves)	31
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. The proposed Horse-Beaver study area has historical survey data dating back to 1980, but surveys began in earnest in the early 1990s. Most of the surveys were implemented for specific forest management projects; however, others were for Late-Successional Reserve assessment and research. There is limited or no survey data in some areas where road access is poor. Various survey protocols were used, so historical survey data across the project area is highly variable. Based on habitat available in the study area, there are an estimated 120 potential spotted owl sites, though not all of these sites are likely occupied at this time. Approximately 75 to 85 percent of the known sites have been recently occupied.

BARRED OWL POPULATION INFORMATION. The first detection of barred owls in the immediate vicinity of the study area was in 2005. Incidental observations of barred owls occurred during protocol surveys for spotted owls. The density of barred owls in the study area is likely low, based on reported results of incomplete surveys, but actual numbers may be underestimated and are likely increasing. Based on this information, we estimate about 8 barred owl sites occur within the proposed study area at this time, but habitat is available for approximately 126 potential barred owl sites, based on recently updated barred owl density estimates within the Hoopa Study Area.

Figure 3-18. Horse-Beaver Study Area.



3.1.5 California

3.1.5.1 Goosenest Study Area

DESCRIPTION. The Goosenest Study Area (Figure 3-19) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 49,000 total acres, barred owl removal would occur on up to approximately 24,500 acres, or up to one-half of the total study area. This area was an early spotted owl demography study area that is now inactive and has a history of intensive spotted owl surveys and banding of birds.

The Goosenest Study Area is located in northern California just south of the border with Oregon between Interstate 5 and Highway 97 in Siskiyou County. The study area is entirely within the Cascades Physiographic Province.

The Goosenest Study Area is in the California Cascade Range at elevations ranging from 2,755 to 7,820 feet. The study area is in the California Cascade Range. This area primarily consists of the Goosenest Late-Successional Reserve. The area is dominated by the mixed-conifer community, which includes Douglas-fir, ponderosa pine, sugar pine, incense-cedar, and white fir. The second most prevalent community is the true-fir community, which is dominated by red fir and white fir, and generally occurs above 5,800 feet. Ponderosa pine, juniper, and oak occur in a very small portion of the study area, typically only below 4,500 feet. Smaller pockets of lodgepole pine and riparian communities occur within the study area as well. The primary spotted owl prey species in the area is the northern flying squirrel, though other small mammals are also taken. The study area contains approximately 13,200 acres of spotted owl nesting and roosting habitat.

A mixture of Federal, State, and privately owned lands occurs in the Goosenest Study Area (Table 3-37). The Klamath National Forest administers approximately 74 percent of the study area, of which 99 percent is designated Late-Successional Reserve (Table 3-38).

Table 3-37. Goosenest Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	36,300	74
State Total	1,300	3
Private Total	11,400	23
Total	**49,000**	**100**

Table 3-38. Goosenest Study Area Northwest Forest Plan land use allocations.

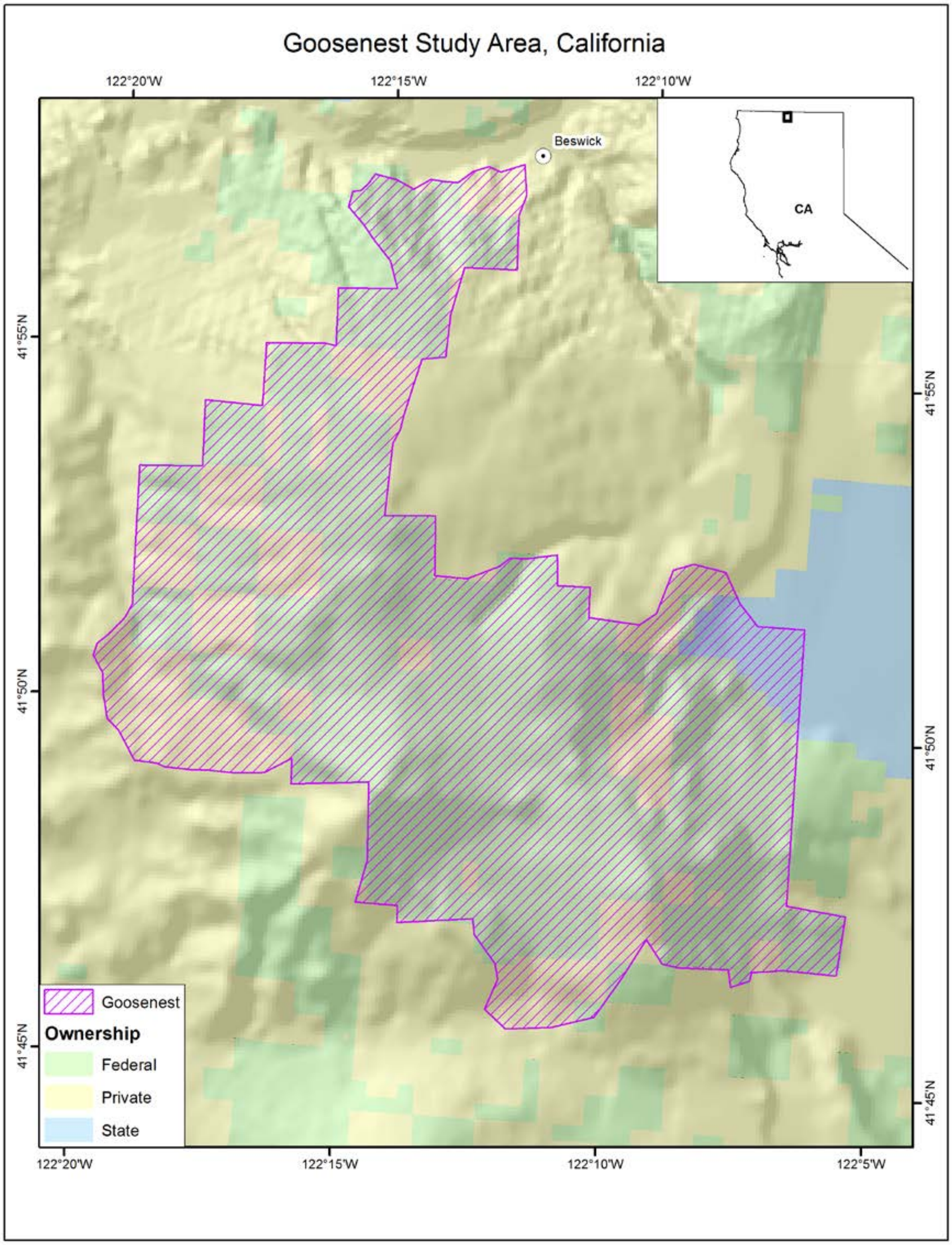
Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Late-Successional Reserves	99
Matrix (includes embedded Riparian Reserves)	less than 1
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. In the early 1980s, surveys were conducted in potential spotted owl habitat. By late 1988 there were six sites being monitored annually. During the 1990s, survey efforts increased to gain a better understanding of occupied habitat, resulting in a total 14 known historical site centers within the study area, and a few sites that overlap with the study area but do not have their centers within the boundaries. Within this study area, territory location, reproductive success, and turnover of marked spotted owls have been monitored since the late 1980s. Twelve of these sites have been occupied within the last 5 years. Based on habitat available, Goosenest has an estimated 25 potential spotted owl sites.

BARRED OWL POPULATION INFORMATION. Despite intensive surveys for spotted owls throughout the Goosenest Late-Successional Reserve and surrounding private timberlands, barred owls were not detected in the area until 1996, when a single male was detected. From 1996 to 2003, only a single barred owl was detected within the study area. As of 2004, only three pairs and three territorial single barred owls occurred in the study area. Some barred owls were removed from this study area in 2005, in cooperation with the California Academy of Sciences. Surveys for both species continued through the breeding season and in 2006 to evaluate responses by spotted owls (recolonization of former territory, identity of individuals, reproductive success) and barred owls (replacement by floaters).

All areas where barred owls were removed are presently occupied by barred owls. Based on updated barred owl density from the Hoopa study area, we estimate that there are approximately 14 barred owl sites within the Goosenest study area.

Figure 3-19. Goosenest Study Area.



3.1.5.2 Hoopa (Willow Creek) Study Area

DESCRIPTION. The Hoopa (Willow Creek) Study Area (Figure 3-20) would include both treatment (removal) and control (non-removal) areas. The study area consists of approximately 158,800 acres; the Willow Creek (68,000 acres) portion of the study area would be used as the control and barred owl removal would occur on up to the entire 90,800 acres of the Hoopa portion of the study area. The Willow Creek portion of the study area is part of the larger Northwest California Spotted Owl Demography Study Area, which is one of the eight long-term ongoing spotted owl demography study areas selected as part of the Northwest Forest Plan Effectiveness Monitoring Program. Spotted owl demographic data has been collected on the Northwest California Spotted Owl Demography Study Area since 1985. Spotted owl demographic information has been collected within the Hoopa portion of the study area, on Hoopa Valley Indian Reservation, since 1992; these data have been used in spotted owl range-wide status and trend meta-analyses.

The Hoopa (Willow Creek) Study Area is located in northern California east of Eureka and west of Redding, in Trinity and Humboldt Counties. The study area lies entirely within the Klamath Physiographic Province.

The Hoopa (Willow Creek) Study Area occurs at elevations ranging from 475 to 5,495 feet where the climate is characterized by cool, wet winters and hot, dry summers. Vegetation is mixed evergreen, Klamath montane, Oregon white oak, and tanoak forest types. The primary spotted owl prey species in the area is the dusky-footed woodrat, though other small mammals are also taken. The study area contains approximately 98,600 acres of spotted owl nesting and roosting habitat.

A mixture of tribal, Federal, and privately owned lands occurs in the Hoopa (Willow Creek) Study Area (Table 3-39). The Hoopa Valley Tribe administers the approximately 90,800 acres Hoopa Valley Indian Reservation (57 percent of the combined study area). The Forest Service administers approximately 38 percent of the combined study area, of which 59 percent is designated Late-Successional Reserve (Table 3-40). Private lands constitute approximately 5 percent of the combined study areas. No wilderness areas are included.

Table 3-39. Hoopa (Willow Creek) Study Area land ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	60,200	38
Tribal	90,800	57
Private Total	7,800	5
Total	**158,800**	**100**

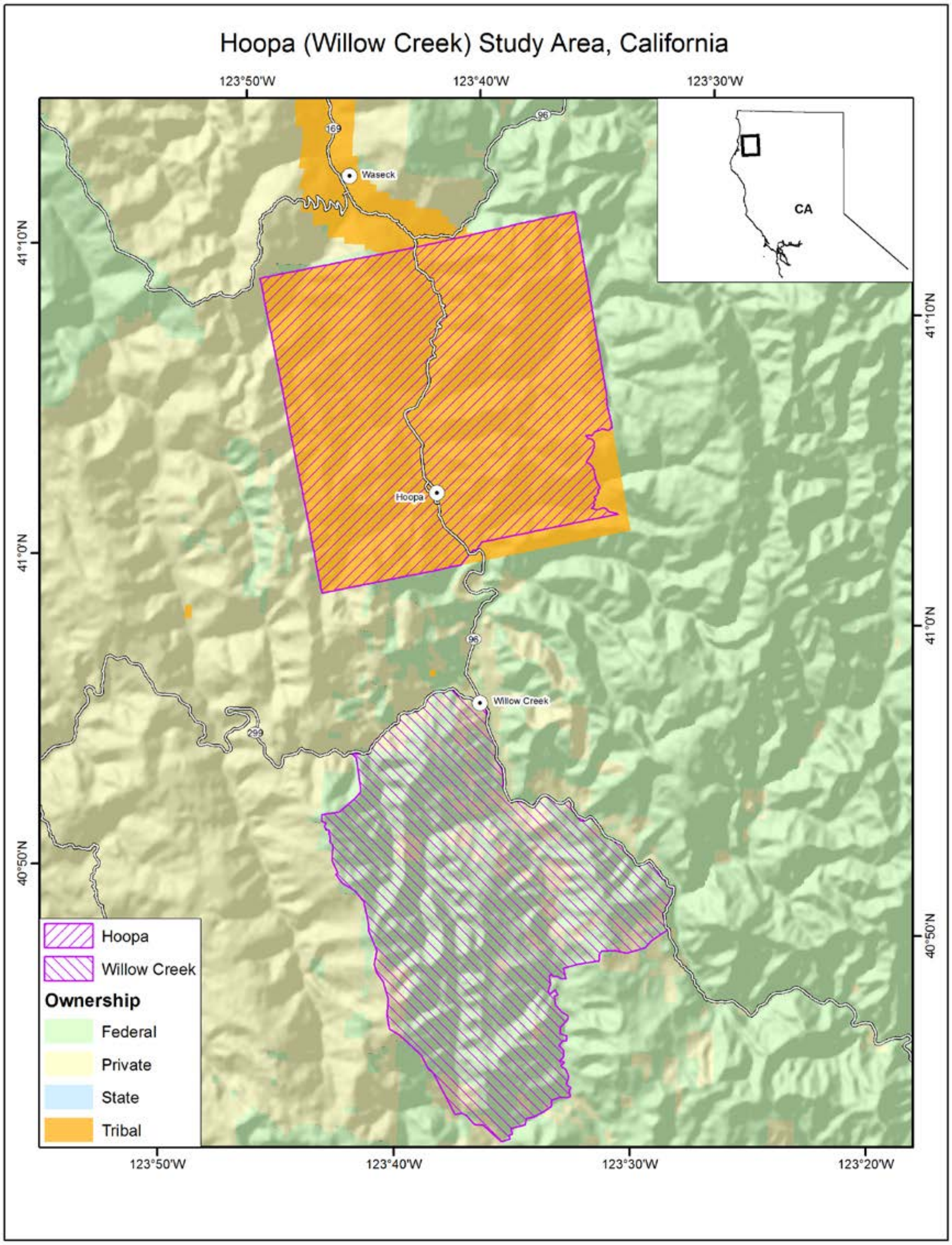
Table 3-40. Northwest Forest Plan land use allocations in the Federal portion of the Hoopa (Willow Creek) Study Area.

Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Congressional Reserves	2
Late-Successional Reserves	60
Adaptive Management Area	37
Administratively Withdrawn	less than 1
Matrix (includes embedded Riparian Reserves)	1
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. Beginning in 1985, spotted owls were marked and surveyed at the Hoopa (Willow Creek) Study Area to assess the status and management of spotted owl populations. Spotted owl sites were surveyed at least twice a year to locate and mark territorial owls and assess reproductive output, survival probabilities, fecundity, and population trends. The Willow Creek portion of the study area has 57 known or surveyed spotted owl sites; the Hoopa portion has 55. Based on habitat available in the study area, there are 57 potential spotted owl sites on the Willow Creek area, and 58 potential spotted owl sites on the Hoopa Valley Indian Reservation.

BARRED OWL POPULATION INFORMATION. Barred owls were first detected in the Hoopa (Willow Creek) Study Area in 1991. Spotted owl territories with barred owl detections increased from zero in 1991 to 21 in 2009. Based on results of focused barred owl surveys through 2012, there are 56 barred owl sites on the Hoopa portion of the study area. This represents an increase of 13 sites from that reported in the Draft EIS, a 30 percent increase in 2 years. Based on this barred owl density, we estimate that there are approximately 51 potential barred owl sites in the Willow Creek portion of the study area. Thus, the combined study area has approximately 107 barred owl sites.

Figure 3-20. Hoopa (Willow Creek) Study Area.



3.1.5.3 Corral Study Area

DESCRIPTION. The Corral Study Area (Figure 3-21) would include both treatment (removal) and control (non-removal) areas. Of the study area's approximately 84,600 total acres, barred owl removal could occur on approximately 42,300 acres, or up to one-half of the study area.

The Corral Study Area is located in northern California, east of Eureka and west of Redding, in Trinity County. The entire study area is within the Klamath Physiographic Province. The study area lies south of Highway 299 between Burnt Ranch and Weaverville in northern California. The Trinity River frames a portion of the northern boundary of the study area.

Elevations vary from 1,140 feet at Sandy Bar along the Trinity River to 5,800 feet at Hayfork Bally along the southern boundary of the study area. The area is mountainous and dominated by mixed-conifer and mixed-conifer/hardwood forests. Mixed Douglas-fir forests are common at lower elevations, with Douglas-fir/true fir forest at higher elevations. The dominant vegetation type in the Corral Study Area is Douglas-fir, white fir, ponderosa pine, and mixed-conifer, with some mixed hardwoods. This study area has large areas on south and west aspects that have shallow soils and hot dry exposures, primarily in the Trinity River Canyon. Most of these slopes contain vegetation that is not conducive to dense coniferous stands. The study area contains approximately 43,400 acres of spotted owl nesting and roosting habitat.

A mixture of Federal and privately owned lands occurs in the Corral Study Area (Table 3-41). The Shasta-Trinity National Forest administers approximately 91 percent of the study area, of which 97 percent is designated Late-Successional Reserve (Table 3-42). No wilderness areas occur within the study area. Primary spotted owl prey species are woodrats, though spotted owls also consume other small mammals, including flying squirrels and voles.

Table 3-41. Corral Study Area Land Ownership.

Landowner or Land Manager	Acres	Percent of Area
Federal Total (Forest Service)	77,300	91
Private Total	7,300	9
Total	**84,600**	**100**

Table 3-42. Corral Study Area Northwest Forest Plan land use allocations.

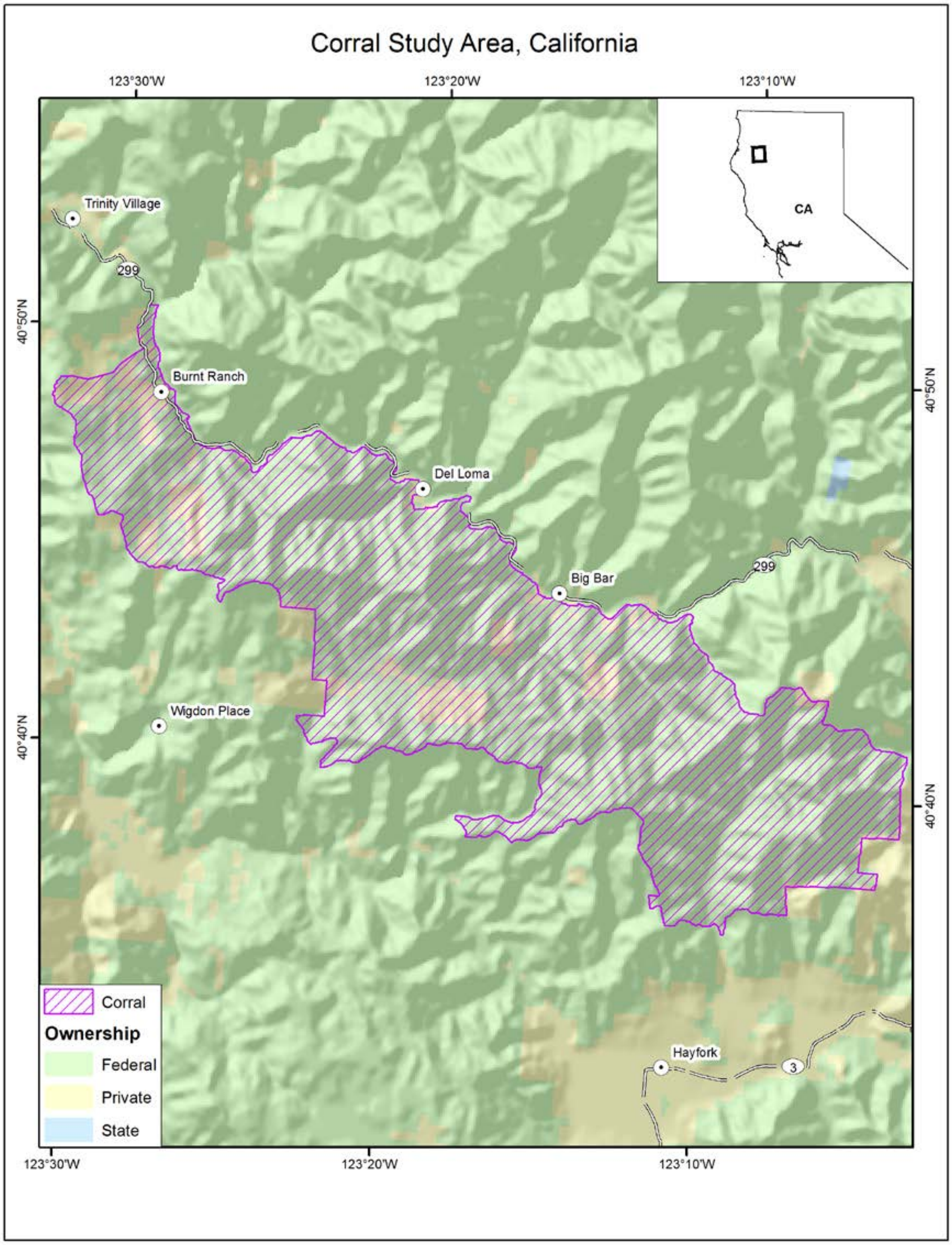
Northwest Forest Plan Land Use Allocations	Percent of Federal Land
Adaptive Management Area	3
Late-Successional Reserves	97
Matrix (includes embedded Riparian Reserves)	less than 1
Total Federal Land	**100**

SPOTTED OWL POPULATION INFORMATION. Spotted owl survey data is available for the Corral Study Area from the 1990s. The Shasta-Trinity National Forest conducted a Late-Successional Reserve Assessment in 1999 that includes this study area, at which time the study area supported 25 spotted owl sites. The extent to which this information was based on professional judgment and modeling or actual surveys is unclear. Based on habitat available in the study area, there are 17 potential spotted owl sites on the Corral Study Area.

Few surveys for spotted owls were conducted from the mid-1990s to the mid-2000s. Surveys were conducted in a few areas within the study area between 2005 and 2008, though not fully consistent with the current survey protocol. Project-specific surveys were completed by the Shasta-Trinity National Forest during that period in a few locations within the study area.

BARRED OWL POPULATION INFORMATION. In 2010, an intensive survey effort was undertaken in the study area to determine the number of sites occupied by barred and spotted owls. Traditional vocal surveys and three-visit detection-dog surveys were also conducted. Only approximately 80 percent of the study was well surveyed because of restricted access due to illegal drug activity. Half of the restricted area was surveyed in November using detection dog surveys and a combination of spotted and barred owl vocalizations. Based on recently updated barred owl density on the Hoopa area, we estimate approximately 46 potential barred owl sites occur within the proposed Corral Study Area.

Figure 3-21. Corral Study Area.



3.2 Affected Environment and Environmental Consequences—Barred Owl

3.2.0 Changes between Draft and Final EIS

- Revised estimates of the number of barred owls to be removed under each alternative, reflecting additional and updated information. Our revised estimates of number removed are somewhat lower than those reported in the Draft EIS, primarily as a result of new information regarding the rate of reoccupancy of sites by barred owls where the prior territorial adult(s) have been removed. Although the reported numbers have changed, these numbers are within the range of variability of our draft estimates, and do not represent significant changes to our effects analysis.
- Updated information on the number of known barred owl sites, and number of individual barred owls, reported for the Hoopa Study Area. Ongoing surveys for barred owls report an increase of number of barred owls sites from 43, as reported in the Draft EIS, to 56 barred owls sites, based on surveys current through the 2012 field season.
- Using the updated barred owl density data from the Hoopa Study Area, we revised our estimates of current barred owl numbers in the Willow Creek, Horse/Beaver, Goosenest, and Corral Study Areas to reflect this new information. New information was not available for Veneta or Cowlitz Valley Study Areas.
- Added Section 3.2.2.2.3 describing the effects to barred owls under our Preferred Alternative.
- Provided an example of the methodology used in estimating barred owl removal numbers.
- Clarified our assumption of 90 percent annual removal of territorial barred owls, and the implications of deviations from that assumption.
- Provided a more detailed description of the rate of barred owl recolonization of treatment areas once removal ceases.
- Updated the results for sub-Alternative 6b to reflect a slight clarification in the description of that alternative in Section 2.2.3.7 of this Final EIS (initiate removal of barred owls during year 1 of the experiment).

3.2.1 Background and Affected Environment

Our discussion of the effects of the proposed removal experiment on barred owls are focused primarily within the range of northern spotted owl, while acknowledging wider range and habitat tolerances of barred owls. This is the area from which we have specific information and data to analyze the effects of removal. For each alternative we describe the anticipated effects to barred owls, including: (a) the number of barred owls we expect to remove by study area; (b) the overall effects of removal to barred owl populations; and (c) an estimate of the extent of removal as a proportion of the total known range of barred owls within the range of the northern spotted owl, and within the barred owl's range in North America.

3.2.1.1 Current Conditions across the Range and in the Action Area

The history of the barred owl's expansion into, and across, the range of the northern spotted owl is summarized in Appendix A of this Final EIS. Barred owls have occupied at least a portion of the range of the northern spotted owl for more than 40 years. More recently, barred owl populations and distribution have greatly increased, to the point where populations may be saturated in Washington and coastal Oregon, are filling in rapidly in southern Oregon and California, and continue to expand south into the range of the California spotted owl (*Strix occidentalis occidentalis*).

Within its historical native range, the barred owl occupies all or portions of at least 26 states in the eastern and midwestern United States, the southern portions of at least four Canadian provinces, and portions of central Mexico. During its range expansion into the western United States and Canada, the barred owl has invaded substantial portions of five western states and five Canadian provinces.

We do not have estimates of the acres of suitable barred owl habitat over that vast area; therefore, we cannot provide a precise estimate of the proportion of the total barred owl range that overlaps the northern spotted owl range. However, we conservatively estimate that the currently occupied barred owl range within the historical range of the northern spotted owl represents approximately 3 percent of the total range of the barred owl in North America, based on a visual approximation. As described under the action alternatives, the area over which barred owls would be removed under each action alternative represents, in itself, a very small portion of this 3 percent, even under the most extensive proposed alternative.

3.2.1.2 Barred Owl Population within Each Study Area

We estimated the number of barred owls that may occur on each study area by extrapolating site occupancy data from three areas where barred owl populations have been rigorously surveyed, and the amount of spotted owl habitat within each study area projected from the Northwest Forest Plan Effectiveness Monitoring Program. These habitat data cover the range of the northern spotted owl, our area of interest, and all ownerships. These habitat data allow us to consistently extrapolate the information from one study area to another, providing a means to compare the effects to barred owl populations among the full set of study areas. We know that barred owls use some habitats not used by spotted owls, and therefore not entirely captured in this habitat calculation. We also know that barred owls consistently occupy habitat suitable for spotted owls and, in forested areas, appear to focus on the same habitat as spotted owls in general. Comparable data specific to barred owl habitat use is not available across the range of the northern spotted owl to provide a consistent basis for comparison. Hence, we rely in this analysis on available spotted owl habitat data as a surrogate for barred owl habitat.

We have data on the number of barred owl sites on three areas: a large and well-surveyed portion of the Cowlitz Valley area in Washington, the Veneta area in coastal Oregon, and the Hoopa area in northwestern California. We used these data and the habitat data for each area to estimate the density of barred owls by dividing the number of barred owl sites by the acreage of spotted owl habitat. Table 3-43 includes the estimated barred owl site density per thousand acres of suitable spotted owl habitat on each of these three survey areas.

Table 3-43. Areas with known densities of barred owls based on surveys.

Study Area	Estimated Number of Barred Owl Sites/1000 Acres of Suitable Spotted Owl Habitat	General Location
Well-surveyed portion of the Cowlitz Study Area	1.79	Washington Cascades
Veneta Area	2.96	Oregon Coast Ranges
Hoopa Area	1.07	California Klamath

We estimated the number of barred owl sites on each proposed but unsurveyed study area by multiplying the acres of spotted owl habitat times the density of barred owls within the survey area. We chose the density value from the surveyed area considered most similar to each study area. In choosing the appropriate survey area as the basis for our estimate of barred owl numbers on unsurveyed study areas, we considered the similarity of forest or habitat type, current forest conditions, available data on barred owl presence, general location along the north to south invasion pathway, and relative proximity to surveyed areas. Since the experiment may not begin until after the 2013 breeding season, we anticipate that the density of barred owls may increase, and reported densities may exceed our current estimate.

In our determination of the number of barred owls within each study area at the start of the experiment, we assumed each barred owl site is occupied by a pair. We believe this is a very reasonable assumption for the northern portion of the northern spotted owl's range. In the southern portion of the range (southwestern Oregon and northwestern California) barred owl populations may still be well below carrying capacity. This assumption is supported by data from the Hoopa Study Area, where there has been, and continues to be, a rapid increase in the number of reported barred owls sites, and no indication (as of 2012) that the population has reached peak density. In this situation, it is possible not all occupied sites contain a pair of barred owls. However, extensive data documenting the proportion of sites occupied by barred owl pairs or singles are not available for most of the study areas at this time. We have no way to determine the level of pairing in these areas. Therefore, we chose to use a consistent, conservative assumption that all occupied barred owl sites contain a pair. This assumption, if incorrect, may result in a slight overestimate of barred owls to be removed. However, this outcome is preferable to underestimating the effects to barred owls of conducting this experiment. Table 3-44 indicates the estimated number of barred owl sites on each of the proposed study areas.

Table 3-44. Estimated number of barred owl sites and barred owls on each area.

Study Area[1]	Acres of Suitable Spotted Owl Habitat	Estimated Number of Barred Owl Sites Per 1000 Acres Spotted Owl Habitat[2]	Estimated Number of Barred Owl Sites	Estimated Number of Barred Owls[3]
Ross Lake	170,000	1.79	304	608
Wenatchee	267,600	1.79	479	958
Cle Elum	143,700	1.79	257	514
Olympic Peninsula	384,700	1.79	689	1,378
Olympic Revised portion of Olympic Revised (Olympic Peninsula)	127,300	1.79	228	456
Rainier	148,500	1.79	266	532
Cowlitz Valley[4]	221,000	**1.79**	396	792
Columbia Gorge	210,900	1.79	378	756
Oregon Coast Ranges	307,200	2.96	909	1,818
Veneta portion of Veneta (Oregon Coast Ranges/Tyee)[4]	39,200	**2.96**	116	232
Tyee	74,100	2.96	219	438
McKenzie	131,800	2.96	390	780
HJ Andrews	224,400	1.79	402	804
Union/Myrtle portion of Union/Myrtle (Klamath)	98,100	2.96	290	580
Klamath	132,300	2.96	392	784
South Cascades	252,300	2.96	747	1,494
Rogue Cascade portion of Rogue Cascades (South Cascades)	79,300	2.96	235	470
Horse/Beaver	117,400	1.07	126	252
Goosenest	13,200	1.07	14	28
Hoopa portion of Hoopa (Willow Creek)[4]	52,500	**1.07**	56	112
Willow Creek portion of Hoopa (Willow Creek)	47,700	1.07	51	102
Corral	43,400	1.07	46	92

[1] Includes five study areas that are treatment areas paired with neighboring areas for control. These include Olympic Revised paired with Olympic Peninsula; Veneta paired with Oregon Coast Ranges/Tyee; Union/Myrtle paired with Klamath; Rogue Cascades paired with South Cascades; and Hoopa paired with Willow Creek.
[2] Estimate of barred owls per 1000 acres of spotted owl habitat based on the following survey areas with extensive, well-documented density estimates: Cowlitz well-surveyed area = 1.79, Veneta = 2.96, Hoopa = 1.07. These areas are indicated in **bold**.
[3] This value is based on the assumption that each site has, or will have by the time of the experiment, a pair of barred owls.
[4] Values for Cowlitz, Veneta, and Hoopa Study Areas based on direct estimate from each study area.

3.2.2 Environmental Consequences

3.2.2.1 Effects under the No Action Alternative

Under the No Action Alternative, a removal experiment would not be conducted. No barred owls would be removed from any of the proposed study areas as a part of this experiment.

In the absence of a removal experiment, barred owl populations are likely to increase in the future until all habitat, including the study areas considered in this proposed action, is fully saturated with territorial barred owls. Within southern Oregon and California, where we believe the current barred owl population density is below carrying capacity, we anticipate barred owl populations would continue to increase until carrying capacity is reached. In areas where barred owls have been present for the longest period, (e.g., western Washington and northwestern Oregon), suitable habitat may already be filled to capacity, and we anticipate less change in the density of barred owls or their overall population numbers in future years. Barred owls may even exceed the carrying capacity of their habitat and prey base due to their rapid rate of population growth. This would be a temporary condition, and we would expect to see the population peak, and then decline to a lower stable level.

If the No Action Alternative is adopted, the Service would continue to consider future applications for research permits for barred owl removal, subject to project-specific NEPA review, to address specific research questions about the barred owl.

If the No Action Alternative is adopted, the Service would not gain the information necessary to evaluate future proposals, if any, to manage barred owls to reduce conflicts between this species and other species, including the spotted owl and California spotted owl. The Service would have to rely on the same information included in this environmental review, plus other data that may incidentally become available, when evaluating the effect of removal on barred owls themselves. Without the new information to be gained through this proposed action, the Service would have to make future management decisions that may consider barred owl removal with less certainty regarding the effectiveness, efficiency, feasibility and operability that would be gained through implementation of any of the action alternatives proposed for this experiment. Using less extensive data from other studies may result in additional impacts to barred owls from future actions. Even if this information could be gained through other studies, we anticipate that it could result in substantial delays to future decisions that may be necessary to conserve the northern spotted owl through barred owl removal.

3.2.2.2 Effects under the Action Alternatives

3.2.2.2.1 Methodology for the Analysis of Effects

ESTIMATING THE NUMBER OF BARRED OWLS TO BE REMOVED UNDER THE ACTION ALTERNATIVES. We estimated the number of barred owls removed from each study area under each action alternative through a methodology described in detail in Appendix F of this Final EIS. We provide a brief description of the estimation methods in this section, and refer the reader to Appendix F of this Final EIS for the details of the calculations.

We used our estimate of barred owl numbers in each study area from Section 3.2.1.2 of this Final EIS, above, as an initial starting point for our estimates of annual removal. We then estimated the number of barred owls removed each year, and for the duration of the removal portion of the experiment, by study area and alternative. Later in this section, we report those numbers and describe the effects of that level of removal of barred owls on their populations, at local, regional, and rangewide scales.

For the removal experiment, we assumed a 90 percent annual rate of removal of territorial barred owls within the treatment areas, and an annual reoccupancy rate that accounts for dispersing juveniles and subadults moving into the study area over time, based on the best information currently available to us. We tested the influence of our assumption on the estimated total number of barred owls removed for the duration of the barred owl removal by varying the annual rate of removal (80, 90, and 100 percent) on a hypothetical treatment area with 360 territorial barred owls. We selected these initial numbers of barred owls sites, and barred owls, simply as representative of a “typical” study area. These results can be scaled and directly compared to other study areas with lower or higher numbers of barred owl sites, under any of the proposed action alternatives. Details of this example analysis can be found in Appendix F of this Final EIS.

For our hypothetical treatment area, the estimated number of barred owls removed under an 80, 90, and 100 percent annual rate of removal of territorial barred owls over a 4-year removal period is 855, 888, and 918 barred owls, respectively. Thus, our estimated number of barred owls removed for an 80 or 100 percent removal rate deviates less than 4 percent in total number of barred owls removed from our assumed 90 percent removal rate. Slightly smaller proportional deviations would occur for even longer experimental periods, as prescribed under some of the action alternatives. While this result may seem counter-intuitive, it is the result of a high annual removal rate. Any territorial barred owl is unlikely to survive beyond 3 years, even under the lower 80 percent removal rate.

We also estimated the effect that a deviation in annual removal rate of newly territorial individuals would have on total removal numbers for a 4-year and 10-year duration fo barred owl removal. In the analysis described above, we assume an annual removal rate of 25 percent of these newly territorial barred owls. To test the effect of deviation from this estimated parameter, we calculated the total number of barred owls removed if the removal rate were substantially lower (12.5 percent, or half of our initial assumption) or higher (50 percent, or double our initial assumption) (see Appendix F of this Final EIS). In each case, the total number of barred owls removed differed by less than 2 percent from our initial estimate, for both the 4-year and 10-year durations of barred owl removal. The estimated differences resulting from substantial changes to our initial parameter estimates are well within the inherent uncertainty in our barred owl population estimates. Thus, if the actual removal rate of either territorial or newly territorial barred owls deviates within the wide range of potential values we analyzed, it would not significantly change the estimated total number of barred owls removed over the duration of the experiment, regardless of study area or alternative.

We estimated the total duration of the effects of removal on barred owl populations in the treatment areas (i.e., the time required for barred owl populations to return to pre-removal levels once experimental removal terminates). Based on our estimated recolonization rates (40 percent of available barred owl sites per year), barred owl populations should return to pre-removal levels within 3 years of the end of the removal effort. This rapid recolonization of treatment areas may be somewhat optimistic, especially in landscapes where barred owl populations are well below carrying capacity. Recent data from the Hoopa Valley Indian Reservation, an area with a lower estimated density of barred owls across the landscape compared to the northern portion of the barred owl invasion, show a population increase from 43 known barred owl sites in 2010 to 56 known sites in 2012 (Higley 2013, pers. comm.), an approximately 15 percent increase per year over a 2-year period. Using these data, barred owl populations on the treatment areas would likely return to pre-removal levels within approximately 5 years of the end of the removal effort. Regardless of the precise recolonization rate, we anticipate that barred owls will recolonize any treatment area within a few years of the cessation of removal, and none of the treatment areas will suffer a long-term extirpation of barred owls.

REGIONAL AND RANGEWIDE CONTEXT. The number of barred owls removed tells only part of the story. We also need to put this removal into a larger context of regional and rangewide barred owl populations. Because we do not have estimates of barred owl populations at a scale other than the individual study areas in the Northwest we cannot directly compare the number of barred owls removed to the total population. Therefore, we used a habitat comparison to describe the level of effect on the barred owl population.

Likewise, we were unable to locate any currently available and scientifically credible data on the amount and distribution of barred owl habitat in the Northwest or rangewide that would allow a direct comparison to the study areas. Therefore, we chose to use spotted owl habitat as a surrogate within the range of the northern spotted owl. This likely underestimates the actual amount of habitat because barred owls use a wider range of habitat than spotted owls. However, since we use this to measure both the treatment (removal) area and the regional/rangewide condition, it provides a reasonable index (or estimate) of the degree to which each alternative may affect barred owl populations. For example, if an alternative includes removal on 5 percent of spotted owl habitat, then we estimate that we are removing approximately 5 percent of the barred owls within the range of the northern spotted owl. We can use this same information to estimate the proportion of the entire population based on the estimate that the range of the northern spotted owl represents approximately 3 percent of the total range of the barred owl in North America.

3.2.2.2.2 Effects Common to Most Action Alternatives

DIRECT EFFECTS. For most study areas under the action alternatives, barred owls would be removed from up to one-half of each study area. The location of the treatment (removal) area would be determined by the principle investigator for each study area, based on conditions in the study area. Barred owls would be removed for a minimum of 3 years, up to a maximum of 10 years, depending on alternative and study area. The duration of experiment's effects on barred owls are described under each action alternative, below.

We anticipate that few, if any, territorial barred owls will move from the surrounding barred owl population into the treatment area, and therefore be removed. Few territorial barred owls are likely to abandon the territories they know well to move into neighboring similar habitat, and any that do would likely be replaced by other territorial individuals in this expanding population. Thus, the removal will have a very small and insignificant effect on the surrounding barred owl population.

Areas immediately adjacent to treatment areas may experience a limited and temporary drop in the total barred owl population as floaters (non-territorial barred owls) near the removal area move to occupy recently. Thus, fewer floaters will be available in these populations. Although no data exist to allow us to calculate the scale and scope of this effect, we anticipate that the affected area would be limited to within a few miles surrounding the perimeter of the treatment area.

SYNERGISTIC EFFECTS OF MULTIPLE STUDY AREAS. Although multiple study areas are included under Alternatives 2 through 7, and under the Preferred Alternative, we do not expect synergistic effects from multiple studies in Alternatives 2 through 6, or in the Preferred Alternative. Study areas selected under these alternatives are sufficiently distant from each other such that the influence of barred owl removal on one study area would have essentially undetectable impact on other study areas included in the alternative. Under Alternative 1, experimental removal would only occur in one study area, so synergistic effects of barred owl removal would not be possible.

Of the 11 study areas included in Alternative 7, four could experience a low synergistic effect due to removal at adjacent study areas. The Wenatchee and Rainier Study Areas share a common boundary and the Corral and Hoopa (Willow Creek) Study Areas have removal areas within a few miles of each other. Because removal would occur on portions of these study areas, slightly fewer dispersing barred owls would be produced in these areas and, therefore, slightly fewer barred owls would be available to recolonize sites on the adjacent study area. Because each treatment area represents a very small portion of the source of recolonizing barred owls for the adjacent study area, we do not anticipate a substantial effect on recolonization. All other study areas in this alternative are separated by sufficient distance to preclude barred owl dispersal between study areas at a measurable or predictable rate, and this dispersal effect is anticipated to be zero. Where the aforementioned study areas are immediately adjacent (e.g., shared boundary or within 5 miles), the removal of barred owl floaters that have become newly territorial in one treatment area may influence the density of floaters in the adjacent area. However, as with dispersing individuals, we expect this effect to be very minor.

We expect substantial reduction of the barred owl population in the treatment (removal portion) of each study area, but little effect in the surrounding landscape. Some local floaters near the treatment area may move into and recolonize sites in the treatment area, temporarily reducing the floater population near the treatment area. We do not anticipate affecting floaters more than 5 miles from the treatment area, and floaters that do move are likely to be replaced by dispersing juvenile and subadult barred owls. We do not expect territorial barred owls to abandon their territories to move into the treatment area; therefore, we do not anticipate substantial changes in the territorial barred owl population near the treatment area.

3.2.2.2.3 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach on four study areas: Cle Elum, Oregon Coast Ranges/Veneta (half), Union/Myrtle (Klamath), and Hoopa (Willow Creek). Barred owls would be removed from approximately one-half of each study area using lethal and nonlethal removal methods for 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. A complete description of each action alternative, including the Preferred Alternative, is provided in Chapter 2 of this EIS.

NUMBER OF BARRED OWLS REMOVED. An estimated 634 barred owls would be removed from the Cle Elum Study Area; 1,263 barred owls would be removed from the Oregon Coast Ranges/Veneta (half) Study Area; 1,430 barred owls would be removed from the Union/Myrtle (Klamath) Study Area; and 276 barred owls would be removed from the Hoopa (Willow Creek) Study Area over the 4 years of barred owl removal. We estimate a total of approximately 3,603 barred owls would be removed during the full complement of four study areas in 4 years of barred owl removal. Year-by-year barred owl removal estimates under the Preferred Alternative are shown in Table 3-45.

As indicated earlier in this document, we do not anticipate significant synergistic effects from multiple study areas under the Preferred Alternative. The four included study areas are sufficiently distant from each other that the influence of barred owl removal on one study area would have essentially undetectable impact on the other study areas.

Table 3-45. Estimated number of barred owls to be removed under the Preferred Alternative, by study area and year.

Study Areas[1]	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment				Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	
Cle Elum	4	129	257	270	153	108	103	634
Oregon Coast Ranges /Veneta (half)	4	256	512	538	305	215	205	1,263
Union/Myrtle (Klamath)	4	290	580	608	345	243	234	1,430
Hoopa (Willow Creek)	4	56	112	118	66	47	45	276
Totals		731	1,461	1,534	869	613	587	3,603

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Union/Myrtle) and associated experimental control area (e.g., Klamath).

REGIONAL AND RANGEWIDE CONTEXT. Implementing the Preferred Alternative on these four study areas would result in the removal of barred owls from approximately 1.72 percent of the suitable habitat within the range of the northern spotted owl and affect approximately 0.05 percent of the range of the barred owl in North America (Table 3-46).

Table 3-46. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under the Preferred Alternative.

Study Areas[1]	Treatment Area Acres of Spotted Owl Habitat	Percent Total Spotted Owl Habitat[2]	Percent of North American Range of Barred Owl[3]
Cle Elum	71,900	0.59	0.02
Oregon Coast Ranges/Veneta (half)	48,200	0.40	0.01
Union/Myrtle (Klamath)	98,100	0.81	0.03
Hoopa (Willow Creek)	52,500	0.43	0.01
Totals	270,700	1.72	0.05

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Veneta) and associated experimental control areas (e.g., Oregon Coast/Tyee).
[2] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.4 Effects under Alternative 1

Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. Depending on the study area selected under this alternative, the estimated number of barred owls removed during the entire experiment would range from 321 on the Hoopa (Willow Creek) Study Area to 2,242 on the Oregon Coast Ranges Study Area. The number of barred owls anticipated to be removed in each of the study areas considered under Alternative 1 is presented in Table 3-47. Since only one study area would be selected under Alternative 1, there would be no additive effects of multiple study areas.

Table 3-47. Estimated number of barred owls to be removed in Alternative 1, by year.

Study Areas [1]	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment							Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	
Cle Elum	7	129	257	270	153	108	103	103	103	103	942
Olympic Peninsula	5	345	689	723	410	289	277	276	-	-	1,975
Rainier	6	133	266	279	158	112	107	106	106	-	869
Oregon Coast Ranges	4	455	909	954	541	381	365	-	-	-	2,242
Tyee	4	110	219	230	130	92	88	-	-	-	540
HJ Andrews	4	201	402	422	239	169	162	-	-	-	992
Klamath	4	196	392	412	233	164	158	-	-	-	967
South Cascades	4	374	747	784	444	313	300	-	-	-	1,842
Hoopa (Willow Creek)	5	56	112	118	67	47	45	45	-	-	321

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Hoopa) and associated experimental control area (e.g., Willow Creek).

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative on Tyee Study Area, the single study area with the least spotted owl habitat, would result in the removal of barred owls from approximately 0.31 percent (less than one-half of 1 percent) of the habitat within the range of the northern spotted owl (Table 3-48). Removal in this study area would affect less than 0.01 percent (that is, less than 1/100th of 1 percent) of the range of the barred owl in North America.

Implementing this alternative on the Olympic Peninsula, the largest single study area, would result in the removal of barred owls from approximately 1.59 percent of the habitat within the range of northern spotted owl (Table 3-48). Removal on this study area would affect less than 0.05 percent of the range of the barred owl in North America. The level of effect on the other seven study areas would fall between these two values.

Table 3-48. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 1.

Study Areas[1]	Treatment Area Acres of Spotted Owl Habitat	Percent Total Spotted Owl Habitat [2]	Percent of North American Range of Barred Owl [3]
Cle Elum	71,900	0.59	0.02
Rainier	74,300	0.61	0.02
Olympic Peninsula	192,400	1.59	0.05
Oregon Coast Ranges	153,600	1.27	0.04
Tyee	37,100	0.31	0.01
HJ Andrews	112,200	0.93	0.03
Klamath	66,200	0.55	0.02
South Cascades	126,100	1.04	0.03
Hoopa (Willow Creek) [1]	52,500	0.43	0.01

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Hoopa) and associated experimental control area (e.g., Willow Creek).
[2] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.5 Effects under Alternative 2

Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of each study area using a combination of lethal and nonlethal removal methods, for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. Depending on the three study areas selected, the estimated number of barred owls removed would vary due to combined study area size and the current density of barred owls on those selected study areas. Because there are 27 potential combinations of study areas, we are presenting the effects of the combination with the least impact, the combination with greatest impact, and the combination developed by the Barred Owl Work Group.

The combination of the Rainier, Tyee, and Hoopa (Willow Creek) Study Areas are expected to result in the fewest number of barred owls removed under this alternative, 1,450 barred owls during the 4 years of barred owl removal (Table 3-49). The combination of theOlympic Peninsula, Oregon Coast Ranges, and South Cascades Study Areas result in the removal of the most barred owls, 5,784 barred owls during the 4 years of barred owl removal. The Barred Owl

Work Group developed a combination of three study areas, the Cle Elum, Oregon Coast Ranges, and Klamath Study Areas. We estimate 3,843 barred owls would be removed during the 4 years of barred owl removal using this combination of study areas.

Table 3-49. Estimated number of barred owls to be removed under Alternative 2, by year.

Study Areas	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment				Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	
Largest Combined Effect Study Areas [1]	4	1,173	2,345	2,462	1,395	984	943	5,784
Barred Owl Work Group Recommendation [2]	4	779	1,558	1,636	927	654	626	3,843
Smallest Combined Effect Study Areas [3]	4	294	588	617	350	247	236	1,450

[1] The "large" combination of three study areas includes the Olympic Peninsula, Oregon Coast Ranges, and South Cascades Demography Study Areas.
[2] The "Barred Owl Work Group" combination of three study areas includes the Cle Elum, Oregon Coast Ranges, and Klamath Demography Study Areas.
[3] The "small" combination of three study areas includes the Cle Elum, Tyee, and Hoopa (Willow Creek) Demography Study Areas.

The estimated number of barred owls removed from each potential study area over the 4 years of the experiment and the total number of barred owls removed under each of the 27 potential scenarios are presented in Table 3-50.

Table 3-50. Estimated number of barred owls to be removed under each possible three-study-area scenario of Alternative 2. Each line represents one possible combination of three study areas with cumulative barred owl removal for that scenario. Note that under Alternative 2, only one combination of three study areas would be selected for the actual experiment.

Washington Study Areas	Estimated Number of Barred Owls Removed [1]	Northern Oregon Study Areas	Estimated Number of Barred Owls Removed [1]	Southern Oregon/ Northern California Study Areas	Estimated Number of Barred Owls Removed [1]	Estimated Total Number of Barred Owls Removed
Cle Elum	634	Tyee	540	Hoopa (Willow Creek) [2]	276	1,450
Rainier	656	Tyee	540	Hoopa (Willow Creek)	276	1,472

Washington Study Areas	Estimated Number of Barred Owls Removed [1]	Northern Oregon Study Areas	Estimated Number of Barred Owls Removed [1]	Southern Oregon/ Northern California Study Areas	Estimated Number of Barred Owls Removed [1]	Estimated Total Number of Barred Owls Removed
Cle Elum	634	HJ Andrews	992	Hoopa (Willow Creek)	276	1,902
Rainier	656	HJ Andrews	992	Hoopa (Willow Creek)	276	1,924
Cle Elum	634	Tyee	540	Klamath	967	2,141
Rainier	656	Tyee	540	Klamath	967	2.163
Olympic Peninsula	1,699	Tyee	540	Hoopa (Willow Creek)	276	2,516
Cle Elum	634	HJ Andrews	992	Klamath	967	2,592
Rainier	656	HJ Andrews	992	Klamath	967	2,614
Olympic Peninsula	1,699	HJ Andrews	992	Hoopa (Willow Creek)	276	2,967
Cle Elum	634	Tyee	540	South Cascades	1,842	3,016
Rainier	656	Tyee	540	South Cascades	1,842	3,039
Cle Elum	634	Oregon Coast Ranges	2,242	Hoopa (Willow Creek)	276	3,152
Rainier	656	Oregon Coast Ranges	2,242	Hoopa (Willow Creek)	276	3,174
Olympic Peninsula	1,699	Tyee	540	Klamath	967	3,206
Cle Elum	634	HJ Andrews	992	South Cascades	1,842	3,468
Rainier	656	HJ Andrews	992	South Cascades	1,842	3,490
Olympic Peninsula	1,699	HJ Andrews	992	Klamath	967	3,658
Cle Elum [3]	634	Oregon Coast Ranges[3]	2,242	Klamath[3]	967	3,843
Rainier	656	Oregon Coast Ranges	2,242	Klamath	967	3,865
Olympic Peninsula	1,699	Tyee	540	South Cascades	1,842	4,082

Washington Study Areas	Estimated Number of Barred Owls Removed [1]	Northern Oregon Study Areas	Estimated Number of Barred Owls Removed [1]	Southern Oregon/ Northern California Study Areas	Estimated Number of Barred Owls Removed [1]	Estimated Total Number of Barred Owls Removed
Olympic Peninsula	1,699	Oregon Coast Ranges	2,242	Hoopa (Willow Creek)	276	4,218
Olympic Peninsula	1,699	HJ Andrews	992	South Cascades	1,842	4,533
Cle Elum	634	Oregon Coast Ranges	2,242	South Cascades	1,842	4,718
Rainier	656	Oregon Coast Ranges	2,242	South Cascades	1,842	4,741
Olympic Peninsula	1,699	Oregon Coast Ranges	2,242	Klamath	967	4,908
Olympic Peninsula	1,699	Oregon Coast Ranges	2,242	South Cascades	1,842	5,784

[1] Numbers reported in this table differ from those reported for other alternatives because the number of barred owls removed under Alternative 2 include only those removed during the 4-year duration of barred owls removal as prescribed under this alternative.
[2] Parenthetical notation indicates that the study area includes both a treatment (in this case, Hoopa) and associated experimental control area (in this case, Willow Creek).
[3] The Cle Elum/Oregon Coast Ranges/Klamath combination of three study areas was developed by the Barred Owl Work Group.

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative on the least extensive combination of three study areas (Rainier, Tyee, and Hoopa (Willow Creek)) would result in the removal of barred owls from approximately 1.33 percent of the habitat within the range of the northern spotted owl (Table 3-51). Removal would affect less than 0.04 percent of the range of the barred owl in North America.

Implementing this alternative on the most extensive combination of three study areas (Olympic Peninsula, Oregon Coast Ranges, and South Cascades) would result in the removal of barred owls from approximately 3.90 percent of the habitat within the range of northern spotted owl (Table 3-51) and affect less than 0.12 percent of the range of the barred owl in North America.

Implementing this alternative on the combination of three study areas developed by the Barred Owl Work Group (Cle Elum, Oregon Coast Ranges, and Klamath) would result in the removal of barred owls from approximately 2.41 percent of the habitat within the range of northern spotted owl (Table 3-51) and affect less than 0.08 percent of the range of the barred owl in North America.

Table 3-51. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 2.

Study Area Combinations	Treatment Area Acres of Spotted Owl Habitat	Percent of Total Spotted Owl Habitat [1]	Percent of North American Range of Barred Owl [2]
Largest Combination of Study Areas [3]	472,100	3.90	0.12
Barred Owl Work Group Recommendation [4]	291,700	2.41	0.08
Smallest Combination of Study Areas [5]	161,500	1.33	0.04

[1] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[2] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.
[3] The "largest" study area combination includes the Olympic Peninsula, Oregon Coast Ranges, and South Cascades Demography study Areas.
[4] The "Barred Owl Work Group Recommendation" study area combination includes the Cle Elum, Oregon Coast Ranges, and Klamath Demography Study Areas.
[5] The "smallest" study area combination includes the Cle Elum, Tyee, and Hoopa (Willow Creek) Demography Study Areas.

3.2.2.2.6 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. We estimate that 572 barred owls would be removed from the Veneta area and 1,431 from the Union/Myrtle Study Area, for a total 2,003 barred owls removed during the 4 years of removal. Year-by-year removal estimates for the duration of the barred owl removal portion of the experiment are included in Table 3-52.

Table 3-52. Estimated number of barred owls to be removed in Alternative 3, by year.

Study Areas [1]	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment				Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	
Veneta (Oregon Coast Ranges/Tyee)	4	116	232	244	138	97	93	572
Union/Myrtle (Klamath)	4	290	580	609	345	243	233	1,431
Total	4	406	812	853	483	341	326	2,003

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Union/Myrtle) and associated experimental control area (e.g., Klamath).

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative would result in the removal of barred owls from approximately 1.13 percent of the habitat within the range of the northern spotted owl (Table 3-53) and affect less than 0.04 percent of the range of the barred owl in North America.

Table 3-53. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 3.

Study Areas[1]	Treatment Area Acres of Spotted Owl Habitat	Percent of Total Spotted Owl Habitat [2]	Percent of North American Range of Barred Owl [3]
Veneta (Oregon Coast Ranges/Tyee)	39,200	0.32	0.01
Union/Myrtle (Klamath)	98,100	0.81	0.03
Totals	137,300	1.13	0.04

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Union/Myrtle) and associated experimental control area (e.g., Klamath).
[2] Total spotted owl suitable habitat within the range of the northern spotted owl is approximately 12,104,100 acres.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.7 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a, pre-removal demography data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. We estimate that 1,074 barred owls would be removed from the Columbia Gorge Study Area and 1,109 from the McKenzie Study Area for total 2,183 barred owls removed during the 5 years of barred owl removal under sub-Alternative 4a. Under sub-Alternative 4b, we estimate 1,235 barred owls would be removed from the Columbia Gorge Study Area and 1,274 from the McKenzie Study Area for a total of 2,509 during the 6 years of barred owl removal. The larger number of barred owls removed under sub-Alternative 4b as compared to sub-Alternative 4a is attributable to the longer removal period under sub-Alternative 4b. Year-by-year removal estimates for the experiment's duration are included in Table 3-54.

Table 3-54. Estimated number of barred owls to be removed under Alternative 4, by year.

Study Areas	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites In Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Total Number of Barred Owls Removed
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Sub-Alternative 4a															
Columbia Gorge	5	5	189	378	0	0	0	0	0	397	225	159	152	142	1,074
McKenzie	5	5	195	390	0	0	0	0	0	410	232	164	157	147	1,109
Total	5	5	384	768	0	0	0	0	0	806	457	322	309	289	2,183
Sub-Alternative 4b															
Columbia Gorge	2	6	189	378	0	0	397	225	159	152	151	151	-	-	1,235
McKenzie	2	6	195	390	0	0	410	232	164	157	156	156	-	-	1,274
Totals	2	6	384	768	0	0	806	457	322	309	307	307	-	-	2,509

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative would result in the removal of barred owls from approximately 1.42 percent of the habitat within the range of the northern spotted owl (Table 3-55). Removal in this study area would affect less than 0.05 percent of the range of the barred owl in North America. This effect would be consistent under either sub-Alternative 4a or 4b since the spatial extent of the effect is identical under both.

Table 3-55. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 4. Data are the same for sub-Alternatives 4a and 4b.

Study Areas	Treatment Area Acres of Spotted Owl Habitat	Percent of Total Spotted Owl Habitat [1]	Percent of North American Range of Barred Owl [2]
Columbia Gorge	105,500	0.87	0.03
McKenzie	65,900	0.54	0.02
Totals	171,400	1.42	0.05

[1] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[2] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.8 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years of barred owl removal for simple occupancy data (Option 1) or 5 years of barred owl removal for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. For the 3 years of barred owl removal for simple occupancy (Option 1), we estimate 818 barred owls would be removed from the Cowlitz Valley Study Area, 479 from the Veneta (Oregon Coast Ranges/Tyee) Study Area, and 1,197 from the Union/Myrtle (Klamath) Study Area for a total of 2,494 barred owls removed. For the 5 years of barred owl removal for occupancy and reproductive analysis (Option 2), we estimate 1,135 barred owls would be removed from the Cowlitz Valley Study Area, 665 from the Veneta (Oregon Coast Ranges/Tyee) Study Area, and 1,663 from the Union/Myrtle (Klamath) Study Area for a total of 3,463 barred owls removed. Year-by-year removal estimates for the duration of the barred owl removal are included in Table 3-56.

Table 3-56. Estimated number of barred owls to be removed under Alternative 5, by year.

Study Areas [1]	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment					Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	Year 5	
Option 1 – Simple Occupancy Experiment									
Cowlitz Valley [2]	3	198	396	416	236	166	-	-	818
Veneta (Oregon Coast Ranges/Tyee)	3	116	232	244	138	97	-	-	479
Union/Myrtle (Klamath)	3	290	580	609	345	243	-	-	1,197
Total	3	604	1,208	1,268	719	507	-	-	2,494
Option 2 - Occupancy and Reproduction Experiment									
Cowlitz Valley [2]	5	198	396	416	236	166	159	158	1,135
Veneta (Oregon Coast Ranges/Tyee)	5	116	232	244	138	97	93	93	665
Union/Myrtle (Klamath)	5	290	580	609	345	243	233	232	1,663
Total	5	604	1,208	1,268	719	507	486	483	3,463

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Union/Myrtle) and associated experimental control area (e.g., Klamath).
[2] Not all sites surveyed every year, last number surveyed 88, total sites historically = 155

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative would result in the removal of barred owls from approximately 2.05 percent of the habitat within the range of the northern spotted owl (Table 3-57). Removal in this study area would affect less than 0.07 percent of the range of the barred owl in North America. This effect would be consistent under either type of occupancy experiment since the spatial extent of the effect is identical under both.

Table 3-57. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 5. Data are the same for Option 1 and Option 2 of this alternative.

Study Areas[1]	Treatment Area Acres in Spotted Owl Lands	Percent of Total Spotted Owl Habitat [2]	Percent of North American Range of Barred Owl [3]
Cowlitz Valley	110,500	0.91	0.03
Veneta (Oregon Coast Ranges/Tyee)	39,200	0.32	0.01
Union/Myrtle (Klamath)	98,100	0.81	0.03
Totals	247,800	2.05	0.07

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Union/Myrtle) and associated experimental control area (e.g., Klamath).
[2] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.9 Effects under Alternative 6

Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a, pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years of barred owl removal for occupancy and reproductive data. Under sub-Alternative 6b, occupancy data would be collected beginning in year 1and removal would occur over 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. We estimate that 941 barred owls would be removed from the Olympic Revised (Olympic Peninsula) Study Area, 805 from the McKenzie Study Area, and 260 from the Horse/Beaver Study Area for a total of 2,007 barred owls removed during 3 years of barred owl removal to conduct a simple occupancy experiment under sub-Alternative 6a. Expanding this alternative to conduct 5 years of removal for an occupancy and reproduction experiment would require removal of an estimated 1,307 barred owls from Olympic Revised (Olympic Peninsula), 1,118 barred owls from McKenzie, and 361 barred owls from Horse/Beaver, for a total removal of 2,786 barred owls.

Under sub-Alternative 6b, approximately 1,125 barred owls would be removed from the Olympic Revised Study Area, 962 from the McKenzie Study Area, and 311 from the Horse/Beaver Study Area for a total of 2,397 barred owls removed during the 4 years of barred owl removal for a simple occupancy experiment. Expanding this alternative to conduct 6 years of barred owl removal for an occupancy and reproduction experiment would require removal of an estimated 1,490 barred owls from Olympic Revised (Olympic Peninsula), 1,274 barred owls from McKenzie, and 412 barred owls from Horse/Beaver, for a total removal of 3,175 barred owls. Year-by-year removal estimates for the duration of barred owl removal are included in Table 3-58.

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative would result in the removal of barred owls from approximately 2.08 percent of the habitat within the range of northern spotted owl (Table 3-59) and affect less than 0.10 percent of the range of the barred owl in North America.

Table 3-58. Estimated number of barred owls to be removed under Alternative 6, by year.

Study Areas[1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment								Estimated Total Number of Barred Owls Removed
					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	
Sub-Alternative 6a													
Olympic Revised (Olympic Peninsula)	3	3 - 5	228	456	0	0	0	479	271	191	183[2]	182[2]	941 - 1,306[2]
McKenzie	3	3 - 5	195	390	0	0	0	410	232	164	157[2]	156[2]	806 - 1,119
Horse/Beaver	3	3 - 5	63	126	0	0	0	132	75	53	51[2]	50[2]	260 - 361
Total – simple occupancy	3	3	473	945	0	0	0	1,021	578	408	-	-	2,007
Total – occupancy and reproduction	3	5	473	945	0	0	0	1,021	578	408	391	388	2,787
Sub-Alternative 6b													
Olympic Revised (Olympic Peninsula)	0	4 - 6	228	456	479	271	191	183	182[2]	182[2]	-	-	1,124 - 1,488[2]
McKenzie	0	4 - 6	195	390	410	232	164	157	156[2]	156[2]	-	-	963 - 1,275
Horse/Beaver	0	4 - 6	63	126	132	75	53	51	50[2]	50[2]	-	-	311 - 411
Total – simple occupancy	0	4	486	972	1,021	578	408	391	-	-	-	-	2,398
Total – occupancy and reproduction	0	6	486	972	1,021	578	408	391	388	388	-	-	3,174

[1] Parentheses indicate the study area includes both a treatment (e.g., Olympic Revised) and associated experimental control area (e.g., Olympic Peninsula).
[2] Sub-Alternatives 6a and 6b each include two options for the experiment's duration. Values for number of barred owls removed include estimates for each the experiment's duration, as reflected in later years of removal, and totals for the full number of years of removal.

Table 3-59. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 6. Data are the same for sub-Alternatives 6a and 6b.

Study Areas[1]	Treatment Area Acres of Spotted Owl Habitat	Percent of Total Spotted Owl Habitat [2]	Percent of North American Range of Barred Owl [3]
Olympic Revised (Olympic Peninsula)	127,300	1.05	0.06
McKenzie	65,900	0.54	0.02
Horse/Beaver	58,700	0.48	0.02
Totals	251,900	2.08	0.10

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Olympic Revised) and associated experimental control area (e.g., Olympic Peninsula).
[2] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.

3.2.2.2.10 Effects under Alternative 7

Alternative 7 involves a combination of demography and occupancy studies on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of study approach. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

NUMBER OF BARRED OWLS REMOVED. We estimate that a total of approximately 8,892 barred owls would be removed during the 10 years until completion of the experiment over the full complement of 11 study areas. Year-by-year barred owl removal estimates under Alternative 7 are included in Table 3-60.

Table 3-60. Estimated number of barred owls to be removed under Alternative 7, by year.

Study Areas [1]	Number of Years of Barred Owl Removal	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Total Number of Barred Owls Removed
				Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Ross Lake	10	152	304	319	181	128	122	122	122	122	122	122	122	1,479
Olympic Revised (Olympic Peninsula)	4	228	456	479	271	191	183	-	-	-	-	-	-	1,125
Rainier	6	133	266	279	158	112	107	106	106	-	-	-	-	869
Wenatchee	3	240	479	504	286	201	-	-	-	-	-	-	-	991
Veneta (Oregon Coast Ranges/Tyee)	10	116	232	244	138	97	93	93	93	93	93	93	93	1,129
HJ Andrews	4	201	402	422	239	169	162	-	-	-	-	-	-	992
Rogue Cascades (South Cascades)	4	235	470	494	280	197	189	-	-	-	-	-	-	1,159
Hoopa (Willow Creek)	10	56	112	118	67	47	45	45	45	45	45	45	45	545
Horse/Beaver	4	63	126	132	75	53	51	-	-	-	-	-	-	311
Goosenest	10	7	14	15	8	6	6	6	6	6	6	6	6	68
Corral	10	23	46	48	27	19	18	18	18	18	18	18	18	224
Total [2]		1,422	2,908	3,053	1,730	1,220	976	390	283	283	283	283	283	8,892

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Hoopa) and associated experimental control area (e.g., Willow Creek).
[2] Note that numeric rounding within columns may result in minor discrepancies in numbers reported in each alternative.

REGIONAL AND RANGEWIDE CONTEXT. Implementing this alternative in its entirety (i.e., implementing experimental removal studies in all 11 potential study areas) would result in the removal of barred owls from approximately 6.53 percent of the habitat within the range of northern spotted owl (Table 3-61) and affect less than 0.20 percent of the range of the barred owl in North America.

Table 3-61. Proportion of area within spotted owl habitat and within the North American range of the barred owl that would be treated under Alternative 7.

Study Areas [1]	Treatment Area Acres of Spotted Owl Habitat	Percent of Total Spotted Owl Habitat [2]	Percent of North American Range of Barred Owl [3]
Ross Lake	85,000	0.70	0.02
Olympic Revised (Olympic Peninsula)	127,300	1.05	0.04
Rainier	74,300	0.61	0.02
Wenatchee	133,800	1.11	0.04
Veneta (Oregon Coast Ranges/Tyee)	39,200	0.32	0.01
HJ Andrews	112,200	0.93	0.03
Rogue Cascades (South Cascades)	79,300	0.66	0.02
Hoopa (Willow Creek)	52,500	0.43	0.01
Horse/Beaver	58,700	0.48	0.02
Goosenest	6,600	0.05	0.00
Corral	21,700	0.18	0.01
Totals [4]	790,600	6.55	0.20

[1] Parenthetical notation indicates that the study area includes both a treatment (e.g., Hoopa) and associated experimental control area (e.g., Willow Creek).
[2] Approximately 12,104,100 acres of spotted owl suitable habitat occurs within the range of the northern spotted owl.
[3] Range of barred owl within range of northern spotted owl is approximately 3 percent of total range of barred owl in North America.
[4] Note that numeric rounding within columns may result in minor discrepancies in numbers reported in each alternative.

3.3 Affected Environment and Environmental Consequences—Northern Spotted Owl

3.3.0 Changes between Draft and Final EIS

- Added Section 3.3.2.3 for Preferred Alternative

3.3.1 Background and Affected Environment

3.3.1.1 Rangewide

Spotted owl populations have been monitored at eight long-term monitoring study areas on Federal lands in Washington, Oregon, and California. These studies were initiated during 1985 through1991 (Lint *et al.* 1999, entire), and have continued through the present. The primary objective of these studies is to provide Federal land management agencies (Forest Service and BLM) with data on the demography (annual survival, reproduction), population status, and population trends of spotted owls to determine if management strategies (primarily the Northwest Forest Plan) are resulting in recovery of the species (Forsman *et al.* 2011a, p. 4). In addition to these eight Federal monitoring areas, a number of additional study areas on State, private, and tribal lands have been studies during the same period. Data from these areas have been analyzed concurrently with those of the eight Federal study areas, and region wide analyses have been conducted approximately every 5 years with the most recent completed in 2009 (Forsman *et al.* 2011a, entire).

The amount of habitat available to spotted owls has declined since the time of listing. On Federal lands, Dugger and Davis (2011, p. 17) estimated a combined nesting/roosting habitat loss of 3.4 percent in California (1994 to 2007 data) and in Oregon and Washington (1996 to 2006 data). Range wide losses have not yet exceeded what was anticipated under the Northwest Forest Plan, although some physiographic provinces have incurred losses of up to 10 percent, primarily due to wildfire. Dispersal habitat increased by 5.2 percent; however, dispersal-capable landscapes have declined by 1 percent. Wildfire remains the leading cause of habitat loss on Federal lands across the range of the species while timber harvest is the main source of loss on nonfederal lands (Dugger and Davis 2011, p. 17).

Spotted owl populations on 7 of 11 ongoing spotted owl demography study areas showed declines in population growth rate from 1990 to 2008 (Forsman *et al.* 2011a, p. 64). When demographic rates were assessed across all 11 areas over the duration of the studies, spotted owl populations have been declining at rate of 2.9 percent per year since 1990 (Forsman *et al.* 2011a, p. 3). Annual survival rate, or the probability of an owl surviving from one year to the next, has declined at 10 of the 11 areas (Forsman *et al.* 2011a, pp. 2, 64). At six areas, annual survival was found to be negatively associated with the proportion of spotted owl territories where barred owls were detected (Forsman *et al.* 2011a, p. 2). Fecundity (number of female offspring produced per adult female owl) declined and was negatively associated with the proportion of spotted owl territories where barred owls were detected at four areas (Forsman *et al.* 2011a, p. 1). The rate of recruitment of new owls into the population of adult spotted owls was negatively associated with barred owl detection at spotted owl sites when data from all 11 areas were combined in a meta-analysis (Forsman *et al.* 2011a, p. 35).

The proportion of spotted owl territories where barred owls have been detected in these long-term study areas increased from less than 5 percent in the 1990s up to 70 percent at some study areas by 2008 (Forsman *et al.* 2011a, p. 80, Appendix B). Because these 11 areas span the range of the northern spotted owl, it is reasonable to infer that barred owl presence in these study areas is representative of increases in barred owl presence across most of the range of the northern spotted owl. Barred owls were first detected in the more northern study areas, but had spread to all study areas by 2008 (Forsman *et al.* 2011a, p. 80, Appendix B).

Habitat quality can influence how likely spotted owls are to survive and reproduce. Franklin *et al.* (2000, p. 539) hypothesized that high-quality habitat can buffer spotted owls from the effects of weather. Owls occupying territories with high-quality habitat have greater access to resources (prey, nest sites) than owls on lower-quality habitat, and are better able to persist during poor weather conditions. Similarly, Forsman *et al.* (2011a, p. 77) argued that, given competitive pressure from barred owls, additional high-quality habitat for spotted owls is likely to be essential for spotted owls to persist. While variation in habitat quality can affect spotted owl persistence, we anticipate that in a barred owl removal experiment, control (non-removal) and treatment (removal) areas would be similar enough in habitat conditions across the study areas to account for variation in habitat quality among individual owl territories.

3.3.1.2 Individual Action Areas

For the 21 study areas being considered in the eight action alternatives, current demographic data, including estimates of annual survival, reproduction, and population growth rate is available only from the ongoing spotted owl demography study areas. One area, Union/Myrtle (Klamath), has been, and continues to be, surveyed annually for spotted owls, several areas have partial survey data current through recent years (Veneta, Cowlitz Valley, Ross Lake, McKenzie, Rogue Cascades), one area was a historical spotted owl study areas with multiple years of demographic surveys (Wenatchee), and several had some surveys conducted in the past, but have minimal data from recent years (Columbia Gorge, Horse Beaver, Goosenest, Corral).

Recent trends and annual estimates of demographic rates for long-term ongoing spotted owl demography study areas are presented in Forsman *et al.* (2011a, entire). For other areas, the amount of data on demographic rates and numbers of spotted owls varies widely, from long-term surveys to limited historical information. Results from Forsman *et al.* (2011a, p. 8) are considered to reflect province and rangewide population trends. Table 3-62 presents a summary of the current information available, including a number of known/monitored sites, estimated sites (see Appendix G in this Final EIS), and demographic rates (if known) for the study areas used in this EIS.

Table 3-62. Numbers of spotted owl sites and demographic rates at the 21 study areas being considered for barred owl removal experiments. Demographic rates are provided for those study areas analyzed in Forsman *et al*. (2011a, pp. 23, 34, 64).

Study Area	Number of Known/ Historical Spotted Owl Sites	Estimated Additional Spotted Owl Sites	Total Possible Spotted Owl Sites	Demographic Rates		
				Mean Annual Rate of Population Change(λ) (SE)	Mean Annual Fecundity for Adult Females (SE)	Mean Annual Survival for Adult Females (SE)
Ross Lake	26	52	78	--	--	--
Wenatchee	161	27	188	--	--	--
Cle Elum	87	12	99	0.937 (0.014)	0.553 (0.052)	0.819 (0.013)
Olympic Peninsula	114	12	126	0.957 (0.020)	0.300 (0.060)	0.828 (0.016)
Olympic Revised portion of Olympic Revised (Olympic Peninsula)	53	0	53	--	--	--
Rainier	68	9	77	0.929 (0.026)	0.302 (0.065)	0.841 (0.019)
Cowlitz Valley	149	10	159	--	--	--
Columbia Gorge	75	27	102	--	--	--
Oregon Coast Ranges	198	77	275	0.966 (0.011)	0.263 (0.040)	0.859 (0.009)
Veneta portion of Veneta (Oregon Coast Ranges/Tyee)	44	0	44	--	--	--
Tyee	133	8	141	0.996 (0.020)	0.305 (0.034)	0.856 (0.008)
McKenzie	111	52	163	--	--	--
HJ Andrews	146	43	189	0.977 (0.010)	0.323 (0.041)	0.865 (0.010)
Union/Myrtle portion of Union/Myrtle (Klamath)	73	14	87	--	--	--
Klamath	141	10	151	0.990 (0.014)	0.377 (0.033)	0.848 (0.008)
South Cascades	156	70	226	0.982 (0.030)	0.347 (0.052)	0.851 (0.010)
Rogue Cascades portion of Rogue Cascades (South Cascades)	100	30	130	--	--	--
Horse/Beaver	unknown	120	120	--	--	--
Goosenest	14	11	25	--	--	--
Hoopa portion of Hoopa (Willow Creek)	55	3	58	0.989 (0.013)	0.230 (0.033)	0.854 (0.014)
Willow Creek portion of Hoopa (Willow Creek)	57	0	57	0.983 (0.008)	0.324 (0.027)	0.844 (0.009)
Corral	17	0	17	--	--	--

3.3.2 Environmental Consequences

3.3.2.1 Effects under the No Action Alternative

If no barred owl removal occurs (No Action Alternative) within the proposed study areas, spotted owl populations would likely continue to show declines in survival, reproduction, and population growth rates. Population declines are likely to be similar to, or greater than, the rangewide decline reported for 1990 to 2008 of 2.9 percent per year (Forsman *et al.* 2011a, p. 3). Spotted owl populations on several ongoing spotted owl demography study areas in Washington have decreased substantially. As of 2010, researchers on the Cle Elum Study Area in central Washington observed 26 spotted owls on 18 territories, as compared to 120 owls on 64 territories in 1992 (Forsman *et al.* 2010, Table 2). Results from Cle Elum are representative of conditions across the northern part of subspecies' range. Competition with barred owls presents the possibility for local or regional extirpation of spotted owls and increased range wide risk to populations.

Barred owl densities continue to increase in many areas, particularly the southern half of the range where they are still establishing populations. As of 2008, the probability that a spotted owl territory had at least one barred owl detected (barred owl encounter rate) ranged from 0.35 to 0.70 in the northern half of the subspecies' range (Forsman *et al.* 2011a, p. Appendix B). In the southern half, the barred owl encounter rate ranged from 0.20 to 0.35 (Forsman *et al.* 2011a, Appendix B). It is reasonable to assume that with no action, barred owls would continue to increase on most areas with and spotted owl populations would continue to decline. Given that declines in spotted owl populations have been documented for the past 2 decades (Anthony *et al.* 2006, p. 34; Forsman *et al.* 2011a, p. 75), an increase in, or continued persistence of, barred owls could lead to local or large-scale extirpation of spotted owls including possible extinction of the species.

Ongoing research has shown that some spotted owls may remain on the landscape in some areas when barred owls are present; however, these spotted owls may not vocalize and may therefore remain undetected until barred owls are removed (Diller 2012, pers. comm.). Because spotted owls vocalize to find mates, establish territories, and raise young, a reduction in vocalization in response to barred owl presence is likely to result in declines in successful reproduction even if some spotted owls remain on the landscape. For spotted owl populations to persist, they must be able to successfully breed and fledge young.

3.3.2.2 Effects Common to All Action Alternatives

There are a number of direct and indirect effects that apply to all the action alternatives, including the following:

DIRECT EFFECTS. The effects of the experiment on spotted owls may result from activities related to spotted owl surveys (on areas that are not part of ongoing spotted owl demography studies), capture and banding of some spotted owls on areas that are not part of ongoing spotted owl demography studies, barred owl surveys, and barred owl removal efforts (lethal or nonlethal) on the treatment areas. The effects include the potential impact of these activities through disruption of normal behaviors, the risk of injuring a spotted owl during barred owl removal (lethal and nonlethal) and banding, and the reduction in barred owl populations on the treatment area(s) as a result of the removal for the duration of the experiment.

Spotted owl surveys have been conducted widely for over two decades on many areas throughout the range of the spotted owl with no observed negative effects. While some spotted owls may move in response to calling surveys or when delivering prey items used to determine reproductive success, many years of experience indicates that there is no significant impact of surveying to spotted owl individuals or the overall spotted owl population.

The capture and banding of unbanded spotted owl would be part of any demography experiment. Methods for safely capturing and banding spotted owls are well-established and have been used safely since the 1980s. However, there is a small risk of injury to individual spotted owls during the capture and banding process.

In all alternatives, barred owl surveys would be conducted on both treatment (removal) and control (non-removal) areas by broadcasting barred owl calls along survey routes. We do not anticipate that conducting these surveys would have a significant effect on spotted owls because barred owls are currently present and vocalizing in these areas. The additional calling of the survey would not significantly change the soundscape for the spotted owls, and therefore would not likely result in any change in normal spotted owl behaviors.

Barred owl removal activities could affect spotted owls through several mechanisms, including disruption due to the noise of shooting, potential for injury or death of spotted owls, and the effect of reduced barred owl populations on the treatment areas.

The potential for disturbance or disruption of spotted owls from barred owl removal is mainly associated with the effects of the sound from lethal removal (shotgun) on breeding behavior. The breeding season for spotted owls is generally March 1 (February 1 in California) through September 30. Disturbance from firing of shotguns as part of this experiment will be of short duration with limited repetition (two shots at most removal sites in one day, with an occasional third shot in any 1 day, and a maximum of two to three visits during the nesting season at any particular spot). Based on the protocol for removal (Appendix D) no lethal removal of barred owls will occur within 300 yards of a known, active spotted owl nest between March 1 and July 31. At a distance of greater than 300 yards, shotgun noise is reduced to a level that would be unlikely to adversely affect spotted owls due to the attenuation of noise across the landscape.

The primary mechanism for disruption of spotted owl breeding by lethal removal activities is the potential to startle adults, causing them to leave the area and potentially leaving young undefended from predators. Once young spotted owls are capable of sustained flight (around mid- to late-July), they are presumably able to move with their parents and thereby minimize the risk of predation. While most barred owl removal activity will occur during the fall and winter, some limited removal may occur during the spotted owl breeding season. Given the limitation on shooting within 300 yards of an active nest area, the short duration of the disturbance, and low number of barred owl removals likely before July 31, we do not anticipate any significant effect on spotted owls from the sound of the lethal removal of barred owls by shotgun.

While we have developed a rigorous protocol with numerous elements to reduce the risk of accidental wounding or killing of a spotted owl in the course of removing barred owls, we cannot totally eliminate this potential. If any spotted owl is injured, they will be immediately transported to a licensed rehabilitation facility. If any spotted owl is injured or killed, all removal activities will cease until the circumstances are investigated and any additional safety measures identified and implemented. We anticipate no more than one accidental injury or death of a spotted owl during the removal efforts.

For nonlethal removal, capturing barred owls will involve broadcast of barred owl calls to locate individuals for capture. Given that barred owl surveys will have been conducted prior to capture efforts to locate barred owls, the amount of broadcast calling during the live capture efforts will be minimal, and we anticipate no significant effects from the calling. However, there is a possibility that a spotted owl may attack the decoy and be ensnared in the nets. Any non-target species will be removed from the net, inspected for injury, and released immediately if uninjured or transported to a licensed rehabilitation facility of injured.

We anticipate decreased competition between spotted owls and barred owls on the treatment area for the duration of the experiment, leading to a potential increase in spotted owl site occupancy rates following barred owl removal. In northern California, spotted owls were found to quickly recolonize areas when barred owls were removed (Diller 2012, pers. comm.). In addition, we hypothesize that spotted owl survival and reproduction on treatment areas is likely to increase following barred owl removal. Changes in annual survival can be measured using a demography study approach. Trends in reproduction can be measured using a demography study approach or by conducting reproductive surveys using an occupancy study approach.

Effects to spotted owl population trends can be measured several ways. Depending on study approach, population trends can be measured either by an increase in the rate of population growth rate (λ (lambda)) or an increase in the number of sites occupied by spotted owls. We expect to see continued declines in spotted owl population performance in the control areas similar to trends reported by Forsman *et al.* (2011a, pp. 1-3). The degree to which we would be able to measure the effects of barred owl removal may be influenced by the current demographic status of the spotted owl population, density of barred owls, and length of time the barred owls have been present in the study area. These conditions follow a gradient across the range of the spotted owl ranging from fewer spotted owls, more barred owls, and a longer duration of barred owl presence in the north to more spotted owls and fewer barred owls in the south. These data are provided for each action alternative in Tables 3-63 to 3-70 in subsequent sections.

Areas recently colonized by barred owls (e.g., southern Oregon, northern California) generally have higher spotted owl site occupancy rates. Spotted owls can likely recolonize sites more quickly once barred owls are removed than areas where barred owls have been established for a longer period of time. Spotted owls that have been recently displaced are more likely to still be present on these landscapes, and can recolonize sites as barred owls are removed. In addition, juvenile spotted owls produced on currently occupied sites can potentially establish territories on sites made available by barred owl removal. We anticipate that the areas with more recent barred owl invasions would likely show more rapid and larger demographic response by spotted owls (e.g., increase in occupancy or demographic rates) than areas where barred owls have been established longer.

In areas where barred owls have been present for a long time and in high numbers (e.g., Washington), we anticipate that it would take longer to show a spotted owl population response, and the response may be reduced given lower spotted owl populations available to recolonize vacant territories. Spotted owls that were displaced by barred owls may no longer be present on the landscape, and the number of juvenile spotted owls produced in these areas is low, due to low spotted owl site occupancy rates and poor reproductive success at these sites. While areas with lower current spotted owl site occupancy have the potential to see large increases in recolonization by spotted owls after barred owl removal, sufficient numbers of spotted owls must be present to recolonize these vacant sites.

In all alternatives, spotted owl population declines and barred owl population expansion would continue on the remainder of the range not under consideration for this experiment and in the control areas of the experiment where removal is not being conducted. The treatment areas for the eight action alternatives on which barred owl removal would occur represent less than 1 percent to approximately 6.55 percent of the total habitat available within the range of the northern spotted owl (Tables 3-63 to 3-70). Because the areas treated are small relative to the range of the northern spotted owl, the effect of barred owl removal on spotted owl site occupancy is expected to diminish after barred owl removal ceases. Barred owls are expected to increase to pre-removal levels after a lag of 3 to 5 years, resulting in subsequent declines in spotted owl site occupancy once the experiment is concluded.

INDIRECT EFFECTS. Indirect effects include secondary events that may occur as a result of barred owl removal. Some researchers have suggested that removing the initial territorial barred owls may result in an influx of juvenile or dispersing barred owls looking to establish territories in the treatment area and that these barred owls may be more aggressive than initial territorial barred owls, potentially displacing spotted owls that were able to maintain territories with the initial territorial barred owls. At this time, there is no research or data that support either of these hypotheses. However, we will be able to detect these effects if they occur. In areas where barred owls have been removed spotted owls have quickly recolonized at least some of the vacant sites (Diller 2012, pers. comm.).

3.3.2.3 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach on four study areas with pre-treatment spotted owl demographic data. Barred owls would be removed from a portion of three ongoing spotted owl demography study areas (Cle Elum, Oregon Coast Ranges, Hoopa); removal on the fourth study areas would occur on an adjacent area with comparable data (Union/Myrtle). Barred owls would be removed from up to one-half of the study area using a combination of lethal and nonlethal methods. We anticipate the experiment will take 4 years to gather sufficient data for a statistically significant result. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

In Washington, the Cle Elum Spotted Owl Demography Study Area will be divided into treatment and control areas. In Oregon, the Oregon Coast Ranges Spotted Owl Demography Veneta Study Areas are combined into a treatment-control area of which only one-half will be used for the experiment. Determination of the actual location of the experiment will be completed before initiation of the experiment in coordination with the ongoing spotted owl demography study. Barred owl removal will occur on one-quarter of this combined area. However, because many spotted owl sites in the Veneta Study Area have not been surveyed for several years, these may be of limited use. To analyze the maximum potential effect, we assumed all removal would occur on the Oregon Coast Ranges Spotted Owl Demography Study Area, resulting in barred owl removal on up to one-third of the Oregon Coast Ranges Spotted Owl Demography Study Area. In southern Oregon, the treatment-control area is comprised of the Union/Myrtle and Klamath Spotted Owl Demography Study Areas, with removal occurring on Union/Myrtle area and the Klamath Spotted Owl Demography Study Area serving as the control areas. In California, the treatment-control area is comprised of the Hoopa and Willow Creek Spotted Owl Demography Study Areas, with treatment occurring on the Hoopa Spotted Owl Demography Study Area and Willow Creek Spotted Owl Demography Study Area serving as the control. Barred owls will be removed using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in the Section 3.3.2.2 of this Final EIS, including possible increases in spotted owl survival, reproduction, and population growth rate on the treatment areas following barred owl removal. We also anticipate continued declines in spotted owl population performance in the control area where barred owls would not be removed similar to what has been observed in ongoing demography studies (Forsman *et al.* 2011a, p.1). While there is a small potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be unlikely given the rigorous protocol for removal of barred owls (see Appendix D of this Final EIS). There is also a small potential for injury of the estimated 20 to 50 unbanded spotted owls that would be captured and banded each year on the Union/Myrtle and Veneta areas.

We anticipate that the overall effects of this alternative on spotted owls across the subspecies' range would be minimal. The total amount of spotted owl habitat potentially affected by barred owl removal ranges is 1.72 percent (Table 3-63). Expected duration of barred owl removal on the experiment is 4 years at each of the three study area configurations. The estimated number of spotted owl territories that could be potentially affected on the treatment area is 363.

As in all alternatives, the scale of effects on spotted owl populations would be influenced by the time it takes to begin the removal of barred owls for the experiment (Table 3-63). For the Preferred Alternative, barred owl removal could begin in the first year because these areas have a long history of spotted owl demographic monitoring, including spotted owl population status, and there is no need to collect pretreatment spotted owl data. The use of multiple study areas provides a greater ability to detect differences in population performance between treatment and control areas (scope of inference) than a single study area because a wider range of habitat conditions are represented and would provide greater statistical power to detect changes in population trends between treatment and control areas than a single study area approach. The use of four study areas in the Preferred Alternative provides strong statistical power to detect changes. The 4 years of barred owl removal under the Preferred Alternative is the second shortest among the alternatives presented.

Among the four study areas (Table 3-63), the proportion of spotted owl territories with barred owl detections is comparable (42 percent of spotted owl territories had barred owl detections). Spotted owl site occupancy rates are 0.48. The more northern areas (Cle Elum, Oregon Coast Ranges) in this alternative have had larger barred owl populations for longer periods of time than the more southern areas (Union/Myrtle (Klamath,) Hoopa (Willow Creek)). The northern areas could potentially have the greatest increase in spotted owl site occupancy; however, the existing spotted owl populations may be too small to provide large numbers of spotted owls to recolonize vacant territories in the near term. We anticipate that the combined removal efforts on four study areas in the Preferred Alternative would have a larger (positive) rangewide effect on spotted owl populations than the single study area approach (Alternative 1) or the three area approach (Alternative 2) due to the larger total area included and the location of study areas in more areas.

Table 3-63. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for three proposed combinations of study areas under consideration for the Preferred Alternative.

Preferred Alternative Study Areas	Acres of Spotted Owl Habitat in Treatment Area	Percent of Rangewide Spotted Owl Habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy	Proportion of Spotted Owl Sites with Barred owls
Cle Elum, Oregon Coast Ranges/Veneta (half), Union/Myrtle (Klamath), Hoopa (Willow Creek)	270,700	1.72	273	4	0.48	0.42
[1] Total rangewide habitat = 12,104,100 acres.						

3.3.2.4 Effects under Alternative 1

Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for from 4 to 7 years of barred owl removal, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We anticipate barred owl removal to result in the direct and indirect effects listed in the Section 3.3.2.2 of this Final EIS, including possible increases in spotted owl survival, reproduction, and population growth rate in the treatment area following barred owl removal. While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Appendix D of this Final EIS). The likelihood is particularly low for this alternative as it includes only one study area and generally lower numbers of barred owls removed. We also expect to observe continued declines in spotted owl population performance in the control area where barred owls would not be removed.

The scale of effects on spotted owl populations would be influenced by the time it takes to begin the removal of barred owls for the experiments, (Table 3-64). Because barred owl populations continue to increase across much of the Pacific Northwest, alternatives that take longer to initiate removal would likely have fewer spotted owls to recolonize sites than if the removal experiment is implemented rapidly. For Alternative 1, barred owl removal could begin immediately because these areas have a long history of spotted owl demographic monitoring and there is no need to collect pretreatment data regarding spotted owl population status. The use of a single study area provides a reduced ability to detect differences and represents a more restricted set of habitat conditions (scope of inference) than alternatives that include multiple study areas; however statistical power will be greater for the larger study areas in this alternative.

Similarly, the magnitude of effects on spotted owl populations would likely be greater in areas where barred owls are less abundant or have invaded more recently and where spotted owl site occupancy is sufficiently high to allow spotted owls to re-establish on vacated territories (i.e., southern study areas). Current spotted owl site occupancy is highest at Klamath (67 percent of the known spotted owl sites are occupied) and lowest at the Olympic Peninsula (22 percent of the known spotted owl sites are occupied) (Table 3-64). The proportion of spotted owl sites with barred owl detections is highest at Oregon Coast Ranges (71 percent of spotted owl sites with at least one barred owl detection) and lowest at South Cascades (18 percent of spotted owl sites with at least one barred owl detection) (Table 3-64).

The magnitude of potential effects of barred owl removal on spotted owl demographic rates would also likely be higher on larger study areas than smaller study areas. On larger areas, more spotted owls would be able to re-establish territories and fewer barred owls would be able to persist with continued removal efforts. On smaller areas, the smaller size of the treatment area would likely allow for a larger influx of barred owls from adjacent lands to recolonize or compete with spotted owls on the treatment area. The largest study area is the Olympic Peninsula and the smallest is Cle Elum. While we anticipate changes in spotted owl demographic performance on the treatment areas, we expect the overall effects of the removal experiment on northern spotted owls across the subspecies' range to be minimal because the total amount of spotted owl habitat potentially affected by barred owl removal ranges from 0.31 percent (Hoopa (Willow Creek) to 1.59 percent (Olympic Peninsula) (Table 3-64). The potential number of spotted owl territories on the treatment areas that could potentially be affected ranges from 38 at Rainier to 137 at the Oregon Coast Ranges (Table 3-64).

Table 3-64. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for nine study areas under consideration for Alternative 1.

Alternative 1 Study Areas	Acres of Spotted Owl Habitat in Treatment Area	Percent of Rangewide Spotted Owl Habitat [1]	Potential Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy	Proportion of Spotted Owl Sites with Barred owls
Washington						
Cle Elum	71,900	0.59	50	7	0.28	0.32
Olympic Peninsula	192,400	1.59	63	5	0.22	0.51
Rainier	74,300	0.61	38	6	0.38	0.32
Northern Oregon						
Oregon Coast Ranges	153,600	1.27	137	4	0.41	0.71
Tyee	37,100	0.31	70	4	0.62	0.65
HJ Andrews	112,200	0.93	94	4	0.59	0.55
Southern OR/CA						
Klamath	66,200	0.55	75	4	0.67	0.25
South Cascades	126,100	1.04	113	4	0.46	0.18
Hoopa(Willow Creek)	52,500	0.43	58	5	0.56	0.22

[1] Total rangewide habitat = 12,104,100 acres.

3.3.2.5 Effects under Alternative 2

Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in the Section 3.3.2.2 of this Final EIS, including possible increases in spotted owl survival, reproduction, and population growth rate on the treatment areas following barred owl removal. We also anticipate continued declines in spotted owl population performance in the control area where barred owls would not be removed similar to what has been observed in ongoing demography studies (Forsman *et al*. 2011a, p.1). While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). While this potential is low, it would be somewhat higher than for Alternative 1 because barred owls would be removed on three areas as opposed to one.

We anticipate that the overall effects of this alternative on spotted owls across the subspecies' range would be minimal. The total amount of spotted owl habitat potentially affected by barred owl removal ranges from less than 1.33 percent (Rainier, Tyee, Hoopa (Willow Creek)) to 3.90 percent (Olympic Peninsula, Oregon Coast Ranges, Klamath) (Table 3-65). Expected duration of barred owl removal is 4 years at each of the three study area configurations. The estimated number of spotted owl territories that could be potentially affected on the treatment area ranges from 166 for smallest combination (Rainier, Tyee, Hoopa (Willow Creek)) to 275 for the largest (Olympic Peninsula, Oregon Coast Ranges, Klamath).

As in all alternatives, the scale of effects on spotted owl populations would be influenced by the time it takes to begin the removal of barred owls for the experiment (Table 3-65). For Alternative 2, barred owl removal could begin immediately because these areas have a long history of spotted owl demographic monitoring, including spotted owl population status, and there is no need to collect pretreatment data. The 4 years of barred owl removal for Alternative 2 is the second shortest among the alternatives presented. The use of multiple study areas provides a greater ability to detect differences in population performance between treatment and control areas (scope of inference) than a single study area because a wider range of habitat conditions are represented and would provide greater statistical power to detect changes in population trends between treatment and control areas than a single study area approach. The use of three study areas in Alternative 2 provides strong statistical power to detect changes.

Among the three proposed combinations of study areas (Table 3-65), the proportion of spotted owl territories with barred owl detections is comparable (0.40–0.49 percent of spotted owl territories had barred owl detections). Spotted owl site occupancy rates are slightly higher for the Rainier, Tyee, Hoopa (Willow Creek) combination (0.52 percent of spotted owl territories were occupied) than for the Olympic Peninsula, Oregon Coast Ranges, Klamath combination (0.45 percent of spotted owl territories were occupied) or the Cle Elum, Oregon Coast Ranges, Klamath combination (0.43 percent of spotted owl territories were occupied) (Table 3-65) combinations. The more northern areas (Rainier, Olympic Peninsula, Cle Elum, Oregon Coast Ranges) within the three proposed groupings have had larger barred owl populations for longer periods of time than the more southern areas (Tyee, HJ Andrews, Klamath, Hoopa (Willow Creek)). The northern areas could potentially have the greatest increase in spotted owl site occupancy; however, the existing spotted owl populations may be too small to provide large numbers of owls to recolonize vacant territories in the near term. We anticipate that the combined removal efforts on three study areas in Alternative 2 would have a larger (positive) rangewide effect on spotted owl populations than the single study area approach (Alternative 1).

Table 3-65. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for three proposed combinations of study areas under consideration for Alternative 2.

Alternative 2 Study Areas (3 groupings of 3)	Acres of Spotted Owl Habitat in Treatment Area	Percent of Rangewide Spotted Owl Habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy	Proportion of Spotted Owl Sites with Barred owls
Rainier, Tyee, and Hoopa (Willow Creek)	163,900	1.33	161	4	0.52	0.40
Olympic Peninsula, Oregon Coast Ranges, and Klamath	472,100	3.90	275	4	0.43	0.49
Cle Elum, Oregon Coast Ranges, Klamath	291,700	2.41	261	4	0.45	0.43

[1] Total rangewide habitat = 12,104,100 acres.

3.3.2.6 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of from 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in the Section 3.3.2.2 of this Final EIS, with possible increases in spotted owl survival, reproduction, and population growth rate in the treatment areas following barred owl removal. We also anticipate continued declines in spotted owl population performance in the control area where barred owls would not be removed similar to what has been observed in ongoing demography studies (Forsman *et al*. 2011a, p. 1). While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). We anticipate that the overall effects of theis removal experiment on spotted owls across the subspecies' range would be minimal. The total amount of spotted owl habitat potentially affected by barred owl removal ranges is 1.13 percent, and there are an estimated 131 spotted owl territories on the treatment area that could potentially be affected by barred owl removal (Table 3-66). This alternative involves 4 years of barred owl removal.

As in all alternatives, the scale of effects on spotted owls would be influenced by the time it takes to begin conducting barred owl removal for the experiment (Table 3-66). For Alternative 3, barred owl removal could begin immediately because the treatment areas have some preexisting demographic data. While the demographic data is not as extensive as for Alternatives 1 and 2, the proposed 4-year of barred owl removal for Alternative 3 is comparable to Alternative 2. The use of two study areas would potentially increase northern spotted owl population performance across a greater proportion of the subspecies' range than would using a single study area (Alternative 1). The use of multiple study areas provides a greater ability to detect differences (scope of inference) than a single study area because a wider range of habitat conditions are represented and would provide greater statistical power to detect changes in population trends between treatment and control areas than a single study area approach.

Table 3-66. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for Alternative 3.

Alternative 3 Study Areas	Acres of Spotted Owl Habitat in Treatment Area	Percent of Rangewide Spotted Owl Habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy	Proportion of Spotted Owl Sites with Barred owls
Union/Myrtle (Klamath) and Veneta (Oregon Coast Ranges /Tyee)	137,300	1.13	131	4	0.67	0.45

[1] Total rangewide habitat = 12,104,100 acres.

3.3.2.7 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a pre-removal demographic data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in the Section 3.3.2.2 of this Final EIS, with possible increases in spotted owl survival, reproduction, and population growth rate in the treatment areas following barred owl removal. We also anticipate declines in spotted owl population performance in the control area where barred owls would not be removed during the experiment, similar to what has been observed in ongoing spotted owl demography studies (Forsman *et al*. 2011a, p. 1). While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). We anticipate that the overall effects of these removal studies on spotted owls across the subspecies' range would be minimal. The total amount of spotted owl habitat potentially affected by barred owl removal is 1.42 percent and the estimated number of spotted owl territories on the treatment area that could potentially be affected by barred owl removal is 133 (Table 3-67).

As in all alternatives, the scale of effects on spotted owls would be influenced by the time it takes to begin to conduct barred owl removal for the experiment (Table 3-67). Expected total duration of the experiment is 10 years for sub-Alternative 4a and 8 years for sub-Alternative 4b. With pretreatment data collection for sub-Alternative 4a, potential effects on spotted owl demographic rates would be delayed for 5 years before barred owl removal is implemented. As pretreatment demographic data on spotted owls would not be collected in sub-Alternative 4b, barred owl removal would begin during year 1, and we anticipate that potential effects on spotted owl demographic rates would occur sooner than for sub-Alternative 4a. The use of two study areas, one in Washington and one in Oregon, would provide greater statistical power to detect changes in population trend between treatment and control areas than a single study area approach. For sub-Alternative 4a, it would likely take 5 years to obtain the demographic data needed to detect changes in the population growth rate. While the pretreatment data would increase the power of the experiment to detect changes, it would also delay the start of barred owl removal for several years. During this time, spotted owls may face increasing negative effects from barred owls. For sub-Alternative 4b, no pretreatment data on spotted owl demographic rates would be collected. Without pretreatment data, it would be more difficult to detect changes in spotted demographic rates that result from barred owl removal. As with Alternative 3, the three study areas proposed for this alternative include areas in Washington, Oregon, and California, thus representing a broad range of habitat conditions used by spotted and barred owls. The use of multiple study areas that encompass a range of spotted owl habitat conditions and barred owl pressures increases our ability to apply results from the removal experiment over a larger geographic scale.

Table 3-67. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for Alternative 4.

Alternative 4 Study Areas	Acres of Spotted Owl habitat in Treatment Area	Percent of Spotted owl habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy [2]	Proportion of Spotted Owl Sites with Barred owls [3]
Columbia Gorge and McKenzie	171,400	1.42	133	5-6	0.49	0.43

[1] Total rangewide habitat = 12,104,100 acres.
[2] Spotted owl site occupancy for these areas were estimated based on rates from the two closest ongoing spotted owl demography study areas: HJ Andrews and Rainier.
[3] Proportion of spotted owl sites with barred owls was estimated for these areas based on rates from the two closest ongoing spotted owl demography study areas: HJ Andrews and Rainier.

3.3.2.8 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal methods to removal barred owls for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in Section 3.3.2.2 of this Final EIS, with possible increases in spotted owl site occupancy and reproduction in the treatment areas following barred owl removal. As barred owls are removed, spotted owls are likely to recolonize vacated territories. These spotted owls may be owls that were in the treatment area but not previously detected or spotted owls that move in from more distant areas. We also anticipate declines in spotted owl population performance in the control area where barred owls would not be removed during the experiment period, similar to what has been observed in ongoing demography studies (Forsman *et al*. 2011a, p. 1). While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). We anticipate that the overall effects of these removal studies on spotted owls across the subspecies' range would be minimal. The total spotted owl habitat potentially affected by barred owl removal is 2.05 percent, and the estimated number of spotted owl sites that could potentially be affected by barred owl removal is 210 (Table 3-68).

The scale of effects on spotted owls would be influenced by the time it takes to begin conducting barred owl removal for the (Table 3-68). The duration of barred owl removal forthis alternative is 3 to 5 years, with 3 years for simple occupancy data and 5 years for occupancy and reproduction data. For Alternative 5, barred owl removal could begin immediately because the treatment areas have preexisting occupancy data. Because these three areas have preexisting occupancy data, we would have a greater ability to assess whether barred owl removal is associated with changes in spotted owl site occupancy than if we did not have baseline occupancy data for the pre-removal years. The proposed duration of barred owl removal of 3 to 5 years is short, and the use of three study areas would potentially affect spotted owl population performance across a greater proportion of the species' range than would using a single study area (Alternative 1). The use of multiple study areas provides a greater ability to detect differences (scope of inference) that a single study area because a wider range of habitat conditions are represented, and would also provide greater statistical power to detect changes in population trend between treatment and control areas than a single study area approach.

Table 3-68. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for Alternative 5.

Alternative 5 Study Areas	Acres of Spotted Owl habitat in Treatment Area	Percent of Spotted owl habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy [2]	Proportion of Spotted Owl Sites with Barred owls [3]
Cowlitz Valley, Veneta(Tyee/Oregon Coast Ranges), and Union/Myrtle (Klamath)	247,800	2.05	210	3 - 5	0.54	0.49

[1] Total rangewide habitat = 12,104,100 acres.
[2] Spotted owl site occupancy for these areas were estimated based on rates from Tyee, Oregon Coast Ranges, Klamath, and Cle Elum.
[3] Proportion of spotted owl sites with barred owls was estimated for these areas based on rates from Tyee, Oregon Coast Ranges, Klamath, and Cle Elum.

3.3.2.9 Effects under Alternative 6

Alternative 6 involves initiation of an experiment using an occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect barred owl removal to result in the direct and indirect effects listed in Section 3.3.2.2 of this Final EIS, with possible increases in spotted owl site occupancy and reproduction in the treatment areas following barred owl removal. As barred owls are removed, spotted owls are likely to recolonize vacated territories. These spotted owls may be owls that were in the treatment area but not previously detected or spotted owls that move in from more distant areas. We also anticipate declines in spotted owl population performance in the control area where barred owls would not be removed during the experiment, similar to what has been observed in ongoing spotted owl demography studies (Forsman *et al.* 2011a, p. 1). Our ability to detect changes in spotted owl site occupancy resulting from barred owl removal would be greater for sub-Alternative 6a than for sub-Alternative 6b. Obtaining baseline data on spotted owl site occupancy rates prior to removal increases the statistical power to detect changes in occupancy rates (see Appendix H of this Final EIS for further discussion). While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). We anticipate that the overall effects of these removal studies on spotted owls across the subspecies' range would be minimal. The total amount of spotted owl habitat potentially affected by barred owl removal is 2.08 percent, and the estimated number of spotted owl territories that could potentially be affected by barred owl removal is 194 (Table 3-69).

The scale of effects on spotted owls would be influenced by the time it takes to conduct the removal experiments, as well as the size of the treatment area (Table 3-69). Expected duration of barred owl removal is 3 to 5 years for this alternative, with 6 to 8 years for sub-Alternative 6a and 4 to 6 years for sub-Alternative 6b. With pretreatment data collection for sub-Alternative 6a, possible effects of barred owl removal on spotted owl site occupancy and reproduction would be delayed for 3 years before barred owl removal is implemented. As pretreatment demographic data on spotted owls would not be collected in sub-Alternative 6b, barred owl removal would begin during year 1, and we anticipate that potential effects on spotted owls would occur sooner than for sub-Alternative 6a. The use of three study areas spanning Washington, Oregon, and California would provide greater statistical power to detect changes in population trend between treatment and control areas than a single study area approach. For sub-Alternative 6a, it would likely take 3 years to obtain the occupancy data needed to detect changes in the population growth rate. While this pretreatment data would increase the power of the experiment to detect changes, it also delays the start of barred owl removal for several years. During this time, spotted owls may face increasing negative effects from barred owls. For sub-Alternative 6b, no pretreatment data on spotted owl site occupancy rates would be collected. Without pretreatment data, it would be more difficult to detect changes in spotted owl site occupancy and population growth rates that result from barred owl removal.

Table 3-69. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for Alternative 6.

Alternative 6 Study Areas	**Acres of Spotted Owl habitat in Treatment Area**	**Percent of Spotted Owl habitat [1]**	**Potential Number of Spotted Owl Territories on Treatment Area**	**Expected Duration of Barred Owl Removal (years)**	**Spotted Owl Site Occupancy [2]**	**Proportion of Spotted Owl Sites with Barred Owls [3]**
Olympic Revised (Olympic Peninsula), McKenzie , and Horse Beaver	251,900	2.08	194	5 - 8	0.43	0.41

[1] Total rangewide habitat = 12,104,100 acres.
[2] Spotted owl site occupancy for these areas were estimated based on rates from the Olympic Peninsula, HJ Andrews, and Green Diamond.
[3] Proportion of spotted owl sites with barred owls was estimated for these areas based on rates from the Olympic Peninsula, HJ Andrews, and Green Diamond.

3.3.2.10 Effects under Alternative 7

Alternative7 involves a combination of demography and occupancy study approaches on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of study. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. We discuss potential effects of these surveys in Section 3.3.2.2 of this Final EIS.

We expect results of barred owl removal to result in the direct and indirect effects listed in Section 3.3.2.2 of this Final EIS, with possible increases in spotted owl population performance (survival, recruitment, population growth rate) or occupancy rates on the treatment areas following barred owl removal. As barred owls are removed, spotted owls are likely to recolonize vacated territories. These may be spotted owls that were on the treatment areas but not previously detected or spotted owls that move in from more distant areas. We also expect to observe a continued decline in spotted owl populations in the control areas where barred owls would not be removed. While there is a potential for accidental killing of a spotted owl during barred owl removal efforts, we expect this to be very unlikely given the rigorous protocol for removal of barred owls (see Section 3.3.2.2 of this Final EIS). We anticipate that the overall effects of these removal studies on spotted owls across the subspecies' range would be minimal, although they would be greater for this alternative than for the other seven action alternatives. The total amount of spotted owl habitat potentially affected by barred owl removal is 6.55 percent (Table 3-70).

The scale of effects on spotted owls would be influenced by the time it takes to conduct the removal experiments, as well as the size of the treatment area (Table 3-70). Duration of the removal of barred owls varies by study area for this alternative. Smaller areas and those with fewer spotted owls would have longer removal durations (6 to 10 years) than larger areas (3 to 4 years). The magnitude of positive effects on spotted owls would likely be greater in areas where barred owls are less abundant or have invaded more recently and where occupancy is sufficiently high to allow spotted owls to re-establish on vacated territories (southern study areas).

The use of multiple study areas would potentially increase northern spotted owl populations across a greater proportion of the subspecies' range than would using a single study area or a combination of three study areas. This alternative includes the greatest coverage over the spotted owl's range, and we anticipate that removal under this alternative would result in the greatest potential positive effect on spotted owls, as removal would occur on approximately 6.55 percent of the northern spotted owl range. Additionally, an estimated 630 spotted owl territories could potentially be affected by barred owl removal on the treatment areas (Table 3-70).

Table 3-70. Amount of habitat, removal duration, spotted owl site occupancy, and proportion of spotted owl sites with barred owl detections for Alternative 7.

Alternative 7 Study Areas	Acres of Spotted Owl habitat in Treatment Area	Percent of Spotted Owl habitat [1]	Potential Number of Spotted Owl Territories on Treatment Area	Expected Duration of Barred Owl Removal (years)	Spotted Owl Site Occupancy [2]	Proportion of Spotted Owl Sites with Barred Owls [3]
Ross Lake	85,000	0.70	39	10	0.28	0.32
Wenatchee	133,800	1.11	94	3	0.28	0.32
Olympic Revised (Olympic Peninsula)	127,300	1.05	53	3	0.22	0.51
Rainier	74,300	0.61	38	6	0.38	0.32
Veneta (Oregon Coast Ranges/Tyee)	39,200	0.32	44	10	0.67	0.45
HJ Andrews	112,200	0.93	94	4	0.59	0.55
Rogue Cascades (South Cascades)	79,300	0.66	130	4	0.46	0.23
Horse/Beaver	58,700	0.48	60	4	0.56	0.20
Goosenest	6,600	0.05	12	10	0.46	0.18
Hoopa (Willow Creek)	52,500	0.43	58	10	0.56	0.22
Corral	21,700	0.18	8	10	0.56	0.22
Total	790,600	6.55	630			

[1] Total rangewide habitat = 12,104,100 acres.
[2] Spotted owl site occupancy for areas in red/italics were based on the closest ongoing spotted owl demography study area.
[3] Proportion of spotted owl sites with barred owls for areas in red/italics was based on the closest ongoing spotted owl demography study area.

3.4 Affected Environment and Environmental Consequences—Future Demographic Analysis in Long-term, Ongoing Spotted Owl Demography Study Areas

3.4.0 Changes between Draft and Final EIS

- Added an analysis of the Preferred Alternative

3.4.1 Background and Affected Environment

Concerns have been raised about the use of long-term ongoing spotted owl demography study areas for conducting barred owl removal experiments given their importance for monitoring northern spotted owl populations on a region wide basis. Sixteen long-term study areas have been included in range wide demography studies of spotted owl populations over the past 2 decades (Franklin *et al.* 1996, pp. 12-14; 1999, pp. 4-7; Anthony *et al.* 2006, pp. 6-8; Forsman *et al.* 2011a, pp. 5-8), eleven of which are still active. We are considering 10 of these areas for potential inclusion in a barred owl removal experiment. These study areas have been used since the late 1980s or early 1990s to monitor spotted owl population trends and demographic rates. While the locations of the study areas were not randomly selected, they do span the geographic range of the subspecies and encompass the majority of forest types used by spotted owls, and have therefore been used to assess the status of northern spotted owls across the range of the subspecies. These studies include a large number of individual spotted owls have been marked (banded) and monitored over time, providing one of the most comprehensive demographic datasets for birds of prey in the world. Some have expressed concern that using these areas for a barred owl removal experiment may compromise their utility for long-term monitoring of spotted owls.

Eight Federal monitoring areas are included in the Effectiveness Monitoring Program of the Northwest Forest Plan: Cle Elum, Olympic Peninsula, Oregon Coast Ranges, Tyee, HJ Andrews, Klamath, South Cascades, and Northwest California (which includes Willow Creek). Other areas, including Hoopa and Rainier, have been part of long-term monitoring efforts and are been included in region wide meta-analyses of spotted owl demographic data; however, these areas are not part of the Northwest Forest Plan Effectiveness Monitoring Program. The Wenatchee Study Area was part of earlier long term monitoring, but comprehensive demographic surveys were discontinued in 2003. Both types of long-term study areas are considered in alternatives for barred owl removal experiments.

One concern is that using up to half of an ongoing demography study area for a removal experiment would change conditions on the treatment (removal) areas relative to the control (non-removal) areas and other ongoing spotted owl demography study areas where barred owl removal is not occurring, limiting the utility of the data from the treatment area for monitoring.

Questions have been raised regarding how this would affect researchers' abilities to use the sites in the treatment area to monitor spotted owl populations. Although conditions would be different in the treatment areas, data from both areas can still be analyzed within the same modeling framework as in the past (Anthony *et al.* 2006, entire; Forsman *et al.* 2011a, entire). This would enable the full datasets for each study area to be used for estimating demographic rates; however, separate rates would be estimated for treatment and control areas. During the removal period, demographic rates from the treatment portion of a study area would not be used to assess spotted owl demographic performance if researchers did not want to include the effects of barred owl removal on rangewide demographic trends. The effects of removing barred owls on treatment areas are expected to diminish after barred owl removal stops.

Implementing a removal experiment on an ongoing spotted owl demography study area would effectively reduce the area that can be used to monitor spotted owl population trends by up to 50 percent. If only the control area can be assumed to reflect natural conditions in the barred owl removal experiment, demographic parameter estimates for this area would be less precise than estimates using the full study area. Detailed technical results of the analysis of effects of conducting a barred owl removal experiment on ongoing spotted owl demography study areas are presented in Appendix I of this Final EIS. While removal experiments would have effects on these study areas, we show that the utility of these areas for long-term monitoring of spotted owl populations can be retained while conducting a barred owl removal experiment.

If a removal experiment is implemented on an ongoing spotted owl demography study area, barred owl surveys would be conducted on both treatment and control portions of study areas. Some people have suggested that barred owl surveys may give the impression of more barred owls in the area than are actually present. As described in Section 3.3.2.2 of this Final EIS, we anticipate a very limited effect. The ongoing spotted owl demography study areas are currently surveyed for spotted owls on an annual basis. Surveyors have reported frequent and consistent barred owl vocalizations while conducting spotted owl surveys in these areas. Because barred owls are already established in these areas, spotted owls are regularly hearing and interacting with barred owls and we do not anticipate that conducting barred owl surveys (three nighttime surveys per survey route per year) would have a large effect on the territorial spotted owls.

Some have suggested that if the control area is in close proximity to treatment area, there is the slight possibility that effects of removal may influence barred owl population dynamics or behavior in the portions of the control area immediately adjacent to the treatment. At this time, there is no research or data that support this hypothesis. However, we will be able to detect these effects if they occur.

3.4.2 Environmental Consequences

3.4.2.1 Effects under the No Action Alternative

Under the No Action Alternative, a removal experiment would not be conducted. No barred owls would be removed from any of the ongoing spotted owl demography study areas proposed for this project. In the absence of a removal experiment, the possible effects of the experiment on spotted owl demographic data would be eliminated.

3.4.2.2 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach on four study areas with pre-treatment spotted owl demographic data. Barred owls would be removed from a portion of three ongoing spotted owl demography study areas; removal on the fourth study area would occur on an adjacent area with comparable data. Barred owls would be removed from up to one-half of each study area using a combination of lethal and nonlethal methods. We anticipate the experiment will require 4 years of barred owl removal to gather sufficient data for a statistically significant result. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Under the Preferred Alternative, treatment would occur on up to one-half of the Cle Elum, one-third of the Oregon Coast Ranges, and the entire Hoopa Spotted Owl Demography Study Areas. Barred owl removal would also occur on the Union/Myrtle area (not part of an ongoing demography study). The Hoopa Spotted Owl Demography Study Area is a demography study conducted by the Hoopa Valley Tribe. It is part of the 5-year demography meta-analysis but not part of the Northwest Forest Plan Spotted Owl Effectiveness Monitoring Program. Four ongoing spotted owl demography study areas (Cle Elum, Oregon Coast Ranges, Klamath, and Willow Creek) would be used as control areas. We anticipate that direct effects of removing barred owls on the treatment area(s) would include an increase in spotted owl survival, reproductive success, and population growth rate. We do not anticipate changes in spotted owl demographic rates on the control area(s) as a result of our removal experiment on neighboring areas. Barred owl surveys would be conducted on all treatment (removal) and control (non-removal) areas. As described above, we anticipate that these barred owl surveys would have minimal effects on spotted owls in these study areas.

Implementing a removal experiment on up to half of an ongoing spotted owl demography study area would effectively reduce the sample size of spotted owls for this study area by up to 50 percent. It would also make the estimates of demographic rates for both treatment and control areas less precise given the smaller sample sizes (see Appendix I of this Final EIS). For example, if half of an ongoing spotted owl demography study area is used for a removal experiment (and this half was not included in the subsequent meta-analysis/workshop), parameter estimates (survival, fecundity, recruitment, rate of population growth (lambda)) would have larger confidence intervals than for the time periods where the full area was analyzed. The change in standard error (SE) on half of a single study area would be (White 2010, pers. comm.):

$$\frac{SE\ (full\ area)}{\sqrt{proportion\ of\ total\ area}} = \frac{SE}{\sqrt{0.5}} = \frac{SE}{0.71}$$

For example, for the Cle Elum Study Area, mean population growth rate for 1990 to 2008 was 0.94 with a standard error of 0.01. If only half the number of owls had been available but the mean population growth rate was the same, standard error for the estimate of population growth rate would increase to 0.02. The 95 percent confident interval (estimate +/- 1.96*SE) around the estimate of population growth rate (0.94) for the full study area is 0.91 to 0.96, while the 95 percent confidence interval for half the study area is 0.90 to 0.98, indicating a very slight increase in variation. Similarly, for the Oregon Coast Ranges Study Area, mean population growth rate for 1990 to 2008 was 0.97 with a standard error of 0.01. If two-thirds of the number of owls had been available (e.g., using one-third for removal), the standard error would increase to 0.02. The 95 percent confident interval (estimate +/- 1.96*SE) around the estimate of population growth rate (0.94) for the full study area is 0.94 to 0.99, while the 95 percent confidence interval for two-thirds of the study area is 0.94 to 1.00, indicating an even slighter increase in variation. Additional examples of how variation in standard error for estimates of population growth rate would increase are shown in Appendix I of this Final EIS.

Once the removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). We anticipate there would be a lag time of several years before the effects of barred owl removal diminish on the treatment area(s). Effects of using ongoing spotted owl demography study areas for removal on our ability to estimate spotted owl demographic parameters under natural conditions would be somewhat greater for the Preferred Alternative than for Alternative 1 given that more areas would be used (see Appendix I of this Final EIS for details) however it would be less than for Alternatives 2 and 7 where removal would occur on portions of three demography study areas. In the Preferred Alternative, only two (Cle Elum, Oregon Coast Ranges) of the four study areas are part of the Northwest Forest Plan Effectiveness Monitoring Program.

3.4.2.3 Effects under Alternatives 1 and 2

Alternative 1 involves a demography study approach on one of nine ongoing spotted owl demography study area. Alternative 2 also involves a demography study approach, on a combination of three ongoing spotted owl demography study areas (Alternative 2). We anticipate that direct effects of removing barred owls on the treatment area(s) would include an increase in spotted owl survival, reproductive success, and population growth rate. We do not anticipate changes in spotted owl demographic rates on the control area(s) as a result of the removal of barred owls on adjacent areas. Barred owl surveys would be conducted on all treatment (removal) and control (non-removal) areas. As described above, we anticipate that these barred owl surveys would have minimal effects on spotted owls in these study areas.

Implementing a removal experiment on up to half of an ongoing spotted owl demography study area could potentially reduce the sample size of spotted owls for this study area by up to 50 percent. This would likely have minimal effect on the estimate of population trend for the control area itself relative to the estimate of population trend for entire study area if the removal experiment were not conducted, but would make the estimates of demographic rates for both treatment and control areas less precise given the smaller sample sizes. This would likely result in an increase in the standard error (precision measure) of the rate of population growth (lambda) of between 0.04 and 0.08 for individual study areas and up to 0.001 for the rangewide meta-analysis (see Appendix I of this Final EIS). Once the removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). We anticipate there would be a lag time of several years before the effects of barred owl removal diminish on the treatment area(s). Effects of using ongoing spotted owl demography study areas for removal on our ability to estimate spotted owl demographic parameters for a region-wide meta-analysis under natural conditions would be somewhat greater for Alternative 2 than for Alternative 1 given that more areas would be used, though still very small (see Appendix I of this Final EIS for details). We considered effects on the most recent estimate of the rate of population growth (lambda) of 0.972 (standard error = 0.006) from Forsman *et al*. (2011a); if up to 50 percent of the three largest study areas were used as treatment areas, the standard error would increase to 0.007. The 95 percent confident interval (estimate +/- 1.96*standard error) around the estimate of the rate of population growth (0.972) for the meta analysis without a removal experiment was 0.960 to 0.984, while the 95 percent confidence interval for Alternative 2 using the three largest study areas would be 0.958 to 0.986, indicating a very slight increase in variation.

3.4.2.4 Effects under Alternatives 4 and 6

These alternatives involve initiating an experiment using a demography study approach (Alternative 4) or occupancy study approach(Alternativs 6). These alternatives would have no impacts on the ongoing spotted owl demography study areas.

3.4.2.5 Effects under Alternatives 3 and 5

Alternatives 3 and 5 involve a demography study approach (Alternative 3) or occupancy study approach (Alternative 5) without any removal on ongoing spotted owl demography study areas. The Oregon Coast Ranges, Tyee, and Klamath Spotted Owl Spotted Owl Demography Study Areas are used only as control (non-removal) areas. Barred owl surveys would be conducted on all treatment and control areas. As described above, we anticipate that these barred owl surveys would have minimal effects on spotted owls in these study areas. We also believe it is unlikely that removal in the treatment areas would affect the ongoing spotted owl demography study areas used as control areas.

3.4.2.6 Effects under Alternative 7

This alternative involves barred owl removal on on up to one-half of three ongoing spotted owl demography study areas as treatment areas (Rainier, HJ Andrews, and Hoopa). Four ongoing spotted owl demography study areas are used as control areas (Olympic Peninsula Oregon Coast Ranges, Tyee, and Willow Creek). We anticipate that the direct effects of removing barred owls in the treatment area(s) would include an increase in spotted owl survival, reproductive success, and population growth rate. We do not anticipate changes in spotted owl demographic rates in the control (non-removal) areas from barred owl removal in the treatment area(s). Barred owl surveys would be conducted on all treatment and control areas. As described above, we anticipate that these barred owl surveys would have minimal effects on spotted owls in these study areas.

Similar to Alternatives 1 and 2, implementing a removal experiment on half of an ongoing spotted owl demography study area would effectively reduce the sample size of spotted owls in the individual study area by up to 50 percent. It would also result in less precise estimates of demographic rates for both treatment and control areas given the smaller sample sizes (see Appendix I of this Final EIS). Once the removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). We anticipate there would be a lag time of several years before the effects of barred owl removal diminish in the treatment area(s). Effects of using ongoing spotted owl demography study areas for removal on our ability to estimate spotted owl demographic parameters under natural conditions for Alternative 7 would be very similar to Alternative 2 where three demographic study areas would be included with the actual change in standard error being less than for Alternative 2 with the three largest areas (see Appendices H and I of this Final EIS for details).

3.5 Affected Environment and Environmental Consequences—Other Wildlife Species

3.5.0 Changes between Draft and Final EIS

- Added an analysis of the Preferred Alternative.
- Corrected and updated species' status in tables

3.5.1 Background and Affected Environment

Sections 3.2 and 3.3 of this Final EIS describe effects to barred owls and northern spotted owls, respectively. Other wildlife species may be affected by the experimental removal of barred owls in the treatment area in two ways: reduction of predation/competition and disturbance from the removal activities. Both effects are limited to the treatment portion of the study area and are temporary. In this chapter we refer to sensitive species, a term we use to encompass the variety of at-risk species in the study areas. This term includes various State and Federal designations such as species of concern, special status species, and sensitive species.

3.5.1.1 Predation and Competition

The reduction of barred owl populations would reduce or eliminate barred owl predation and competition in the treatment area for the duration of the proposed experiment. This would affect not only spotted owls, but many other wildlife species. This effect would be limited to species that are either potential prey or competitors of barred owls. Therefore, to understand the potential effect of barred owl removal, we need to determine which species are likely to be affected by barred owl predation and competition. To evaluate the effects of predation or competition by barred owl on other wildlife species and of the reduction of barred owl populations in the treatment areas, we summarized the known and potential effects of barred owls on species other than spotted owls in the northwest, including both documented impacts and potential impacts based on food habits.

Barred owls are generalist predators and opportunistic hunters. While considered primarily nocturnal, they also hunt during the day (Mazur and James 2000, p. 5). Barred owls often hunt from perches, waiting to pounce on potential prey. They have been known to perch over water to catch fish, or wade in shallow water for crayfish or fish. They can also hunt from the ground, running and pouncing on prey such as amphibians, and probably plunge into snow for small animals (Mazur and James 2000, p. 5).

Barred owls eat almost any species they encounter, including small mammals, birds, reptiles, amphibians, fish, earthworms, snails, slugs, insects, and crayfish (Livezey *et al.* 2008, p. 188). They consume a wide variety of birds, including ducks, hawks, other owls, grouse, woodpeckers, and songbirds. The barred owl diet varies across the seasons. They take advantage of seasonally available prey, with amphibians, reptiles, and invertebrates representing a large portion of their summer diet (Mazur and James 2000, p. 5) in some areas. The primary limiting factor in prey item selection is probably the size of the item. Snowshoe hare (2.2 pounds) was the largest item identified in the barred owl diet. See Appendix A of this Final EIS for more details on barred owl food habits.

Data on the food habitats of barred owls specific to the west are limited. In unpublished data from Oregon, 7 northern saw-whet owls and 5 western screech-owls were identified from a total of 3,686 individual barred owl prey items (Graham, 2011, unpubl. data). Hamer *et al.* (2001, p. 224) analyzed prey in 265 pellets from 12 barred owls in western Washington. The barred owl diet consisted of 74.5 percent mammals, 19.4 percent birds, and 6.1 percent combined fish, amphibians, mollusks, and insects. Barred owl diets were dominated by terrestrial species and included a high proportion of diurnal prey (Hamer *et al.* 2001, pp. 225–226). Northern flying squirrel made up 20 percent of the prey items (18.4 percent of the biomass), shrews were 9.8 percent of the prey items (0.4 percent of the biomass), snowshoe hares were 8.3 percent of the prey items (35 percent of the biomass), and Douglas squirrels were 8.3 percent of the prey items (14.1 percent of the biomass). In Alberta, Takats (1998, p. 103) reported barred owls as specialists on microtines (rodent subfamily that includes voles) and sciurids (squirrel family) (56.9 percent of diet items), with 68.1 percent of their overall diet being mammals. Thirty-seven pellets collected from two barred owl territories in winter in western Montana included mostly microtines associated with meadows and riparian areas; however, this may have been a period of microtine abundance (Marks *et al.* 1984, pp. 27–28).

Because the impact of a new predator or competitor is likely to be more serious for species that are already reduced in abundance or at risk, we were particularly interested in any direct evidence of endangered, threatened, candidate, or sensitive species in the barred owl diet. Graham (2011, unpubl. data), analyzed pellets containing 187 prey items collected from Eugene BLM and Siuslaw Resource Area in Oregon, and from Olympic National Park in Washington. Although no Federal- or State-listed species were found among the prey items, two Oregon species of concern were positively identified in the samples: red tree vole and band-tailed pigeon (See Appendix J of this Final EIS for more details). The North Oregon Coast Distinct Population of the red tree vole, located north of the Siuslaw River, is now a Federal candidate species under the ESA.

We also sought evidence of barred owl effects on other wildlife species populations. Between 1998 and 2002, western screech-owls disappeared from 22 locations in lower mainland British Columbia. The decline of screech owls was linked by timing to the barred owl expansion, predation by barred owls, and competition for nest cavities and habitat loss (Elliott 2006, p. 8). During screech owl surveys, Elliott detected barred owls in 27 out of 215 surveys, and was attacked 11 times (Elliott 2006, p. 9). Barred owls are thought to be a predator of northern pygmy owls in British Columbia, but little specific evidence exists aside from an observation of an attack (Darling 2003, p. 5). However, there were fewer observations of northern pygmy owls with increases in barred owl observations in southwest British Columbia (Darling 2003, p.5). Declines in screech owl detections coincide with an increase in barred owl detections in the results of 15 years of owl surveys from 1995 to 2010 on Bainbridge Island in Washington, west of Seattle. Barred owls were first detected on the island in 1993. In 1995, western screech-owls were detected at 11 locations on the island. By July 2008, 90 barred owls were detected. No screech owls have been detected since the 2008 to 2009 season (Acker, undated, unpubl. data).

We used the diet and effects data to estimate which native northwest species were most likely to be affected by barred owl predation or competition and therefore affected by their removal. Given the information on food habits, we conclude that any forest species under 35 ounces, or any aquatic forest species that either uses shallows at some point in its life cycle or comes to the surface, are potential prey for barred owls.

3.5.1.2 Disturbance Effects

Species that are sensitive to human presence or noise may be affected by the removal experiment surveys or removal activities. These activities would include one to three people at forested sites for 15 minutes (surveys) to a few hours (nonlethal removal), including one or more times during the late fall and winter. Surveys would be repeated up to six times each year. All visits to a particular location would be scattered in time and space. Removal efforts might involve visiting a particular point two or three times each year. Survey locations are in the closest proximity, but still one-quarter to one-half mile apart. Removal locations are based on the presence of a territorial barred owl and are likely at least one-half mile or more apart.

The presence of a few people in the woods is not likely to disturb most wildlife. However, the firing of a few (usually no more than two) shotgun shots spaced 5 or more minutes apart within or adjacent to the forest (lethal removal only) may affect very sensitive species. Removal is not expected to occur more than two to three times in a year, and would probably be separated in time by several days to years. Removal locations are based on the presence of a territorial barred owl and are likely at least one-half mile or more apart.

3.5.1.3 Wildlife Species Considered in this Analysis

While many species are at risk of predation from barred owls, we believe that for most common species this predation does not represent a risk to their populations. Therefore, removal of barred owls on the treatment areas would not significantly affect these species. However, we must give special consideration to species already considered at risk or sensitive, including those with small or declining populations. We are concentrating our discussion of effects to species listed as threatened or endangered under State or Federal law, and those identified as State or Federal species of concern, special status species, or sensitive species. We have limited this list to species that live in or pass through forest habitat (since species that do not use forests are unlikely to be barred owl prey or competitors) and species that barred owls are likely to prey on or compete directly with (eliminating large mammals such as grizzly bears and plants). We anticipate a greater potential for field activity disturbance effects on species that have been identified as already at some risk.

Appendix J of this Final EIS includes tables of the listed, candidate, or species of concern/special status species that occur within the action areas. The status of the species provides some indication of its level of risk. That is, endangered species are likely at more risk than sensitive species. These effects may be negative (disturbance) or positive (removal of predation or competition from barred owls in treatment areas). Even most of these species are unlikely to be significantly affected by removal activities.

3.5.2 Environmental Consequences

3.5.2.1 Effects under the No Action Alternative

Under the No Action Alternative, a removal experiment would not be conducted. No barred owls would be removed from any of the study areas proposed for this project. In the absence of a removal experiment, barred owl populations are likely to increase into the future until all suitable habitat is fully saturated with territorial barred owls, including within the study areas considered in this proposed action. Within southern Oregon and California, where the current barred owl population density is likely below carrying capacity, we anticipate barred owl populations would continue to increase until all suitable habitat is occupied.

As barred owls continue to expand their range and populations, vulnerable species will experience increasing predation or competition. Barred owl populations are currently lower in the southern study areas, thus species in these areas are likely to experience the greatest increase in effects under the No Action Alternative. This would represent a slight increase in impact to these species, but only for the duration of the barred owl removal (3 to 10 years) and the recovery time for the barred owl population (3 to 5 years). Therefore, this does not represent a significant effect.

3.5.2.2 Effects Common to All Action Alternatives

As stated above, the species most likely affected are those already considered endangered, threatened, or sensitive. Not all species within the range of the northern spotted owl (our focus area) are likely to encounter barred owls. For example, lampreys are river bottom dwellers and not likely to come into contact with barred owl. We limited our list to species that occur in the forest environment and whose range overlaps with at least one study area.

The tables in the alternative effects section below include Federal endangered, threatened, candidate, and proposed species and State listed species. Some state listed species may be Federal species of concern. Federal species of concern is an informal term, not defined in the Federal ESA, and commonly refers to species that are declining or appear to be in need of conservation. The Service in California does not maintain a species of concern list, though the State of California maintains lists of Species of Special Concern. These lists provide essential information for land management planning and conservation efforts. The table provides the status and the study areas where each species is likely to occur.

The action alternatives all have two potential effects on species other than barred and northern spotted owls: the effects from the removal of barred owls and the effects of the experimental activities.

BARRED OWL REMOVAL: GENERAL EFFECTS. In the treatment (removal) area, the reduction of barred owl populations to very low levels could affect prey species or species with which barred owls compete for prey, habitat, or space. It could reduce pressure on barred owl prey species (small vertebrates and invertebrates) and reduce competition with other predators of small vertebrates and invertebrates (e.g., owls, hawks, raccoons, and American marten) for the duration of the experiment. However, if spotted owl populations increase, the reduction in pressure may be somewhat offset by increased predation by spotted owls for species that are also prey for spotted owls. This effect is temporary and any predation/competition pressure would return within 3 to 5 years of the termination of the removal as barred owl populations recover. We have focused our analysis of effects on species already at risk or with reduced populations, where the reduction in predation or competition has the greatest potential impact on the overall population health.

BARRED OWL REMOVAL: EFFECTS ON PREY. We examined existing food habit data to identify if any of the federally listed, candidate, or sensitive species have been documented as barred owl prey. Remains of 147 red tree voles were found in samples, representing 1.8 percent of prey biomass in a Eugene BLM barred owl diet study (Graham 2011, unpubl. data). This species is a Federal candidate north of the Siuslaw River in northern Oregon, and is also an Oregon State species of concern. Remains of seven band-tailed pigeons were found in samples, representing 1.3 percent of prey biomass. Band-tailed pigeons are a Federal species of management concern. No other endangered, threatened, candidate, or sensitive species were found in analyses of barred owl pellets from the west. However, current pellet analysis is limited to a few studies from limited areas. Failure to detect a species in current barred owl food habit studies does not indicate that they are not taken on occasion as opportunity allows, only that they are not a primary food item in the areas where the pellet studies have been conducted. For endangered or threatened species, even opportunistic predation may be of substantial concern.

In some cases, pellet remains cannot be identified to species, so the remains may be that of endangered, threatened, candidate, or sensitive species. Salmonids, bats, and frogs were among the groups identified studies in the west (Graham 2011, unpubl. data). Salamander skeletal remains could not be identified to species. Small salamanders found in samples from Olympic National Park could be Van Dyke's salamander, a Species of Concern. Unidentified shrews occurred in barred owl pellets at a rate of 37.5 percent in the Olympic National Park study, where the Trowbridge's shrew, a Species of Concern, is found.

Some species found in prey studies may indicate that similar endangered, threatened, candidate, or sensitive species are also likely prey. For example, the Pacific sideband snail, which was found in the barred owl diet study, is similar to the Trinity bristle snail, listed as threatened in the State of California and found within barred owl study areas.

Some species appear to be vulnerable though we have no hard evidence they are barred owl prey. While marbled murrelets have not been found in barred owl prey studies, young marbled murrelets are likely vulnerable to opportunistic predation while in the nest. Adult murrelets may also be vulnerable if caught while incubating eggs or brooding young. Marbled murrelet nesting habitat is also barred owl habitat, making an encounter likely.

In 2009, the Service expressed concern about the potential effects of barred owls on the endangered Shasta crayfish. Because other species of crayfish are a barred owl prey, barred owls could negatively affect Shasta crayfish populations, and based on the large number of crayfish barred owls are known to consume in some areas, a single barred owl could potentially deplete an area of Shasta crayfish in a relatively short period of time (USFWS 2009, unpublished data). However, the life history of the Shasta crayfish makes it less vulnerable than the signal crayfish, an introduced species that is a threat to the Shasta crayfish.

Species which are documented or potential prey for barred owls may experience a positive effect on reduced predation on the treatment areas for the duration of the experiment.

EXPERIMENTAL ACTIVITY: GENERAL EFFECTS. The potential for effects from the experiment depend on the type and intensity of the activity and the sensitivity of the species. The removal activity, with its potential for disturbance by shotgun blast or presence of people in the forest may affect very sensitive species. This effect would only occur during the removal activities of the experiment.

Surveys for spotted and barred owls involve the presence of surveyors in vehicles along roads and walking on trails. These are activities similar to those that normally occur within the study area and, therefore, we do not anticipate this activity would result in an increasing background level of human presence. This portion of the activity has no significant effect on other wildlife species.

Some surveys would involve using recorded barred owls calls at survey points to locate barred owls. If members of a species are very sensitive to, and disturbed by, the sound of barred owls, this could elicit a reaction. However, only a few surveys would be conducted each year. Thus, exposure to this activity is very low. In addition, barred owls already occur in all these areas and undoubtedly call often. Animals in these areas are likely already used to hearing barred owl calls on a more regular basis than the surveys. Therefore, surveys would not likely increase the background level of calling significantly, and we anticipate no significant effect of calling surveys on other wildlife species.

This leaves the action of removal itself. Removal can be accomplished through lethal or nonlethal methods, each of which represents a different level and type of potential disturbance.

Lethal removal involves the presence of a small crew at the site (two to three people) for a short period (15 minutes to 1 hour) and the sound of shotguns. All areas designated for removal are open for human use, so the presence of a small crew is within the normal background activity. Therefore, we do not anticipate effects from the crew's presence. Based on our removal protocol, shotgun blasts should generally be limited to only two shots at a single location during each removal effort. The shots would be separated by a few minutes or days, depending on whether both members of the barred owl pair are removed in a single visit. Because barred owls may reoccupy the sites in a single season, this could happen two or three times a year at some sites.

At this time, based on the protocol, most removal would occur during the fall and winter. Most of the treatment areas, with the exception of National Parks, are open for hunting (which often happens in the fall) and shooting. Animals in these areas are likely to be somewhat habituated to the sound of shots. Our limited shooting in these areas is likely to blend into the background noise and not affect most species. In National Park areas within the park but near the boundary, animals probably experience some level of habituation to hunting and shooting on neighboring lands. In areas deeper within a National Park, sounds of shots may be novel. To the extent that individuals react to the unknown, this may cause some potential for short-term disturbance.

Most species are likely habituated to, or little disturbed by, this short-term limited shooting activity. The primary exception to this is species already at risk, and then only if the shooting occurs during periods when they are particularly sensitive to disturbance. For most other wildlife species, we don't anticipate any significant effect from the limited disturbance of one to two shotgun shots due to the limited duration and scope of the disturbance. While individuals may respond by startling or flushing (flying or moving away from the noise), these are very limited and normal responses that are unlikely to permanently affect individuals or populations.

Nonlethal removal (trapping) requires the presence of a small crew at the site (two to four people) for a short period of time (1 to 2 hours). All removals would occur in areas open to human use and, therefore, the presence of a crew would be within the normal background activity. Trapping usually involves the placement of mist nets near the ground and a decoy, recorded barred owl calls, and entanglement as the barred owl attempts to attack the decoy. Because nets are placed close to the ground, there is limited potential for the capture of nontarget species. Nets are always attended so there would be little risk to other wildlife species, which can be removed immediately if accidentally captured. Therefore, we anticipate no significant effects on other wildlife species from nonlethal removal.

EXPERIMENTAL ACTIVITY: DISTURBANCE EFFECTS. Of all the species listed in Tables J-1 and J-2 (See Appendix J of this Final EIS) few are likely to be disturbed by the experiment. We have identified a potential for disturbance to marbled murrelets from shotgun shots under certain conditions. On some of our study areas, marbled murrelets may still be nesting or feeding young during the first month of the removal period (September). Adult marbled murrelets typically feed young around dawn and dusk, although fewer feedings take place at dusk and during the day. Our removal efforts would often occur at dusk or in the early evening. If the shots are in the immediate vicinity of an active nest, this could potentially interrupt the feeding of young. Excessive noise, particularly if repeated often, may affect food delivery by adults to the young, flush adults thus exposing its egg or young to predation, cause premature fledging of young. In this case, the noise is limited in duration, would not be repeated often, and most would occur outside the marbled murrelet breeding season. This effect would be limited to treatment areas in the likely range of nesting marbled murrelets and would be covered under the effects of each applicable alternative. There is a low likelihood of a measurable impact to marbled murrelet populations due to the limited potential for exposure and short duration of exposure. Most removal occurs in the fall and winter, after the marbled murrelet breeding season, and the disturbance is of short duration with limited repetition (two shots at most in any 1 day and a maximum of two to three visits during the nesting season at any particular spot).

We have not identified any threats from disturbance to any other endangered, threatened, candidate, or sensitive species.

3.5.2.3 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach on the Cle Elum, one-half of the combined Oregon Coast Ranges and Veneta, the Union/Myrtle (Klamath), and the Hoopa (Willow Creek) Study Areas. These are areas with ongoing spotted owl demography studies or with current or recent data on banded spotted owls. Barred owls would be removed from up to one-half of the Cle Elum Study Area, up to one-quarter of the combined Oregon Coast Ranges and Veneta Study Area, the Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area, and the Hoopa portion of the Hoopa (Willow Creek) Study Area using a combination of lethal and nonlethal removal methods. Barred owls would be removed for an estimated duration of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The Preferred Alternative would reduce the potential predation of other wildlife species by barred owls in the treatment areas of the four study areas for the duration of the experiment. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-71 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet. A portion of the Cle Elum and the Union portion of the Union/Myrtle (Klamath) Study Area lie within the inland range of the marbled murrelet. The Oregon Coast Ranges/Veneta (half) Study Area is fully within the inland range of the marbled murrelet. This could result in the potential for disturbance of marbled murrelets. Removal will occur on the Hoopa portion of the Hoopa (Willow Creek) Study Area, which lies within the potential inland range of the marbled murrelet. However, extensive surveys of the Hoopa portion of the Hoopa (Willow Creek) Study Area have not verified any marbled murrelet use.

Table 3-71. Listed forest species in study areas in Preferred Alternative.

		Listed Species within Study Areas [2]				State-Listed Status [3]		
Common Name	**Federal-Status [1]**	**Cle Elum**	**Oregon Coast Ranges/Veneta (half)**	**(Union/Myrtle) Klamath**	**Hoopa (Willow Creek)**	**WA**	**OR**	**CA**
Fisher, West Coast DPS [4]	C	x		x	x	E	--	--
Red Tree Vole, North Oregon Coast DPS (North of Siuslaw River)	C		x			--	SS	--

Common Name	Federal-Status [1]	Listed Species within Study Areas [2]				State-Listed Status [3]		
		Cle Elum	Oregon Coast Ranges/Veneta (half)	Klamath (Union/Myrtle)	Hoopa (Willow Creek)	WA	OR	CA
Marbled Murrelet	T	x	x	x		T	T	E
Western Yellow-billed Cuckoo	C	x				C	--	E
Flammulated Owl	none	s				C	--	--
Northern Spotted Owl	T	x	x	x	x	E	T	--
Western Toad	SOC	s				C	--	--
Oregon Spotted Frog	C		x			E	--	--
Coho Salmon DPSs	T		x	x	x	--	--	T
Steelhead DPSs	T/ SOC	x	x			C	--	--
Chinook Salmon DPSs	E/T		x			C	--	T
Oregon Chub	T		x			--	--	--
Bull Trout DPSs	T	x	x			C	--	E
Eulachon DPS	T				x	C	--	--
Trinity Bristle Snail					x	--	--	T

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.4 Effects under Alternative 1

Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 1 would reduce the potential predation of other wildlife species by barred owls in the treatment area for the duration of the experiment. The smallest effect would occur if we chose the smallest study area, the Hoopa (Willow Creek) Study Area, and the largest if we chose the Oregon Coast Ranges Study Area. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-72 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the ongoing spotted owl demography study areas.

The only species for which disturbance may be an issue is the marbled murrelet. Six of the nine potential study areas are within the inland range of the marbled murrelet. There is a potential for disturbance if we select one of the following study areas: Olympic Peninsula, Rainier, Oregon Coast Ranges, Tyee, or Hoopa (Willow Creek).

Table 3-72. Listed forest species in study areas in Alternatives 1 and 2.

		Listed Species within Study Areas [2]									State-Listed Status [3]		
Common Name	**Federal-Listed Status [1]**	**Olympic Peninsula**	**Cle Elum**	**Rainier**	**Oregon Coast Ranges**	**Tyee**	**HJ Andrews**	**Klamath**	**South Cascades**	**Hoopa (Willow Creek)**	**WA**	**OR**	**CA**
Fisher, West Coast DPS [4]	C	x	x	x		x		x	x	x	E	--	--
Mazama Pocket Gopher	C	x		x							T	--	--
Red Tree Vole, North Oregon Coast DPS (North of Siuslaw River)	C				x						--	SS	--
Keen's Myotis Bat	none	s		s							C	--	--
Marbled Murrelet	T	x	x	x	x	x		x			T	T	E
Western Yellow-billed Cuckoo	C	x	x	x							C	--	E
Flammulated Owl	none		s								C	--	--
Northern Spotted Owl	T	x	x	x	x	x	x	x	x	x	E	T	--
Western Pond Turtle	SOC			s							E	--	--
Western Toad	SOC	s	s	s							C	--	--
Oregon Spotted Frog	C			x	x		x		x		E	--	--
Chum Salmon DPSs	T	x		x							C	--	--
Coho Salmon DPSs	T				x	x	x	x	x	x	--	--	T
Steelhead DPSs	T/ SOC		x	x	x		x			x	C	--	--
Chinook Salmon DPSs	E/T			x	x		x			x	C	--	T
Oregon Chub	T				x		x				--	--	--

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]									State-Listed Status [3]		
		Olympic Peninsula	Cle Elum	Rainier	Oregon Coast Ranges	Tyee	HJ Andrews	Klamath	South Cascades	Hoopa (Willow Creek)	WA	OR	CA
Bull Trout DPSs	T	x	x	x	x		x		x		C	--	E
Eulachon DPS	T									x	C	--	--
Trinity Bristle Snail										x	--	--	T

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.5 Effects under Alternative 2.

Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 2 would reduce the potential predation of other wildlife species by barred owls in the treatment areas for the duration of the experiment. The smallest effect would occur if we chose the smallest combination of study areas: Rainier, Tyee and Hoopa (Willow Creek). The largest effect would occur if we chose the Olympic Peninsula), Oregon Coast Ranges, and Klamath Study Areas. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-72 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the ongoing spotted owl demography study areas.

The only species for which disturbance may be an issue is the marbled murrelet. Six of the nine potential study areas are within the inland range of the marbled murrelet. There is a potential for disturbance if we select one or more of the following as part of the three study areas: Olympic Peninsula, Cle Elum, Rainier, Oregon Coast Ranges, Tyee, and Hoopa (Willow Creek).

3.5.2.6 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of from 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 3 would reduce the potential predation of other wildlife species by barred owls in the treatment areas of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas for the duration of the experiment. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-73 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet. The Veneta (Oregon Coast Ranges/Tyee) Study Areas are within the inland range of the marbled murrelet, as is a small area of the Union portion of the Union/Myrtle (Klamath) Study Areas. This could result in the potential for disturbance of marbled murrelets.

Table 3-73. Listed forest species in study areas in Alternative 3

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]		State-Listed Status [3]		
		Veneta (Oregon Coast Ranges/Tyee)	Union/Myrtle (Klamath)	WA	OR	CA
Fisher, West Coast DPS [4]	C		x	E	--	--
Red Tree Vole, North Oregon Coast DPS (North of Siuslaw River)	C	x		--	SS	--
Marbled Murrelet	T	x	x	T	T	E
Northern Spotted Owl	T	x	x	E	T	--
Oregon Spotted Frog	C	x		E	--	--
Coho Salmon - Oregon Coast	T	x	x	--	--	--
Chinook Salmon - Upper Willamette River	T	x		--	--	--
Oregon Chub	T	x		--	--	--
Bull Trout	T	x		C	--	E

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.7 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a pre-removal demographic data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 4 would reduce the potential predation of other wildlife species by barred owls in the treatment areas of the Columbia Gorge and McKenzie Study Areas for the duration of the experiment. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-74 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet, however neither of these study areas are within the likely inland range of the marbled murrelet.

Table 3-74. Listed forest species in study areas in Alternative 4.

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]		State-Listed Status [3]		
		Columbia Gorge	McKenzie	WA	OR	CA
Fisher, West Coast DPS [4]	C	x		E	--	--
Western Gray Squirrel	SOC	s		T	--	--
Western Yellow-Billed Cuckoo	C	x		C	--	E
Northern Spotted Owl	T	x	x	E	T	--
Western Pond Turtle	SOC	s		E	--	--
Western Toad	SOC	s		C	--	--
Cascade Torrent Salamander	none	s		C	--	--
Oregon Spotted Frog	C	x	x	E	--	--
Chum salmon - Lower Columbia River	T	x		C	--	--
Coho salmon - Oregon Coast	T		x	--	--	--

Steelhead DPSs	T	x	x	C	--	--
Chinook Salmon DPSs	E/T	x	x	C	--	--
Oregon Chub	T		x	--	--	--
Bull Trout DPSs	T	x	x	C	--	E

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for State-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.8 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 5 would reduce the potential predation of other wildlife species by barred owls in the treatment areas of the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas for the duration of the experiment. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-75 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet. The Cowlitz Valley and Veneta (Oregon Coast Ranges/Tyee) Study Areas are within the inland range of the marbled murrelet, as is the western portion of the Union/Myrtle (Klamath) Study Area. This could result in the potential for disturbance of marbled murrelets.

Table 3-75. Listed forest species in study areas in Alternative 5.

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]			State-Listed Status [3]		
		Cowlitz Valley	Veneta (Oregon Coast Ranges/Tyee)	Union/Myrtle (Klamath)	WA	OR	CA
Fisher, West Coast DPS [4]	C	x		x	E	--	--
Red Tree Vole, North Oregon Coast DPS (North of Siuslaw River)	C		x		--	SS	--
Mazama (Western) Pocket Gopher	C	x			T	--	--
Marbled Murrelet	T	x	x	x	T	T	E
Western Yellow-billed Cuckoo	C	x			C	--	E
Northern Spotted Owl	T	x	x	x	E	T	--
Western Pond Turtle	SOC	s			E	--	--
Western Toad	SOC	s			C	--	--
Cascade Torrent Salamander	none	s			C	--	--
Oregon Spotted Frog	C	x	x		E	--	--
Chum salmon - Lower Columbia River	T	x			C	--	--
Coho salmon - Oregon Coast	T		x	x	--	--	--
Steelhead DPSs [4]	T	x			C	--	--
Chinook Salmon DPSs	E/T	x	x		C	--	--
Oregon Chub	T		x		--	--	--
Bull Trout DPSs	T	x	x		C	--	E

[1] Federal Species of Concern by study area.. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.9 Effects under Alternative 6

Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 6 would reduce the potential predation of other wildlife species by barred owls in the treatment areas of the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas for the duration of the experiment. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-76 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet. The Olympic Revised (Olympic Peninsula) Study Area is within the inland range of the marbled murrelet, which could result in the potential for disturbance of marbled murrelets.

Table 3-76. Listed forest species in study areas in Alternative 6.

		Listed Species within Study Areas [2]			State-Listed Status [3]		
Common Name	**Federal - Listed Status [1]**	**Olympic revised (Olympic Peninsula)**	**McKenzie**	**Horse/Beaver**	**WA**	**OR**	**CA**
Fisher, West Coast DPS [4]	C	x		x	E	--	--
Mazama (Western) Pocket Gopher	C	x			T	--	--
Keen's Myotis Bat	none	s			C	--	--
Marbled Murrelet	T	x			T	T	E
Western Yellow-billed Cuckoo	C	x			C	--	E
Great Gray Owl	none			s	--	--	E
Northern Spotted Owl	T	x	x	x	E	T	--
Western Toad	SOC	s			C	--	--

Common Name	Federal - Listed Status [1]	Listed Species within Study Areas [2]			State-Listed Status [3]		
		Olympic revised (Olympic Peninsula)	McKenzie	Horse/Beaver	WA	OR	CA
Scott Bar Salamander	none			s	--	--	T
Siskiyou Mountains salamander	none			x	--	--	T
California Red-Legged Frog	T			x	--	--	--
Oregon Spotted Frog	C		x	x	E	--	--
Chum Salmon DPSs	C	x			C	--	--
Coho Salmon DPSs	T		x	x	--	--	T
Steelhead DPSs	T		x	x	--	--	--
Chinook Salmon DPSs	E/T		x		--	--	E
Oregon Chub	T		x		--	--	--
Bull Trout DPSs	T	x	x		C	--	E
Eulachon DPS	T			x	C	--	--

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for State-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.5.2.10 Effects under Alternative 7

Alternative7 involves a combination of demography and occupancy studies on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of study. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 7 would reduce the potential predation of other wildlife species by barred owls for the duration of the experiment in the treatment areas on the largest combination of study areas, including the Ross Lake, Olympic Revised (Olympic Peninsula), Wenatchee, and Rainier Study Areas in Washington; the Veneta (Oregon Coast Ranges/Tyee), HJ Andrews, and Rogue Cascades (South Cascades) Study Areas in Oregon; and the Horse/Beaver, Goosenest, Hoopa (Willow Creek), and Corral Study Areas in California. Species for which predation is the most serious, and therefore removal has the most positive effect, include endangered, threatened, and candidate species. Table 3-77 provides a list of all federally endangered, threatened, and candidate species that are potential prey for barred owls and are likely to occur in forests or are potential food competitors on each of the study areas.

The only species for which disturbance may be an issue is the marbled murrelet. All or a portion of the Ross Lake, Olympic Revised (Olympic Peninsula), Wenatchee, Rainier, and Veneta (Oregon Coast Ranges/Tyee Study Areas are within the inland range of the marbled murrelet. This could result in the potential for disturbance of marbled murrelets.

Table 3-77. Listed forest species in study areas in Alternative 7.

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]											State-Listed Status [3]		
		Ross Lake	Olympic revised (Olympic Peninsula)	Wenatchee	Rainier	Veneta (Oregon Coast Ranges/Tyee)	HJ Andrews	Rogue Cascades (South Cascades)	Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral	WA	OR	CA
Fisher, West Coast DPS [4]	C	x	x	x	x			x	x		x	x	E	--	--
Red Tree Vole, North Oregon Coast DPS (North of Siuslaw River)	C					x							--	SS	--
Mazama (Western) Pocket Gopher	C		x		x								T	--	--
Western Gray Squirrel	SOC	s		s	s								T	--	--
Keen's Myotis Bat	none	s	s		s								C	--	--
Marbled Murrelet	T	x	x	x	x	x							T	T	E
Western Yellow-billed Cuckoo	C	x	x	x	x								C	--	E
Flammulated Owl	none			s									C	--	--
Great Gray Owl	none								s				--	--	E
Northern Spotted Owl	T	x	x	x	x	x	x	x	x	x	x	x	E	T	--
Western Pond	SOC				s								E	--	--

Common Name	Federal-Listed Status [1]	Listed Species within Study Areas [2]											State-Listed Status [3]		
		Ross Lake	Olympic revised (Olympic Peninsula)	Wenatchee	Rainier	Veneta (Oregon Coast Ranges/Tyee)	HJ Andrews	Rogue Cascades (South Cascades)	Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral	WA	OR	CA
Turtle															
Western Toad	SOC	s	s	s	s								C	--	--
Scott Bar Salamander	none								s				--	--	T
Siskiyou Mountains Salamander	none								x				--	--	T
California Red-Legged Frog	T								x	x			--	--	--
Oregon Spotted Frog	C	x			x	x	x	x	x	x			E	--	--
Chum Salmon - Lower Columbia River	T		x		x								C	--	--
Coho Salmon DPSs	T					x	x		x		x	x	--	--	T
Steelhead DPSs	T/SOC			x	x	x	x		x	x	x	x	C	--	--
Chinook Salmon DPSs	E/T	x		x	x	x	x				x		C	--	E / T
Oregon Chub	T					x	x						--	--	--
Bull Trout DPSs	T	x	x	x	x	x	x						C	--	E
Eulachon DPS	T								x		x	x	C	--	--
Trinity Bristle Snail	none										s	s	--	--	T

[1] Federal Species of Concern by study area. E = endangered, T = Threatened, C = candidate, SOC = species of concern.
[2] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[3] State listing status. E = endangered, T = threatened, C = candidate, SS = special status, WA = Washington, OR = Oregon, CA = California.
[4] DPS = Distinct population segment.

3.6 Affected Environment and Environmental Consequences—Social Effects and Ethical Considerations

3.6.0 Changes between Draft and Final EIS

- No substantial changes.

3.6.1 Introduction

This chapter presents information gathered during the scoping process about those aspects of the social environment that are likely to be affected by the alternatives presented in this Final EIS. This includes additional information on the Barred Owl Stakeholders Group, whose deliberations on the ethical questions raised by the proposed experimental removal helped inform aspects of the alternatives developed for the Draft EIS and considered in this Final EIS. While the Barred Owl Stakeholders Group's work in this regard and other ethical considerations are not specific considerations under NEPA, the Service believes it provides helpful background information

3.6.2 Background - Ethical Considerations

This section of this Final EIS focuses on the ethical considerations faced by the Service when considering alternatives for a barred owl removal experiment. The Revised Recovery Plan for the Northern Spotted Owl identified Recovery Action 29, which recommended implementation of large-scale removal experiments to assess the effects of barred owl removal on spotted owl populations (USFWS 2011, pp. III-62, III-65). At the time the recovery plan was released, the Service received a number of public comments expressing concerns regarding this proposal. Based on this, the Service anticipated some public interest in any proposal to remove from 250 to 9000 barred owls from the wild, particularly if that removal involves lethal methods. Through the work outlined below, the Service has taken pains to evaluate and address ethical issues.

3.6.2.1 Barred Owl Stakeholder Group Background and Process

As part of the implementation process for the 2008 Northern Spotted Owl Recovery Plan (USFWS 2008, entire), the Service established the Barred Owl Stakeholder Group as a recovery implementation team under ESA § 4(f)(2). We invited over forty representatives from relevant government agencies, the forest product industry, Native American tribes, environmental organizations, and animal welfare and protection groups. We contracted an ethicist with expertise in the area of environmental policy and wildlife management to lead the group through a series of presentations, workshops, facilitated dialogues and field trips that focused on the scientific, policy and ethical information relevant to the debate over barred owl management. The members of this group did not make formal recommendations to the Service, but rather helped the agency identify and better respond to ethical issues presented by this proposal. The individual stakeholders explored two key questions through open-ended dialogue -- was the removal experiment ethically justified, and could it be done humanely? The stakeholder group was not formed to make formal recommendations to the Service, and it did not do so.

The information presented below summarizes the key ethical debates and considerations stemming from the participants' discussions regarding the barred owl removal experiment and how the Service has incorporated this and other information on values and ethics in the Final EIS.

Based on the available information, the Barred Owl Stakeholders Group did not have a shared opinion as to whether or not humans were culpable for the range expansion of barred owls. However, most participants believed that, whether or not humans were the cause of the barred owl's range expansion, society is responsible for protecting the well-being of both barred and spotted owls, as well as the biodiversity of old growth forests. Another perspective of most participants in the Barred Owl Stakeholders Group was that barred owls are now so widely distributed throughout the Pacific Northwest that wildlife managers are unlikely to ever eliminate them from the landscape entirely. While this may change in the future, for now, many members of the group considered barred owls as de facto members of the biotic community.

In light of these considerations, most participants in the Barred Owl Stakeholders Group believed the task of environmental policy and wildlife management should be to help spotted owls cope with the threats posed by interspecific competition, in a manner as scientifically based and rigorous as used with other threats. After learning more about the barred owl and spotted owl interactions and competition, most participants found the barred owl threat facing spotted owls is of crisis proportions and a policy and management response is necessary. Members generally shared the perspective that barred owl removal may be necessary if the spotted owl was to remain viable in the wild. Out of a sense of the crisis and triage, the group participants shared a perspective concerning the need to conduct a removal experiment to answer critical questions. Unless specifically stated, the following discussion of removal relates to the experimental removal proposal, not larger-scale management.

Based on their identification of the barred owl as a significant threat, some in the Barred Owl Stakeholders Group were willing to consider humane methods of removal to prevent the extinction of the spotted owl, preserve native biodiversity and contribute to ecological integrity. While both lethal and nonlethal removal was discussed, lethal removal generated the most concern amongst interested parties, yet was also considered by many the most feasible approach. At the same time, some members saw lethal removal as potentially inhumane, ineffective and carried a risk of ignoring other habitat-focused actions (i.e., habitat protection and fire reduction).

Once the Barred Owl Stakeholders Group came to a shared understanding about the magnitude of threats facing spotted owls and the need to take action to address this threat, the question then became how to do so as humanely as possible: humanely being defined in this context as minimizing pain and suffering. Many of the subsequent discussions were shaped by a number of key elements, including the values of compassion and avoidance of suffering, a focus on the well-being of owls themselves, resisting management solutions that would too easily support lethal removal without sufficient reason and reflection, pressing for the fair consideration of nonlethal alternatives to removing owls, and insisting that any policy or management decision do everything possible to prevent owls from physical or other suffering. The focus of discussion turned to alternatives to lethal removal, and whether lethal methods could be humane.

Amongst the nonlethal alternatives, the options discussed included protecting more spotted owl habitat, actively managing habitat for spotted owls, supplementing the food sources for spotted owls, and diversionary feedings of barred owls. Unfortunately, because barred and spotted owls share highly overlapping niches, these alternatives do little to resolve the specific threat of interspecific competition.

Disrupting barred owl reproduction by oiling or removing eggs was evaluated but would not prevent barred owls from attempting to nest again, and continuing to occupy spotted owl habitat. Removing nestlings and sterilizing adults were also considered but would result in high levels of stress and mortality from the capture and handling. The participants determined this to be arguably no better than lethal removal in many cases, and was likely to be inhumane as well due to pain and suffering. All of these options are discussed in Section 2.3 of this Final EIS.

The Barred Owl Stakeholders Group discussed the option of translocating barred owls in some detail. While seemingly an attractive alternative, the likely stress and injury to owls during translocation, the poor survival rates of translocated individuals, the robust populations in other locales, and the possible genetic effects of cross-breeding sub-populations, were all cause for substantial humane and ecological concerns (See Section 2.3.9 and Appendix C of this Final EIS for more detailed discussion). As a result of these discussions, the participants generally concluded that many of the nonlethal alternatives also caused pain and suffering and could be inhumane, despite being nonlethal, but suggested that there be continuing research into nonlethal methods.

Having fully considered nonlethal alternatives, most members of the participants acknowledged that the lethal removal of barred owls may be necessary. The group's attention turned to the manner and number of barred owls to be lethally removed, with recognition that compassion and the avoidance of suffering are crucial values when managing such an effort. In order to proceed with lethal removal of barred owls, the ethical discussions turned to protocol to ensure it provided specific guidance in the removal of barred owls in as humane manner as possible. A quick and relatively painless approach was preferable. Capturing and euthanizing barred owls was considered, but determined to be too difficult to accomplish in the field and so stressful to the barred owls as to be inhumane. The remaining alternative would be to shoot barred owls under carefully managed conditions. No one was enthusiastic about this alternative, and yet few saw any other viable methods at this time.

Participants in the Barred Owl Stakeholder's Group also expressed concerns that the removal experiment would be used to proceed with a decision to lethally manage barred owls across a broad swath of the Pacific Northwest landscape without evaluating its effectiveness. The Service acknowledges this concern, and wishes to make the following point. This experiment is intended to implement Recovery Action 29 – experimental removal of the barred owl – of the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011, p. III-65), and we hope the experiment would provide important data to help decide the best policy and management options to barred and spotted owl competition. There would be other factors, such as funding, permits, etc., that would help shape any future decisions regarding barred owl management. For the reasons stated above, the experimental removal of barred owls would not be open-ended, and proceeding with the experiment does not in any way mean that a decision has been made regarding long-term management of the barred owl. The experiment would help by providing better information with which to develop future policy and management options. Future management decisions about barred owls would require a public process to be conducted at that time.

The primary perspectives from the ethical management of wildlife that are directly pertinent to the removal experiment identified by Dr. Lynn are as follows:

- A crisis for northern spotted owls is at hand. Act accordingly.
- Use the most humane methods available, and continue to develop nonlethal alternatives.
- Establish endpoints for the removal experiment and future management actions.

Based on their discussions, most Barred Owl Stakeholder Group participants felt that removal experiments may be justified, but they should be of limited duration, humane, include a defined protocol, and be conducted by professionals. The Service has taken this perspective into consideration as appropriate in developing the alternatives identified in the Draft EIS and considered in the Final EIS. All of the alternatives have a clearly defined end point, no more than 10 years of barred owl removal, at which time removals would be stopped and they all use the detailed removal protocol, which was developed using many of the suggestions provided by the participants in the Barred Owl Stakeholders Group, in light of the concerns articulated in their discussions. The experimental design alternatives are delimited in time and space, no more than 10 years of barred owl removal, and from one to eleven study areas. By historical and ecological measures, this would be a brief and focused intervention in the population of barred owls. These experimental delimitations also create endpoints, allowing the experiment to be ended when sufficient data is gathered, sufficient data proves impossible to gather, or the experiment has run its course. Barred owls would not be removed indefinitely as part of the experiment.

3.6.2.2 Other Ethical Considerations and Information

Based on the discussions of the Barred Owl Stakeholder Group, comments received, and discussions during the scoping period, each individual's reaction to the alternatives of this Final EIS are strongly affected by their individual ethical values relative to wildlife and natural resources. Each individual has their own value system, though we can characterize some of the general concepts. For example, some people's values are centered on humans; with animals and nature valued to the extent they provide resources to people. Others' values are centered on individual animals, animal populations, natural communities, or even the broader social community. Few personal value systems include only one of the categories. For the most part, people integrate some elements of all these views, simply placing more or less emphasis on each aspect. For example, a person may be very concerned about killing individual barred owls, but also concerned about saving the northern spotted owl from extinction. We do not consider any of these values right or wrong, but acknowledge that they lead people to different judgments about the alternatives in this Final EIS.

We received 54 comments in response to our December 10, 2009, Notice of Intent for the Draft EIS. We received an additional 75 comments on the Draft EIS. Many of these commenters expressed concerns based on ethics and values. People expressed some opinions on the experimental removal of barred owls during the scoping process and Draft EIS review, potentially reflecting personal values. Most comments fell into four general categories:

- Some people were totally opposed to any removal of barred owls or human intervention in the interaction of barred and spotted owls. Some of these people believe spotted and barred owls will learn to live together and we will not lose spotted owls; others were willing to risk losing the spotted owl.
- Some people were concerned for the welfare of barred owls, but felt that the need to ensure the spotted owl's survival made the removal experiment necessary and justified. Their primary concerns were that any removal be as humane as possible and limited to that which was necessary to complete the experiment.
- Some people felt the experiment was a necessary and important step in the efforts to recover the northern spotted owl and were concerned that any experiment be adequate to support strong scientific evaluation and results that could be applied across the range of the northern spotted owl.
- Finally, some people consider the barred owl an invasive species that arrived here only because of human manipulation of the environment and felt that we have a moral obligation to manage barred owls to save the native spotted owls. Some expressed support for moving beyond the experiment and into large-scale barred owl management immediately.

We also received recommendations and issues from discussions with the Federal agencies managing the lands on which the experiment would be conducted. This allowed us to identify another ethical issue, the use of firearms to lethally remove barred owls in National Parks. Three National Parks in Washington are included in one or more alternative, Olympic National Park, Mount Rainier National Park, and North Cascades National Park. None of these are included in the Preferred Alternative. Although the lethal removal of animals remains controversial in National Parks, there is precedent for doing so when pro-actively attempting to conserve and protect a threatened or endangered species. For example, in the Channel Islands National Park alone, feral rabbits, donkeys, pigs, goats, sheep, and rats, as well as introduced turkeys, deer and elk, have all been extirpated over the past 25 years. All of these removals were controversial.

Generally, visitors to the National Parks do not anticipate, nor expect, the killing of animals within National Parks, with the possible exception of animals that act aggressively towards humans. Even these removals create significant controversy. Some National Park supporters have expressed concern about safety, given that National Parks are often viewed as one of the few safe places to hike during hunting season because hunting is not allowed. At a deeper level, parks are often some of the last places where ecosystem processes and species are allowed to proceed naturally. The idea of potentially killing a large number of barred owls may be of concern to some National Park supporters, particularly those who view the expansion of the barred owl as a natural event. Other supporters may consider management of barred owls to maintain the native and long-term member of the ecosystem, the northern spotted owl.

As with the concerns of the Barred Owl Stakeholders Group, all concerns or issues raised in the scoping and comment periods were considered in developing the action alternatives identified in this Final EIS.

SUMMARY OF ETHICAL CONSIDERATIONS. Ethics and values are very important to individuals, and will affect the way in which each person views the various alternatives in this Final EIS. However, these are individual-level issues. We do not anticipate the proposed experimental removal of barred owls will change or impact individual values in a manner that would affect the larger regional social environment.

3.6.3 Social Affected Environment and Environmental Consequences

Social effects are those which change communities, institutions, and social and cultural conditions. Any social effect resulting from the implementation of any of these alternatives would be felt primarily within the range of the northern spotted owl. We have identified three ways in which the alternatives may impact the social environment: (1) public health and safety, (2) environmental justice, and (3) economic effects.

3.6.3.1 Public Health and Safety

The use of firearms for the removal of barred owls presents potential public safety issues. Firearms are already used for hunting on many of the lands potentially included in the alternatives.

Under the No Action Alternative no removal would occur, thus there are no public safety issues.

Under the Preferred Alternative and other action alternatives, regardless of alternative or location, any experimental removal of barred owls proposed in this Final EIS would be guided by a strict protocol that includes elements to protect human health and safety, as well as ensure barred owls are removed humanely (See Appendix D of this Final EIS for details). Removal would be conducted by trained, authorized professionals only, and would not be part of a public hunting effort. The permits for the removal would be obtained as necessary from the proper authorities and the research would conform to any additional safety requirements included in these permits.

Safety of crews conducting barred owl removal, particularly in unroaded areas, is important. Ultimately the principal investigator is responsible for ensuring basic safety and responding to specific concerns from land management agencies about particular areas or conditions where removal would take place. In issuing permits, land management agencies will have the opportunity to work with the principal investigator to ensure that specific safety concerns are addressed about particular conditions or areas within the study area.

All lethal removal would be conducted using shotguns, reducing the area of potential risk. Shotgun ammunition does not carry over long distances as with rifles, and when combined with dense forest understory and safety requirements of the protocol, presents a negligible risk of injury. Consequently, the Service does not anticipate any significant public safety issues. There is additional discussion of safety issues in Section 3.7 of this Final EIS.

3.6.3.2 Environmental Justice

In 1994, President Clinton issued an executive order on environmental justice (59 FR 7629, February 16, 1994), here defined as avoiding or rectifying the undue environmental burdens of pollution on the public, with a special focus on minority and low-income populations. This executive order made achieving environmental justice a responsibility of each Federal agency.

With respect to the possible removal experiments, there are no foreseeable direct or indirect effects from any of the alternatives that create any pollution or other deleterious environmental justice effects. Therefore, the removal experiments do not raise concerns about environmental injustice.

3.6.3.3 Economic Effects

We anticipate some potential, though temporary effects on some aspects of the economy in the Northwest. These are detailed and discussed in Section 3.8 of this Final EIS.

3.7 Affected Environment and Environmental Consequences—Recreational and Visitor Use

3.7.0 Changes between Draft and Final EIS

- Added an analysis of the Preferred Alternative.

3.7.1 Background and Affected Environment

Given the expanse of the proposed study sites throughout lands in Washington, Oregon, and California, we anticipate that activities associated with the proposed action would occur within, or adjacent to, designated recreational areas or areas heavily used by visitors. The primary mechanism for effects to recreation and visitor use includes the presence of small crews on the ground and the sound of shotgun reports.

Visitor expectations relate to the immediate and physical impacts from sounds or activities that are unexpected, such as the sound of gunshots in a National Park where hunting is not allowed. Even there, gunshots are heard near the borders of the parks where the neighboring lands are open for hunting. In addition, visitors or even members of the public who have not necessarily visited an area may believe that shooting animals, even of species not historically present in the area, is contrary to the purpose or intent of a National Park or wilderness area, and therefore do not expect, or want, barred owl removal to occur there. Some visitors, on the other hand, would expect the National Park Service to be implementing conservation measures to conserve native fauna such as the spotted owl.

Since the primary effects of barred owl lethal removal on recreation and visitor use is related to the sound of shotguns, we considered whether hunting or target shooting was allowed in a study area, how likely is it for a visitor to hear gunshots, the timing or seasonality of the gunshots, and the potential for visitors to be present in the area during the removal activity. Nonlethal capture has very little potential to disturb visitors or recreationists.

We have organized our discussion around five categories, based on differences in land ownership and management: (1) National Parks, where hunting is not allowed; (2) other Federal lands (National Forests, BLM lands, and National Recreation Areas) where hunting, and often target shooting, is allowed; (3) nonfederal lands, where hunting and shooting may or may not be allowed; (4) the Hoopa Valley Indian Reservation, where tribal hunting can occur year-round; and (5) wilderness areas.

Hunting may or may not be allowed in wilderness areas, depending upon the underlying Federal management. Hunting is typically not allowed within most units of the National Park System, based on the enabling legislation for each National Park. Hunting of native and nonnative species is allowed, subject to State regulations, in areas managed by the Forest Service or BLM. Regardless of ownership of wilderness areas, visitor expectations about "wildness" may affect their view of the removal experiment in a wilderness.

The presence of small crews (two to four people) involved in surveying and removal are within the normal size of groups using all lands under consideration for this experiment, and we do not anticipate any substantial effect of their presence. We do anticipate the potential for effects on the soundscape, and through the soundscape, on some visitor's experience.

We anticipate that the sound of gunshots is more apt to disturb visitors and recreationists in areas where hunting and target shooting are prohibited than where these activities are allowed, due to changes in the soundscape. In addition, the potential disturbance due to noise associated with barred owl removal would be greater if it occurs at a time when visitors are unaccustomed to experiencing it. Because the barred owl removal would take place in the fall, winter, and spring when fewer recreational visitors are apt to be present, there would be fewer visitors who might be disturbed than if shooting occurred in the summer. Where hunting or target shooting is allowed, the addition of the limited shooting during the experiment is unlikely to change the soundscape from its baseline.

In this section, we would discuss the current conditions of the study areas. In particular, we describe whether these areas are open to hunting or shooting, and what visitor expectations are likely to be regarding the appropriateness of gunshots in the area.

3.7.1.1 National Parks

The greatest potential for effects to recreation or visitor use occurs in National Parks; therefore, we conducted a detailed review of National Park policies and processes. Three of the 21 study areas include National Parks. The Ross Lake Study Area includes North Cascades National Park, Ross Lake Recreation Area, and Lake Chelan National Recreation Area. The Olympic Peninsula Study Area includes Olympic National Park. The Rainier Study Area includes Mount Rainier National Park.

NATIONAL PARK SERVICE POLICIES. The National Park Service Management Policies (NPS 2006, entire) define the purpose of parks and the activities consistent with this purpose. Relative to the potential physical effects of this proposed experiment, the policy states that the National Park Service will preserve, to the greatest extent possible, the natural soundscapes of parks, i.e., sounds of animals and physical processes (NPS 2006, 56). The National Park Service will protect natural soundscapes from unacceptable impacts by preventing and minimizing unnatural sounds that, through frequency, magnitude, and duration, adversely affect the natural soundscape, or other park resources or values (NPS 2006, p. 56).

National Park Service policy also discusses "impairment," i.e., the National Park Service must leave resources and values unimpaired (NPS 2006, p. 11). An impact is less likely to constitute impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values (NPS 2006, p. 11). The definition of "park resources" includes wildlife and the processes and conditions that sustain them (NPS 2006, p. 11). "Unacceptable impacts," are defined as unreasonably interfering with an atmosphere of peace and tranquility or the natural soundscape (NPS 2006, p. 12). The policy also states, "The National Park Service must ensure that park uses that are allowed would not cause impairment of, or unacceptable impacts on park resources and values. When proposed park uses and the protection of park resources and values come into conflict, the protection of resources and values must be predominant" (NPS 2006, p. 13).

Research studies in National Parks are encouraged within the framework of avoiding impairment. The policy states that the National Park Service should encourage studies that will provide a scientific basis for park planning and management, among other activities (NPS 2006, p. 39). Studies involving physical impacts to park resources or removal of specimens may be permitted, but studies that will lead to the impairment of park resources and values are prohibited (NPS 2006, p. 40). Restoration is also an important focus of National Park Service policy. "[T]he National Park Service will use the best available technology to restore the biological components of these systems, accelerating their recovery…Efforts may include removal of exotic species" (NPS 2006, p. 39). Native species are defined as all species that have occurred, now occur, or may occur as a result of natural processes on lands designated as units of the National Park System. Exotic species are those that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities (NPS 2006, p. 43). Unfortunately, as described in Appendix A of this Final EIS, there is insufficient data to determine whether the range expansion of barred owls is natural or facilitated by humans.

The National Park Service relies on natural processes to maintain native animal species whenever possible, however, it may manage individuals or populations when such intervention will not cause unacceptable impacts to populations of species, and when it is necessary to protect rare, threatened, or endangered species. Removal of individuals may also occur as part of a National Park Service research project conducted by others who have been issued a scientific research permit (NPS 2006, p. 44). For any research study to occur on National Park Service lands, the National Park Service would need to issue a scientific research permit after conducting an analysis of impairment.

VISITOR USE OF NATIONAL PARKS. Visitors use National Parks for a wide variety of recreation including, but not limited to, hiking, camping, scenic viewing, bird watching, skiing, rock and mountain climbing, nature study, and photography. Some activities take visitors into the backcountry, away from roads and developed areas, where they may encounter researchers engaged in this experiment. In the Pacific Northwest, visitation is generally highest in the summer, dropping off in the fall with the start of school and inclement weather. However, visitors access portions of the parks in all seasons.

PRECEDENT FOR REMOVAL. There is much precedent for removal of species in National Parks, such as the removal of golden eagles, mule deer, and Roosevelt elk from the Channel Islands, Burmese pythons from the Everglades, mountain goats from the Olympic, feral hogs from Great Smoky Mountain, fallow and axis deer from Point Reyes National Seashore, brown-headed cowbirds from Grand Canyon and Golden Gate National Parks, to name a few. However, prior instances have generally been management activities and not research studies, as is this proposal.

3.7.1.2 Other Federal Lands

All of the 21 study areas include National Recreational Areas, BLM-managed lands, and National Forests. Hunting, and in many cases target shooting, is allowed on these lands. The National Recreation Areas within the Ross Lake Study Area, while managed by the National Park Service, are open for hunting. The Columbia River Gorge Scenic Area, a portion of which occurs within the Columbia Gorge Study Area, is under the jurisdiction of the Forest Service and hunting is allowed under State laws.

Recreational activities on these lands include a wide array from hiking and backpacking to recreational vehicle camping. Some activities take visitors away from roads and developed areas, where they may encounter researchers engaged in this experiment. Because hunting is allowed in most of these areas, the sound of shots is part of the background soundscape. This soundscape includes not only shooting, but traffic noise and many other human sounds in developed areas, and airplane noise, and in some places, all-terrain vehicles in undeveloped areas.

Hunting on all lands must be in compliance with State regulations, and generally takes place in the fall, with some hunting seasons extending into the spring. Therefore, we anticipate that the sound of gunshots may be heard in areas open to hunting in the fall and spring. As with the National Parks, we anticipate more visitor use during the warm summer weather, though the inclusion of hunters creates additional recreation in the fall.

3.7.1.3 Nonfederal Lands

All study areas contain at least some nonfederal lands (State, municipal, or private lands) which may or may not allow hunting. Some State and municipal lands, primarily State or County Parks, are managed similar to National Parks, and people do not anticipate the sound of gunshots. The remaining lands are usually open to hunting and target shooting, making the sound of gunshots part of the background soundscape.

In many study areas, where a checkerboard pattern of ownership occurs, nonfederal lands are interspersed with Federal lands that are open to hunting, so the sound of gunshots may be heard in many areas of these nonfederal lands regardless of whether or not they are open to hunting. We have no way of determining the acreage of nonfederal lands where hunting is allowed. We note that, when hunting is restricted, nonfederal landowners often restrict other recreation through posting of no trespassing signs. If these lands are closed, then there should be no recreation or visitor use, and therefore no visitors to disturb. For purposes of this discussion, we assume that all nonfederal lands are open to hunting and other recreational purposes. We also assume that recreational visitors could occur throughout these lands, although probably not to the extent they could be present on National Parks or other Federal lands.

3.7.1.4 Tribal Lands

Only one study area, the Hoopa area in California, contains tribal land, the Hoopa Valley Indian Reservation. The area is open to tribal hunting year-round, so the sound of gunshots may occur at any time. In this instance, we do not anticipate any change in the soundscape as a result of our proposed experiment.

3.7.1.5 Wilderness Areas

Wilderness areas occur on Federal lands, and are affected by the land management policies for those lands. For example, wilderness areas in National Parks are subject to the same hunting restrictions as the rest of the park. However, wilderness areas also have their own management direction. Congress designates wilderness areas on Federal lands meeting specific requirements concerning the absence of human development. Federal agencies administer wilderness areas to leave them preserved and unimpaired for future use and enjoyment as wilderness. Federal landowner agencies strive to restrain human influences in wilderness areas so that ecosystems can change over time naturally, free as much as possible from human manipulation. Roads, motor vehicles, motorized equipment or motorboats, aircraft landing, mechanical transport, or structures or installations are generally prohibited (section 4(c)). Nothing in the Wilderness Act prevents any activity for the purpose of gathering information if the activity is conducted in a manner compatible with wilderness preservation (section 4(d)(2).)

In wilderness areas, the focus is on maintaining the wildness of the landscape, and limiting active management to that necessary to maintain the wilderness nature. Under the Wilderness Act, designation is a protective overlay that Congress applies to areas of National Forests, National Parks, wildlife refuges, and other public lands intended to be consistent with the standards of the Federal management agency. Wilderness areas within National Parks, for example, are managed to a different standard than those within a National Forest. The activities common in wilderness are similar to that occurring on surrounding Federal land, except that wilderness areas are roadless and motorized use is prohibited.

Activities in National Forest wilderness area include hiking, camping, fishing and hunting. Hunting and fishing is regulated by the States. Because hunting is allowed in wilderness areas outside of National Parks, the sounds from the limited shooting during the experiment are unlikely to change the soundscape from its baseline, even though some users may not realize that these areas are open to hunting. Visitor use of wilderness areas within the study areas is probably more concentrated in the summer and early fall months than other recreation lands. Due to their roadless nature, access in inclement weather is more restricted. Hunting extends use in the fall.

WILDERNESS IN NATIONAL PARKS. All three study areas containing National Parks include wilderness areas within the parks. The National Park Service Management 2006 Policies describes how the National Park Service evaluates the appropriateness of a management activity. If a compromise between wilderness resources or character is unavoidable, only those actions that preserve wilderness character or have localized, short-term adverse impacts are acceptable. Activities will be scheduled to avoid creating adverse resource impacts or conflicts with visitor use (NPS 2006, p. 82).

The statutory purpose of wilderness includes scientific activities, and the National Park Service Management Policy (NPS 2006, pp. 82-83) encourages and permits these activities when consistent with the National Park Service responsibilities to preserve and manage wilderness. The National Park Service describes a responsibility to support scientific activities that may improve wilderness management, and recognizes that scientific activities may be critical to the long-term preservation of wilderness (NPS 2006, p. 82). In evaluating whether a scientific activity is appropriate that may involve a potential impact to wilderness resources or values (including animal welfare), the policy states that the activity should be allowed when the benefits of what can be learned outweigh the impacts on wilderness resources or values (NPS 2006, p. 82). In making the determination, the National Park Service weighs the impacts against the benefits to wilderness, and requires that the activity use the minimum tools needed to accomplish the objectives.

Wilderness management includes the principle of non-degradation. Insofar as possible, natural processes are allowed to shape and control wilderness ecosystems. Management seeks to sustain the natural distribution, numbers, population composition, and interaction of indigenous species. Intervention should only be undertaken to the extent necessary to correct past mistakes, the impacts of human use, and influences originating outside of wilderness boundaries. Management actions should be attempted only when the knowledge and tools exist to accomplish clearly articulated goals, including control of invasive alien species and management of endangered species.

WILDERNESS IN NATIONAL RECREATION AREAS, NATIONAL FORESTS, AND BLM-MANAGED LANDS. The U.S. Forest Service Manual on Recreation, Wilderness, and Related Resource Management (Forest Service Manual), Chapter 2320 Wilderness Management (U.S. Forest Service 2006, entire) describes management of wilderness in National Forests. The Forest Service manages wilderness areas to maintain and perpetuate the enduring resource of wilderness as one of the multiple uses of National Forest lands. The agency manages wilderness in a manner designed to leave ecosystems unaffected by human manipulation and influences, allowing plants and animals to develop and respond to natural forces, and minimizing the impact of human uses and activities prohibited by the Wilderness Act. It also strives to protect wilderness character and public values, including opportunities for scientific study as long as research is carried out in a manner compatible with preserving the wilderness environment. The Forest Service Manual encourages appropriate research in wilderness areas, as long as that research is conducted in such a way as to minimize adverse impacts on the wilderness resource or its users (U.S. Forest Service 2006, sec. 2323.37). The intent is to provide an environment where the forces of natural selection and survival, rather than human actions, determine which and at what population levels wildlife species exist (U.S. Forest Service 2006, sec. 2323.31). The Forest Service Manual notes the need for protecting known populations and aiding recovery of federally listed species. The Forest Service also has directions (U.S. Forest Service 2006, sec. 2323.35) to achieve a balance of wildlife and fish with their habitat through cooperation with State agencies in managing public hunting, fishing, and trapping.

3.7.2 Environmental Consequences

3.7.2.1 Effects under the No Action Alternative

Under the No Action Alternative, the proposed barred owl removal experiment would not be implemented. Since there would be no activities on the ground, there would be no effect on recreation or visitor use within or adjacent to the proposed study areas. The current management of the proposed study sites would continue to provide protection to existing recreational resources. In the absence of the experiment, barred owls would continue to increase across the range of the northern spotted owl, and spotted owls would become more rare and elusive, potentially affecting opportunities for birdwatchers to observe spotted owls. Northern spotted owls would continue to exist for some time in the southern portion of their range, and the other subspecies of spotted owls (California and Mexican) are likely to persist for even longer, providing opportunities for birdwatchers to view spotted owls in other areas.

3.7.2.2 Effects Common to All Alternatives

The barred owl removal experiment would entail the presence of one to three people at sites in the forest for 15 minutes (surveys) to a few hours (nonlethal removal). Surveys would be repeated up to six times each year, at any time of the year. All visits to a particular location would be scattered in time and space. Survey locations would be about one-quarter to one-half miles apart. Depending upon the alternative, barred owl removal would continue yearly for 3 to 10 years.

Removal efforts may involve visiting a particular point two to three times each year, primarily in the fall and winter. Removal locations are based on the presence of a territorial barred owl and are likely at least one-half mile or more apart. Lethal removal would involve firing a few (usually no more than two) shotgun shots within or adjacent to the forest. If more than one shot is required, they would usually be no more than a few minutes apart. Removal efforts on a particular site are likely to be separated in time by several days to years.

Given the nature of the proposed action (i.e., lack of ground disturbance, relative remoteness of most proposed study sites, and timing of the activity) we anticipate that the primary direct effect of the proposed action on recreational resources and visitor use is the short-term elevated sound levels resulting from the discharge of a firearm one or two times, primarily at dusk or early evening.

Some portion of each study area would be used as a control (non-removal) area, where surveys would be completed but no barred owls would be removed. For control areas, the experimental activity would include only the presence of the survey crew, and would not be substantially different than hikers or birdwatchers using the same area. Since no shooting would take place, this activity would not affect the visitor experience, and we would expect no effect on the control portion of all study areas.

Nonlethal removal would involve attracting barred owls with recorded call, catching the responding birds in nets or with other trapping devices, and transporting the captured owls to a temporary holding facility. It is unlikely that visitors would directly observe a capture, as these are usually some distance from roads and trails, transient, and may occur at dusk when most recreational users are out of the forest or settled into camps. Because the activity would not result in changes to the soundscape, we anticipate no effect in all study areas.

Lethal removal would involve attracting barred owls with recorded calls and shooting birds that respond and approach closely. This method would result in one to two shots fired during a removal visit. If both birds are not removed in a single visit, or new barred owls reoccupy the site during the removal period, additional shots may be required, though these would be separated by days or weeks from the initial removal. In areas where hunting or target shooting is not common, this may change the soundscape for recreationists or visitors in the area.

EFFECTS IN NATIONAL PARKS. For alternatives that include study areas with barred owl removal on National Park lands, we anticipate potential effects in areas open to recreational or visitor use but closed to hunting. This situation would be limited to National Parks. Because visitors would not expect to hear gunshots, especially in the interior parts of the park, the sound of gunshots could impact their recreational experience and potentially cause concern and distress for some individuals. It is also possible that some visitors may alter their plans to avoid treatment areas. We do not anticipate the experiment will require any area closures. Safety protocols would ensure that there is no danger to users. We will consider the use of “silenced” or other modifications to standard shotguns in areas of high human use and potential conflicts, though these may require special permits and/or licenses. We will discuss this with the researcher responsible for lethal removal of barred owls. However, the Service is not requiring the use of silencers or other methods/equipment to reduce firearm noise.

Because removal occurs primarily in the fall and winter, as well as at dusk or night, we anticipate fewer visitors would be exposed to the sound of gunshots than during the summer peak visitor season. Therefore, fewer visitors would be directly affected or actually hear gunshots. This still represents a potential effect on the soundscape for those visitors that are in the area.

Where alternatives include National Parks as control areas only, no removal would occur. We anticipate no effect in any area that is used only as control area.

EFFECTS ON OTHER FEDERAL LANDS. Outside of National Parks, most Federal lands are open to hunting, and in many cases target shooting. Because the sound of gunshots is not unexpected in these areas, we do not anticipate any significant effects on National Forests, BLM lands, and National Recreation Areas within study areas. In addition, we anticipate no effect from the sound of gunshots during the experiment, as the sound of barred owl removal would not be a significant change in the background noise and activity levels from hunting and target shooting.

EFFECTS ON NONFEDERAL LANDS. All study areas contain nonfederal lands that may be part of, or adjacent to, barred owl treatment areas. Where these lands are open to use (not closed to all uses), hunting is usually allowed and any users would likely be accustomed to the sound of occasional gunshots. Therefore, we expect that the experiment would have no effect on recreation or visitor use on these lands. Where hunting and trespassing is prohibited on these lands, we would also expect no effect because no recreational visitors would be present.

EFFECTS ON TRIBAL LANDS. The Hoopa (Willow Creek) Study Area is the only area that contains tribal lands. Tribal members are allowed to hunt year-round on these lands. Therefore, visitors should be acclimatized to the sound of gunshots, and we expect that the experiment would have no effect on recreation or visitor use on these lands.

EFFECTS IN WILDERNESS AREAS. We expect potential effects in wilderness areas that are closed to hunting (those within National Parks), just as we do for any treatment area within a park. Because hunting or target shooting is not allowed in these areas, the sound of gunshots could affect the visitors' experience. The potential for disturbance is greater in the interior portions of these wilderness areas where only natural sounds would prevail, and the sounds of gunshots would be outside of visitor expectations. Some visitors may alter their plans to avoid treatment areas in these wilderness areas within National Parks.

Twelve of the 21 study areas include non-park wilderness areas. Because hunting is allowed in these wilderness areas, gunshots could be heard in these areas during the fall and winter. This generally coincides with the timing of most barred owl removal, so we would expect no significant effect in terms of disturbance to recreation in these areas compared with current conditions.

In wilderness areas, the focus is on maintaining the wildness of the landscape, and policies support scientific study that is compatible with preserving the wilderness environment. While we may reduce barred owl populations to very low levels for the duration of the experiment, it is a short-term experiment and is focused on assessing our ability to manage the recently arrived barred owl as a component of an effort to maintain a historical member of the ecosystem, the northern spotted owl.

While wilderness areas are ideally managed so as to leave ecosystems unaffected by human manipulation, Federal agencies also have a responsibility to aid in the recovery of federally listed species. Policies caution that management for endangered species or of invasive species should be done only when the appropriate knowledge and tools exist. This Final EIS is for an experiment to inform future management decisions and would not involve ongoing management of barred owls. That would be a separate decision. The longest duration for barred owl removal for this experiment would be 10 years and, based on the rate of recolonization, we anticipate that barred owl populations would return to current conditions within 3 to 5 years.

Thus, on both National Park and non-park wilderness, we anticipate only a minor and temporary effect on wilderness value from the experimental removal of barred owls. We believe that the effect would be insignificant, in part, because barred owls are a nonnative species that is not yet integrated into the ecosystem. Yet it may displace a prehistorical native species in the northern spotted owl, an important part of the ecosystem. We do not anticipate any significant effect of the experiment on the "wildness" as discussed in the Wilderness Act.

3.7.2.3 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach using a combination of lethal and nonlethal removal methods on four study areas spread across the range of the northern spotted owl. The four study areas include the Cle Elum in Washington, the Oregon Coast Ranges/Veneta (half) in northern Oregon, the Union/Myrtle combined with the Klamath in southern Oregon, and the Hoopa combined with the Willow Creek in California. Removal would occur on the Cle Elum, the Oregon Coast Ranges/Veneta (half), the Union/Myrtle, and the Hoopa Study Areas, and the Klamath and Willow Creek Study Areas would be the control.

We anticipate no effect on recreational or visitor use for this alternative because barred owl removal would take place on Federal lands or Tribal lands where hunting and some target shooting already occurs. The study areas contain no National Parks or Recreation Areas. As described in Section 3.7.2.2, the sound of the occasional gunshots from the experiment would not unexpected in these areas or be significantly different than the background sounds. Therefore we do not anticipate that users will change their recreational use as a result of this experiment.

3.7.2.4 Effects under Alternative 1

Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

We anticipate the primary effect on recreational and visitor use would occur on National Park lands. These are total acres; barred owl removal would only occur on up to half of the total area (Table 3-78). Most of the study areas do not include National Park lands.

Table 3-78. Acres of lands by ownership, National Parks, and Wilderness under Alternative 1 and 2.

Study Area	Duration of Experiment	Acres of National Parks	Acres of Other Federal Lands	Acres of Nonfederal Lands	Acres of Tribal Lands	Acres of Wilderness [1]
Cle Elum	7	0	271,200	169,600	0	300
Olympic Peninsula	5	389,000	210,400	35,000	0	43,900
Rainier	6	231,900	178,000	117,100	0	228,480
Oregon Coast Ranges	4	0	509,700	329,300	0	22,223
Tyee	4	0	108,000	145,200	0	0

HJ Andrews	4	0	367,500	28,600	0	20,929
Klamath	4	0	158,700	183,200	0	0
South Cascades	4	0	549,600	34,800	0	143,336
Hoopa (Willow Creek)	5	0	60,200	7,800	90,800	0
[1] Wilderness overlays Federal lands in the study areas. These are not unique acres.						

Selecting either the Rainier or Olympic Peninsula Study Areas could have an effect on visitor expectations as barred owl removal would take place in a National Park. Selecting any of the other study areas would have no significant effect on recreational or visitor use as these Federal lands, most nonfederal lands, and the wilderness areas are all open to hunting and some target shooting. As described in Section 3.7.2.2, the sound of the occasional gunshots from the experiment would not unexpected in these areas or be significantly different than the background sounds. Therefore we do not anticipate that users will change their recreational use as a result of this experiment.

3.7.2.5 Effects under Alternative 2

Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas (Table 3-78). To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

For our analysis, we are selecting two combinations that represent a range of effects on recreational and visitor use, varying from the largest to smallest potential effect. The National Parks, where we anticipate potential effects from removal on recreational and visitor use, occur only within Washington State. Any combination of study areas that include the greatest acreage of National Park lands, Olympia Peninsula (removal on up to one-half of 389,000 acres of National Park), would represent the highest potential effect on recreational and visitor use.

Any combination of study areas that does not include the Olympic Peninsula or Rainier Study Areas would have no significant effect on recreational or visitor use as these Federal lands, most nonfederal lands, and the wilderness areas are all open to hunting. As described in Section 3.7.2.2, the sound of the occasional gunshots from the experiment would not unexpected in these areas or be significantly different than the background sounds. Therefore we do not anticipate that users will change their recreational use as a result of this experiment.

3.7.2.6 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis (Table 3-79). Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of from 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

We would expect no effect on recreational or visitor use for this alternative because the barred owl removal would take place on Federal lands where hunting and some target shooting already occurs, and the sound of gunshots would not be unexpected in these areas. These control areas are both in checkerboard Federal/nonfederal lands and have limited recreational use beyond hunting. The control areas would be adjacent to ongoing spotted owl demography study areas where the presence of surveyors would not be any different from what may now occur from visitors who are hiking or bird watching.

Table 3-79. Acres of lands by ownership, National Parks, and Wilderness under Alternative 3.

Study Area	Acres of National Park	Acres of Other Federal Lands	Acres of Nonfederal Lands	Acres of Wilderness
Veneta (Oregon Coast Ranges/Tyee)	0	79,800	113,600	0
Union/Myrtle (Klamath)	0	106,000	121,500	0

3.7.2.7 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study on the Columbia Gorge and McKenzie Study Areas (Table 3-80). Under sub-Alternative 4a pre-removal demographic data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Table 3-80. Acres of lands by ownership, National Parks, and Wilderness under Alternative 4.

Study Area	Acres of National Park	Acres of Other Federal Lands	Acres of Nonfederal Lands	Acres of Wilderness
Columbia Gorge	0	227,600	332,000	8,900
McKenzie	0	200,000	463,000	0

We would expect no effect on recreational or visitor use for this alternative because barred owl removal would take place on Federal lands where hunting and some target shooting already occurs, and the sound of gunshots would not be unexpected in these areas

3.7.2.8 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, all areas with current or recent spotted owl occupancy data (Table 3-81). Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Table 3-81. Acres of lands by ownership, National Parks, and Wilderness under Alternative 5.

Study Area	Acres of National Parks	Acres of Other Federal Lands	Acres of Nonfederal Lands	Acres of Wilderness
Cowlitz Valley	0	528,100	5,100	104,824
Veneta (Oregon Coast Ranges/ Tyee)	0	79,800	113,600	0
Union/Myrtle (Klamath)	0	106,000	121,500	0

We would expect no effect on recreational or visitor use for this alternative because the barred owl removal would take place on Federal lands where hunting and some target shooting already occurs, and the sound of gunshots would not be unexpected in these areas.

3.7.2.9 Effects under Alternative 6

Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas (Table 3-82). Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods.

Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

We would expect no effect on recreational or visitor use for this alternative because the barred owl removal would take place on Federal lands where hunting and some target shooting already occurs, and the sound of gunshots would not be unexpected in these areas. There would be no effect on the Olympia National Park, which would be part of the control area paired with the Olympia Revised Study Area. The presence of a survey crew in Olympic National Park would have no effect on visitors as it would not be any different from hikers or bird watching activities currently taking place in the area.

Table 3-82. Acres of lands by ownership, National Parks, and Wilderness under Alternative 6.

Study Area	Acres of National Park	Acres of Other Federal Lands	Acres of Nonfederal	Acres of Wilderness outside National Parks
Olympic Revised (Olympic Peninsula)	0	225,900	1,100	32,277
McKenzie	0	200,000	463,000	0
Horse/Beaver	0	314,700	45,300	16,615

3.7.2.10 Effects under Alternative 7

Alternative7 involves a combination of demography and occupancy studies on 11 study areas across the range of the northern spotted owl (Table 3-83). Barred owl removal would last from 3 to 10 years, depending on the study area and type of study. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

We anticipate that use of the Ross Lake and Rainier Study Areas could have a potential effect on visitor use as barred owl removal would take place in a National Park where hunting is not allowed. We anticipate that using any of the other study areas for barred owl removal would result in no effect on recreational or visitor use as hunting and some target shooting is allowed in these areas.

The control (non-removal) areas for the Olympic Revised Study Area would include Olympic National Park. We anticipate no effect on recreational or visitor use from activities taking place in the control areas, as the presence of a survey crew would be equivalent to hikers or birdwatchers, and unlikely to disturb visitors using the area.

Table 3-83. Acres of lands by ownership, National Parks, and Wilderness under Alternative 7.

Study Area	Duration of Experiment	Acres of National Park	Acres of Other Federal Lands	Acres of Nonfederal Lands	Acres of Tribal Lands	Acres of Wilderness
Ross Lake	10	484,800	380,500	19,100	0	117,521
Wenatchee	3	0	837,700	67,400	0	314,008
Olympic Revised (Olympic Peninsula)	4	0	225,900	1,100	0	32,277
Rainier	6	231,900	178,000	117,100	0	228,480
HJ Andrews	4	0	367,500	28,600	0	20,929
Veneta (Oregon Coast Ranges/Tyee)	10	0	79,800	113,600	0	0
Rogue Cascades (South Cascades)	4	0	169,400	221,700	0	0
Horse/Beaver	4	0	314,700	45,300	0	16,615
Goosenest	10	0	36,300	12,700	0	0
Hoopa (Willow Creek)	10	0	60,200	7,800	90,800	0
Corral	10	0	77,300	7,300	0	0

3.8 Affected Environment and Environmental Consequences—Economics

3.8.0 Changes between Draft and Final EIS

- Added an analysis of the Preferred Alternative.
- Revised the discussion of the analysis approach.

3.8.1 Background and Affected Environment

The economy in the Pacific Northwest has continued to change over time. European settlers arriving in the area quickly established sea ports and river towns to service a commodity economy focused on farming, fishing, mining, and timber harvesting. This process intensified during and after World War II (1941 to 1945), driven by the increased demand for resources and industrial mechanization. Many small- to medium-sized industries were established near the resource sites, usually in rural areas, often followed by the establishment of nearby communities. In the 1950s, urban centers comprised 58 percent of the population. Investments and profits from these natural resource-based industries helped the regional economy grow, with booms occurring from 1910 to 1930 and again from 1950 to 1960 (USDA and USDI 1994a, p. 3&4-262). In the 1980s and 1990s, the region began a transition from this commodity-based economy to a more mixed economy, and its population became increasingly more urban. Currently, 80 percent of the U.S. population lives in metropolitan areas (U.S. Census Bureau 2001, p. 5).

As a result of these changes, the nature of the economic base has changed as well. Over the past few decades, for a wide array of reasons, many of these rural, natural resource-based industries have changed. Driving factors include technological innovations in the wood products industry, consolidation and globalization in the forest products industry, and changes in Federal land management. The regional economy has made the transition to more diversified goods and services, including agribusiness and viticulture, aerospace, construction, entertainment, finance, high technology, higher education, real estate development, and tourism. Forestry and other commodity industries, such as fishing and mining, play a decreasing role in the region's economy (Access Washington 2000, entire; Oregon State Archives 2000, entire; Schwantes 2000, pp. 515-522). In 2000, the census identified 1.9, 3.2, and 2.5 percent of the populations of California, Oregon, and Washington as working in agriculture, forestry, fishing and hunting, or mining occupations (U.S. Census Bureau 2002a, p. 4; 2002b, p. 4; 2002c, p.4).

While the timber industry plays a decreasing role in the regional economy, many small rural communities in western Washington, western Oregon, and northwestern California remain substantially dependent on the timber industry.

The experimental removal of barred owls is designed to test the potential efficacy of managing barred owl populations and reducing their negative impact on northern spotted owl recovery. One of the possible outcomes of implementation of this barred owl removal experiment is that spotted owls will colonize or recolonize territories where they have been absent in recent years.

This outcome is unlikely to have any effect on most aspects of the diverse economy of the Pacific Northwest, with the potential exception of two areas: recreational birdwatching and timber harvest.

The barred owl is a species of interest for birdwatchers, some of whom are known to travel long distances to see a species they have not seen before. This sort of travel can infuse large amounts of money into local economies on an annual basis for travel, lodging, food, equipment, and supplies. Barred owls would continue to be present and common in currently occupied areas, including areas directly adjacent to the treatment areas and the local communities. Therefore, we do not believe there would be any economic impacts from a reduction in barred owl bird watching opportunities resulting from the barred owl removal experiment. Spotted owls are rarer and more likely to be the focus of bird trips for birdwatchers. The increase in spotted owls on treatment areas may attract some birdwatchers, but the effect would be temporary and other areas remain for viewing spotted owls.

The presence of spotted owls can cause a change in the potential forest management of a tract of land, depending on ownership, current laws, and management direction This, in turn, may temporarily impact the economic value of the existing timber resources for the duration of the experiment. This impact is described and analyzed in detail below.

3.8.1.1 Affected Environment across the Range of the Northern Spotted Owl

The Service contracted for a study outlining the potential annual effect to timber resources from our barred owl removal experiment (Mason, Bruce, and Girard 2011, entire). They found that the average annual timber harvest within the range of the northern spotted owl in Washington, Oregon, and California is 8 billion board feet. Timber resources are harvested to varying degrees from Federal, State, county, tribal, and private, lands.

The northern spotted owl was listed in 1990 as a result of widespread loss and modification of spotted owl habitat across its entire range, and the inadequacy of existing regulatory mechanisms to conserve the species. This listing initiated the requirement under the Federal ESA to avoid take of spotted owls on all lands (section 9 of the ESA), and to conduct section 7 consultation on projects with a Federal nexus when an activity may affect the spotted owl. Washington, Oregon, and California all have Forest Practice Laws regulating the management of private forest lands around known spotted owl sites, providing varying degrees of protection for spotted owls from timber harvest. Most State forests with managed forest resources have Forest Resource Management Plans that guide timber management. Most tribal reservations also have Forest Resource Management Plans that often undergo section 7 consultation (due to a Federal nexus through Bureau of Indian Affairs). On Federal lands within the range of the spotted owl, timber management follows the standards and guides of the Northwest Forest Plan. The Northwest Forest Plan defines areas where management is geared towards development of late-successional (which includes mature and old-growth) forests, areas where timber harvest is a priority, and areas where aquatic resources are the main consideration. The Northwest Forest Plan is designed to provide for spotted owls along with hundreds of other species dependent on late-successional forests. All of these laws, regulations, and management plans were considered in evaluating the potential effect of the experiment on the economics of the local areas.

3.8.1.2 Affected Environment within the Action Area

Each of the 21 study areas is actively managed for a variety of goals, including timber harvest. Table 3-84 shows the estimated average annual harvest of all timberlands in the treatment (removal) portion of each study area, and the amount of the harvest that may come from spotted owl habitat within the treatment portion of each study area. These values are based on rotation age, and therefore represent likely regeneration harvests (e.g., clearcut). The values do not include lands where timber harvest is not part of the management scenario, such as Northwest Forest Plan Late-Successional Reserves and National Parks. This table provides a comparison of potential timber harvest between study areas.

Table 3-84. Study areas and their average annual acres of timber harvest.

Study Area	Average Annual Timber Harvest from Treatment Portion of Study Area (acres)	Average Annual Timber Harvest of Spotted Owl Habitat from Treatment Portion of Study Area (acres)
Ross Lake	12	6
Wenatchee	827	229
Cle Elum	1,460	389
Olympic Peninsula	221	58
Olympic Revised (Olympic Peninsula)	17	4
Rainier	786	144
Cowlitz Valley	499	161
Columbia Gorge	2,343	735
Oregon Coast Ranges	2,509	340
Veneta (Oregon Coast Ranges/Tyee)	1,927	196
Tyee	1,205	210
McKenzie	3,852	484
HJ Andrews	652	208
Union/Myrtle (Klamath)	2,336	842
Klamath	1,716	570
South Cascades	646	168
Rogue Cascades (South Cascades)	4,281	613
Horse/Beaver	461	97
Goosenest	104	11
Hoopa (Willow Creek)	1,402	880
Corral	81	28

3.8.2 Environmental Consequences

3.8.2.1 Effects under the No Action Alternative

Without the experimental removal of barred owls, the barred owl population would continue to increase throughout the range of the northern spotted owl. This outcome could result in a reduction in spotted owl populations and a potential concurrent reduction in the regulatory restrictions on some Pacific Northwest forest lands, in particular on nonfederal lands. This could lead to a small increase in timber harvest levels, though other factors also determine the level of harvest. This increase would likely be small from a regional perspective in the near term, and not likely to affect the volume of timber produced in the regional significantly.

3.8.2.2 Approach for Analysis of Effects for the Action Alternatives

To determine the estimated timber harvest potentially impacted for each of the eight action alternatives listed below, we first determined the potential for timber harvest effects from the experimental removal by ownership and management designation. Because different land owners or managers are affected by different laws and regulations, and have different management goals and requirements, we broke the lands into six categories: Federal reserved, Federal non-reserved, tribal, State, industrial private forest, and nonindustrial private forest lands.

Timber harvest on Federal lands is conducted under the provisions of the Northwest Forest Plan (land use allocations and management direction) and Federal laws and regulations. Under section 7 of the ESA, Federal agencies are required to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species . . . . and " . . . in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species . . . . ". 16 U.S.C. §§ 1536(a)(1)&(2). If, after consultation, it is determined that such federal action is not likely to jeopardize the listed species, they may receive an incidental take statement, compliance with which provides an exemption from the prohibition on take discussed below." 16 U.S.C. § 1536(o).

Section 9 of the ESA makes it unlawful for any person, including State and Federal agencies, companies, and private landowners to " . . . take any such [endangered] species within the United States or the territorial sea of the United States;" 16 U.S.C. § 1538(a). Take is defined as ". . . The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." 16 U.S.C. § 1532(19). Harm is defined by regulation as ". . . an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." ." 50 C.F.R. § 17.3. By regulation, the ESA's prohibition on "take" of endangered species also applies to species listed as threatened, unless a special rule has been promulgated. 50 C.F.R. § 17.31. However, nonfederal entities may apply for a permit to take listed species incidental to an otherwise lawful activity pursuant to section 10 of the ESA. 16 U.S.C. § 1539(a).

State laws and regulations vary across the range of the northern spotted owl. We address the specific effects of the regulations related to spotted owls and timber harvest below.

3.8.2.2.1 Land Ownership and Management Designation

FEDERAL RESERVED LANDS. These include National Parks, Wilderness Areas, National Recreation Areas, and lands designated as late-successional reserves or other mapped reserves under the Northwest Forest Plan. As these lands have no scheduled timber harvest, we anticipate no effect from any potential increase in occupied spotted owl sites as a result of experimental removal of barred owls on the treatment areas.

FEDERAL NONRESERVED LANDS. These include lands managed, at least in part, for timber production. The Federal agencies involved in these study areas manage large areas of land within, and in the vicinity of, the study areas. Therefore, it is likely that, in many cases, the Federal agencies can and would relocate or modify timber harvests to avoid removing habitat for known or new spotted owl sites that may show up on the treatment areas as a result of this experiment. Relocation or modification would be consistent with Recovery Action 10 in the Revised Recovery Plan. This effect is also likely temporary, as we anticipate barred and spotted owl populations would return to baseline conditions within 3 to 5 years of the end of the experiment, so the total potential for economic effect would run from between 6 and 15 years.

In the event that the Federal agencies are unable to avoid a new or reoccupied spotted owl site, there are still options that likely allow them to meet their timber sale goals. Any timber sale that includes a spotted owl site, or even spotted owl habitat, may require a consultation with the Service under section 7 of the ESA. During the consultation process, the Service biologists assess whether the project as proposed is likely to jeopardize the existence of listed species or destroy or adversely modify its critical habitat (as those terms are used in section 7); those that are not likely to jeopardize the species' existence and do not destroy or adversely modify its critical habitat may proceed, sometimes with minor modifications to minimize impacts to those species. We have a long history of working out issues during the consultation process and do not expect this to change on the study areas.

Therefore, based on the above, we anticipate little to no temporary timber harvest effects from the experimental removal of barred owls on non-reserved Federal lands within the study areas.

TRIBAL LANDS. The only tribal land included in any study area is the Hoopa Valley Indian Reservation portion of the Hoopa (Willow Creek) Study Area. This would be the treatment portion of this study area; therefore, new or reoccupied spotted owl sites would be expected. The Hoopa Valley Tribe has a forest resources management plan that provides management direction for a subset of the known spotted owl sites on their reservation. These sites are managed for spotted owls, as well as other late-successional associated species such as American marten and pileated woodpeckers. The Service's section 7 consultation on the Hoopa Tribal Forest Management Plan approved take for all other spotted owls at sites that are not managed for spotted owls and other species. The reoccupancy of currently vacant sites by spotted owls would not impact the timber management program. Therefore, we anticipate no timber harvest effects of the experimental removal of barred owls on tribal land.

STATE LANDS. Washington State lands (managed by the Department of Natural Resources) within the study areas are covered by a habitat conservation plan. Based on the provisions of the habitat conservation plan, the State would not need to modify their timber management if new spotted owl sites develop or spotted owls reoccupy currently vacant sites as a result of the experimental removal of barred owls. Therefore, we anticipate no timber harvest effects from the experimental removal of barred owls on Washington State lands.

California State lands are managed under a State law that mandates the management of known spotted owl sites in a manner that is effectively similar whether the known site is currently occupied or not. All spotted owl sites that would likely be reoccupied as a result of the experimental removal of barred owls are already managed as if occupied. Therefore, we anticipate no timber harvest effects from the experimental removal of barred owls on California State lands.

Conversely, Oregon State lands within the study areas have no habitat conservation plan that allows for take of spotted owls or any State laws or regulations that would protect known and newly occupied sites at a level consistent with Federal law. Therefore, there is some potential for timber harvest on Oregon State lands within the study area to be temporarily affected by the experimental removal of barred owls and reoccupation by spotted owls.

PRIVATE LANDS (INDUSTRIAL AND NONINDUSTRIAL). In addition to the Federal ESA prohibition against taking northern spotted owls, Washington, Oregon, and California all have forest practices laws regulating timber management activities on private lands where northern spotted owls occur or have been known to occur.

In Washington and California, these laws mandate the management of known northern spotted owl sites in a manner that is effectively similar whether the site is currently occupied or not. All spotted owl sites that would likely be reoccupied as a result of the experimental removal of barred owls are already managed as if occupied.

In Washington, known spotted owl sites can be declared abandoned by a three-party board, but application of this process has been, and is expected to continue to be, rare. Absent a determination that a spotted owl site is abandoned, that site continues to be managed for the benefit of spotted owls much as it would if it were occupied.

In California there is also a northern spotted owl site abandonment review process conducted in cooperation with the Department of Forestry and Fire Protection and the Service. Sites determined to be abandoned, however, are those in which the habitat would not likely support spotted owls due to changes in habitat conditions, such as fire or historical timber harvest impacts. This doesn't include sites where spotted owls have been replaced by barred owls but where habitat conditions have not been degraded because those sites may still be important for spotted owls in the near-term. Therefore, sites with sufficient habitat to support spotted owls typically retain regulatory provisions for spotted owl management regardless of whether the site is currently unoccupied. Because this regulatory provision results in no change in timber management requirements if spotted owls reoccupy a site, timber harvest impacts on private lands in California and Washington have been subtracted in their entirety.

Based on State laws, we anticipate no timber harvest effects from the experimental removal of barred owls on private lands in Washington and California.

Oregon State law is less stringent than that in Washington and California. Protection is limited to 70 acres of the best habitat around occupied spotted owl site centers. This protects only about 5 to 7 percent of the habitat used by a pair of spotted owls. Habitat outside the 70 acre core is not protected under state law. Once spotted owls abandon a site, this 70 acre core is no longer protected from timber harvest. If spotted owls do reclaim territories that have been abandoned in the past, the 70 acre core requirement would be re-applied and could potentially affect harvest of some timber that is currently unencumbered until the experiment ends and the barred owls reestablish their dominance in the area. Therefore, timber harvest on Oregon State and private lands within the study area may be temporarily affected by the experimental removal of barred owls. None of these lands within our study areas in Oregon are covered under a habitat conservation plan or other Federal permit process that would allow for the take of spotted owls. Therefore, section 9 prohibitions against the take of northern spotted owls apply to all lands.

Based on the above analysis, we anticipate no effect on timber harvest on any Federal, tribal, State, or private lands in Washington and California. We anticipate some potential, though temporary, effects on State and private lands in Oregon.

3.8.2.2.2 Analysis approach

Timber harvest may be affected if it involves harvesting spotted owl habitat on State or private lands in Oregon. Harvest on Federal lands and in Washington and California are not likely to be affected for the reasons described above.

To estimate the potential economic effect, we used available data on the percentage of known spotted owl sites that are currently unoccupied and the estimated annual timber harvest acres by ownership category in the study areas (Table 3-85).

To determine the potential effect on timber harvest we used a worst case approach, assuming that any spotted owl habitat on State and private lands could be immediately repopulated by spotted owls and affected by the 70 acre core rule, and therefore be unavailable for harvest for the duration of the experiment and until barred owl populations returned to pre-removal levels. See below for discussion on why these are worst case assumptions.

The economic effects of the alternatives to timber harvest are analyzed in terms of the annual and total acres of spotted owl habitat that would potentially be harvested in the absence of the barred owl removal experiment, but that could be encumbered in the advent that spotted owls reoccupy the sites. This assessment accounts for the number of currently occupied sites on each study area (as these would remain with or without the experimental removal of barred owls).

Table 3-85. Estimated average annual timber harvest of spotted owl habitat from State and private lands on the treatment portion of study areas in Oregon and percentage of spotted owl sites that are currently unoccupied.

Study Area	Estimated Average Annual Timber Harvest [1] (acres)	Estimated Percent of Unoccupied Spotted Owl Sites	Maximum Estimated Annual Timber Harvest Effected (acres)
Oregon Coast Ranges	340	59	201
Veneta	196	59	116
Tyee	210	38	80
McKenzie	484	90	436
HJ Andrews	208	41	85
Union/Myrtle	842	35	295
Klamath	570	35	200
South Cascades	168	54	91
Rogue Cascades	306	54	165
Horse/Beaver	4	54	2
Oregon Coast Ranges and Veneta (half)	438	54	236

[1] This represents the estimated average annual timber harvest of spotted owl habitat on State and private lands within the treatment portion of the study area.

The annual acres of timber harvest potentially affected are the total acres of spotted owl habitat in the study area multiplied by the percent of unoccupied spotted owl habitat (sites). The effect of the currently occupied sites is not affected by the experiment.

To determine the maximum total acres of timber harvest potentially affected, we multiply the annual acres of spotted owl habitat that might be harvested by the number of years spotted owls may remain on the newly occupied sites. We anticipate a return to the baseline condition for barred owl populations, with a commensurate reduction in spotted owl site occupancy, within 3 to 5 years of completion of the experiment. For this analysis we assume 3 years as this was the estimate associated with the most extensive data. This is estimated based on one-third of the sites being reoccupied by barred owls in each year, leaving two-thirds of the sites occupied by spotted owls in the first year after removal ceases, one-third the following year, and none in year 3. Thus, effects of the action alternatives are temporary, lasting for between 6 and 13 years, depending on the implemented alternative.

This analysis represents a worst case analysis, and likely considerably overestimates the economic impacts, for several reasons:

- We assume that all currently unoccupied spotted owl sites will become occupied by spotted owls immediately upon our removal of the territorial barred owls. The actual reoccupancy is likely to occur on only a portion of the potential sites because barred owls will likely reoccupy some sites and there may not be enough spotted owls in the immediate area to reoccupy all sites.

- We assume that any spotted owl habitat on State and private lands could be immediately affected by the 70 acre core rule. However, the 70 acre core represents a very small portion of the spotted owl's territory (approximately 5 to 7 percent). Even if all sites were reoccupied by spotted owls, most acres of currently unoccupied spotted owl habitat would probably not be part any new 70 acre core.
- State and large private industrial timber landowners may also be able to maintain their timber harvest levels while avoiding newly occupied or reoccupied spotted owl sites for the limited duration of this experiment by shifting the location of harvests that do fall within a 70 acre core. We do not attempt to account for this in our analysis.
- In the removal areas, the Service will explore the potential for Safe Harbor Agreements with nonfederal landowners willing to cooperate with the experiment. Safe Harbor Agreements are voluntary agreements under which landowners manage for listed species and their habitats with an assurance that they may later return their lands to the baseline condition without regulatory ESA restrictions. This could reduce the impacts of this experiment on timber harvest to a very low or no effect by providing management flexibility. However, as these are voluntary on the part of the landowner, and each is developed relative to the specific conditions of the area, we did not attempt to assume any specific reduction in the maximum potential effect.

Thus, the maximum potential timber harvest effect on State and private lands in Oregon may actually vary from none (if one or more of the above bullets apply) to our maximum estimated effects as analyzed by each alternative below.

3.8.2.3 Effects under the Preferred Alternative

The Preferred Alternative involves a demographic experiment using a combination of lethal and nonlethal removal methods on four study areas spread across the range of the northern spotted owl. The four study areas include the Cle Elum Study Area in Washington, one-half of the combined Oregon Coast Ranges and Veneta Study Area in northern Oregon, the Union/Myrtle (Klamath) Study Areain southern Oregon, and the Hoopa (Willow Creek) Study Area in California. Removal would occur on up to one-half of the Cle Elum Study Area, one-quarter of the combined Oregon Coast Ranges and Veneta Study Area, the Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area, and the Hoopa portion of the Hoopa (Willow Creek) Study Area. Barred owl removal would occur for an estimated 4 years.

The potential economic effect of the Preferred Alternative is up to the value of the timber on the 2,400 acres for 4 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. This effect would be temporary and the acres would likely be available for harvest within 3 years after cessation of barred owl removal even if affected during the experiment.

3.8.2.4 Effects under Alternative 1

Alternative 1 involves a demographic study approach on one of the nine ongoing spotted owl demographic study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Table 3-86 displays the estimated maximum potential acres of timberland affected by study area. Due to State law and habitat conservation plans, there is no effect on timber harvest of this alternative in Washington and California. For Oregon study areas, the potential economic effect is up to the value of the timber on the lands in Table 3-86, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. This effect would be temporary, and the acres would likely be available for harvest within 3 years cessation of barred owl removal, even if affected during the experiment.

Table 3-86. Alternative 1; potential study areas, length of experiment and maximum acres of timberland potentially affected.

Study Area	Years of Removal	Maximum Acres Potentially Affected
Cle Elum	7	0
Olympic Peninsula	5	0
Rainier	6	0
Oregon Coast Ranges	4	880
Tyee	4	370
HJ Andrews	4	75
Klamath	4	895
South Cascades	4	135
Hoopa (Willow Creek)	5	0

3.8.2.5 Effects under Alternative 2

Alternative 2 involves a demographic study approach on three of the nine ongoing spotted owl demographic study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Of the 27 potential combinations of study areas that meet the distribution requirements of this alternative, the three study areas with the largest potential effect on timber harvest are any combination that includes the Oregon Coast Ranges and Klamath Study Areas. The potential economic effect is up to the value of the timber on the 1,775 acres over the 4 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. The combination of study areas with the least effect is the Rainier, Tyee, and Hoopa (Willow Creek) Study Areas. The potential effect is between zero and the value of the timber on the 370 acres in the Oregon portion of this alternative (Tyee Study Area) over the 4 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. In both cases this effect would be temporary, and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

3.8.2.6 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of from 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The potential effect is up to the value of the timber on the 1,515 acres for the 4 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. This effect would be temporary and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

3.8.2.7 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a pre-removal demographic data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The potential economic effect of sub-Alternative 4a is up to the value of the timber on the 2,106 acres for the 5 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. The potential economic effect of sub-Alternative 4b is up to the value of the timber on the 2,457 acres for the 6 years of the treatment (removal) component of the experiment, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. In both cases, this effect would be temporary and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

3.8.2.8 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The potential effect of Alternative 5, Option 1 is up to the value of the timber on the 1,212 acres for the 3 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. The potential economic effect of Alternative 5, Option 2 is up to the value of the timber on the 1,818 acres for the 5 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. In both cases, this effect would be temporary and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

3.8.2.9 Effects under Alternative 6

Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The potential economic effect of sub-Alternative 6a is up to the value of the timber on the 2,109 acres for the 3 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. The potential economic effect of sub-Alternative 6b is up to the value of the timber on the 2,812 acres for the 4 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. In both cases, this effect would be temporary and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

3.8.2.10 Effects under Alternative 7

Alternative7 involves a combination of demographic and occupancy studies on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of experiment. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The potential economic effect is up to the value of the timber on the 2,893 acres for the 3 to 10 years of barred owl removal and 3 years for recovery of the barred owl population, depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. This effect would be temporary, and the acres would likely be available for harvest within 3 years after cessation of barred owl removal, even if affected during the experiment.

As previously stated, the above costs are an estimate of annual potential effects, which allows for a comparison of each of the alternatives. However, amounts of actual acres and timber harvest affected by spotted owls returning to the study areas cannot be quantified at this time.

3.9 Affected Environment and Environmental Consequences—Estimated Costs of Barred Owl Removal

3.9.0 Changes between Draft and Final EIS

- Revised the cost analysis approach to clarify that the ongoing spotted owl demography study surveys are not part of this study and are therefore not part of the cost of the study. While we will make use of data on spotted owl populations from these studies, they are not part of this removal experiment.
- Added substantial detail on the process used to estimate costs by alternative. This includes a change in the cost of spotted owl surveys and barred owl removal.
- Added analysis of the effect of the Preferred Alternative.

3.9.1 Background and Affected Environment

Any barred owl removal experiment has three components: surveys for spotted owls, surveys for barred owls, and actual removal of barred owls on the treatment portion of the study area. Spotted owl surveys have been conducted for over 2 decades, the process is well established, and we have estimates of annual costs from ongoing spotted owl demography studies. Barred owl survey protocols have been developed, and while some intensive barred owl surveys have been conducted, these are recent efforts. We lack extensive, region-wide data on the annual costs of barred owl surveys. Barred owl removal has been conducted on only two areas: on the Green Diamond Resource study area in northern California and in British Columbia. Neither of these removal efforts is directly comparable to the experiment proposed in this Final EIS, and we lack specific cost data for these studies. Therefore, we estimate the cost of each alternative using a comparison to the effort required for spotted owl surveys, using the following approaches.

3.9.1.1 Spotted Owl Surveys

3.9.1.1.1 Cost Analysis

We have annual experimental costs for seven ongoing spotted owl demography study areas (Table 3-87). These areas vary in size, number of spotted owls tracked, and accessibility.

It is important to note that these studies are part of a separate program, funded by the Federal agencies or others for monitoring the effect of land management on spotted owl populations. While we will make use of data from these studies, they are not part of the removal experiment or this action. We anticipate that they will continue to be funded with or without the removal experiment, and continue to operate as directed by the funding agencies or groups, independent of the removal experiment. In the event that the funding agencies or groups decide to cease data collection for a spotted owl demography study area on which we are conducting a removal experiment we would seek additional funding to continue the spotted owl demographic surveys for the duration of the removal experiment. We included the cost of ongoing spotted owl demography studies in the total cost calculations for the Draft EIS to allow comparison of the entire cost of gathering the information between the alternatives. We have corrected this in the Final EIS, showing the costs required to implement the removal experiment, and do not include the cost of ongoing demography studies. We have included the information on the cost of the ongoing demography studies separately to assist with comparisons of the experimental costs.

To estimate costs for study areas without data from ongoing demography studies we calculated the weighted average annual cost per spotted owl site for an ongoing spotted owl demography study areas: approximately $1,500 per site surveyed. This is the base information used in the remainder of our calculations.

Table 3-87. Data used to estimate the cost of spotted owl surveys per site surveyed.

Study Area	Annual Costs	Number of Spotted Owl Sites Surveyed in Demography Study	Cost per Spotted Owl Site	Weighted Average Cost per Spotted Owl Site (for Total Only)
Cle Elum	130,000	173	1,913	
Olympic Peninsula	194,000	160	1,056	
Oregon Coast Ranges	331,000	78	1,666	
Tyee	169,000	99	1,959	
HJ Andrews	227,000	167	1,359	
South Cascades	224,000	169	1,325	
Total	1,275,000	846		1,507
Hoopa [1]	180,000	55	3,272	

[1] Costs on the Hoopa study area are substantially different from the other demographic survey study areas. This may reflect different costs included in the total, and not necessarily differences in actual survey costs. We did not include this information in our weighted average cost per site surveyed.

3.9.1.1.2 Methodology for Estimating Cost of Each Alternative

For the Preferred Alternative, our estimates of cost combine elements of the Alternatives 2 and 3 cost analyses described below. For the Cle Elum and Hoopa (Willow Creek) Study Areas, spotted owl surveys are borne completely by the ongoing spotted owl demography study areas. For the combined Oregon Coast Ranges/Veneta (half) Study Area and Union/Myrtle (Klamath) Study Area, we use the approach described for Alternative 3 below.

For Alternatives 1 and 2, the costs of spotted owl surveys are borne by the ongoing spotted owl demography studies and are not part of the cost of this experiment.

For the portions of the study area in Alternative 3 without ongoing spotted owl demography studies but where surveys include known spotted owl sites and banded spotted owls we estimate the annual cost of spotted owl demographic surveys by multiplying the weighted average cost per spotted owl site by the estimated number of sites on the portion of the study area not included in ongoing spotted owl demography studies to estimate annual costs for spotted owl surveys. Because we will need to survey potential sites whether or not they are currently occupied by spotted owls, we use the estimated number of spotted owl sites, not the number of currently occupied sites.

Alternative 4 involves a demography study approach, where study areas are without complete and current data on the location of spotted owls and we lack a completely banded spotted owl population. In this case, we anticipate the need for added effort in the first 2 years to locate and band spotted owls. Therefore, the cost for year 1 is estimated at twice the cost of ongoing surveys on a per estimated site basis. We anticipate some additional work in year 2 to complete location and banding of spotted owls, so we multiply the estimated number of sites by 1.5. All subsequent years are calculated by multiplying the cost per site by the estimated number of sites on the study area.

Alternative 5, Option 1 involves a simple occupancy study approach on a single study area with recent data on spotted owl locations. Simple occupancy surveys are less complex and time consuming than demographic surveys because they do not require any visual location or banding of spotted owls. For simple occupancy annual survey costs we anticipate this will take approximately half the effort of a demographic survey, so we multiply one-half the cost per site for demography studies by the estimated number of spotted owl sites.

Alternative 5, Option 2 involves tracking both occupancy and reproductive success. Tracking of reproductive success requires daytime walks into sites to determine reproductive status or number of young. This effort is similar to ongoing spotted owl demography study efforts, so we anticipate this effort will cost the same as demography studies of similar size and situation.

Under Alternative 6 we lack current spotted owl location information on the study areas for this occupancy experiment. To initiate this experiment under these conditions requires an initial increased effort, similar in effort in a demography experiment. We estimated the costs for year 1 by multiplying the cost per site by the estimated number of sites on the study area. For year 2 and beyond, we revert to the simple occupancy calculation of annual survey costs on study areas equals one-half the cost per site for demography studies multiplied by the estimated number of spotted owl sites.

For Alternative 7, we calculated the cost of each study area separately and combined them as appropriate (Table 3-88). We used the type of analysis approach that fit the level of pre-treatment information and the experiment type.

Table 3-88. Analysis method used to determine cost of spotted owl surveys for each study area in Alternative 7.

Alternative 7 Study Areas	Type of Study [1]	Method Used to Estimate Cost (Based on Other Alternative Approaches)
Ross Lake	OS	Alternative 5, Option 2
Wenatchee	OS	Alternative 5, Option 2
Olympic revised (Olympic Peninsula)	OS	Alternative 5, Option 2
Rainier	D	Alternative 1
Veneta (Oregon Coast Ranges/Tyee)	D	Alternative 3
HJ Andrews	D	Alternative 1
Rogue Cascades(South Cascades)	OS	Alternative 3
Horse/Beaver	OS	Alternative 5, Option 2
Goosenest	OS	Alternative 5, Option 2
Hoopa (Willow Creek)	D	Alternative 1
Corral	OS	Alternative 5, Option 2

[1] Experiment Type: OS = occupancy experiment, D = demography experiment.

3.9.1.2 Barred Owl Surveys

For this analysis, we assume that barred owl surveys would be conducted separately from spotted owl surveys. Surveys to locate barred owl sites are similar to spotted owl simple occupancy studies, and no banding or reproductive surveys are required. To use the information we have on the cost of spotted owl surveys to estimate barred owl survey costs, we compared the requirements and effort of barred owl versus spotted owl surveys.

Number of sites in an area: Barred owls occupy smaller territories than spotted owls, at a ratio of up to four barred owl territories per spotted owl territory. While it should take about one-quarter of the time to survey a barred owl territory compared to a spotted owl territory, there would be up to four times as many potential territories to survey. Thus, for a particular area, the time required to cover the area is the same for spotted and barred owls.

Barred owl population density: Barred owl surveys would need to cover all potentially suitable habitat for barred owls, whether or not it is known to be occupied by the species. The cost does not differ based on the current barred owl population level. Current barred owl population levels in some areas are not at carrying capacity and habitat is not fully occupied, but these areas would still have to be surveyed annually to detect new barred owls. Therefore, we cannot simply use the number of estimated barred owl sites to calculate survey costs as we did with spotted owls.

Ideally we would calculate the cost based on the amount and distribution of barred owl habitat within the study area. Unfortunately, we do not have accurate maps or analyses of barred owl habitat. We used the information we have on spotted owl habitat to estimate the cost for barred owl surveys on the same area. Because barred owls may use some habitats not suitable for spotted owls, using spotted owl habitat may slightly underestimate the available barred owl habitat. However, based on the interspersion of forest types, long distance carrying of the vocalizations from surveys, and the intensive survey efforts, we believe that most of the habitat will be covered in these survey efforts. Thus we chose to use the estimated cost of spotted owl surveys, a value based only on the presence of suitable spotted owl habitat, to estimate barred owl costs.

Number of survey visits: The existing barred owl survey protocol requires only three visits per year compared with up to six for spotted owl surveys. Thus, the cost of barred owl surveys would be approximately one-half the cost of spotted owl demographic surveys for the same area.

In the case of barred owls, we also gain efficiency from the fact that some barred owls are likely to respond to spotted owl surveys and therefore can be located without supplemental barred owl surveys. For this analysis, we assume one-third of the barred owl sites would be found during spotted owl surveys. Once the barred owls are located, these areas would not require specific barred owl surveys. As described above, barred owl surveys require about half the effort of spotted owl demographic surveys for an area. Thus, we estimate that the cost of barred owl surveys is one-half of the two-thirds of the estimated surveys for the area, or 0.33 times the cost of spotted owl demographic surveys for a similar area.

In spotted owl surveys, initial surveys provide information that increases the efficiency of later surveys. In the case of barred owls on the treatment (removal) portion of the study area, we would be removing barred owls so we would need to survey all areas each year, looking for barred owl recolonization. After the first year, surveys on the control (non-removal) portion of the study area may be more efficient due to an increase in known barred owl sites. We do not have sufficient information to estimate how this might change the survey effort. Thus, our estimate for the control area may be somewhat higher than actual costs.

3.9.1.3 Barred Owl Removal

As with barred owl surveys, we have limited information to allow us to estimate the actual cost of removing barred owls. Barred owl removal has been conducted on only two areas to date; the Green Diamond Resource study area in northern California and British Columbia. Neither of these removal efforts is directly comparable to the experiment proposed in this Final EIS, and we lack specific cost data for these studies. Therefore, we again use the spotted owl demographic survey cost data and a comparison of the required effort to develop a cost estimate per barred owl removed.

Removal of barred owls would only occur on the treatment (removal) portion of each study area. We started by estimating the probable number of barred owls on each study area. (See Section 3.2.1.2 and Appendix F of this Final EIS for a description of the process). Because barred owls would be removed from only up to one-half of the study area, estimated number of barred owls on the removal portion of the experiment.

Based on discussions with barred owl researchers currently involved in barred owl removals, we anticipate that it will require one, or occasionally two, visits to each known barred owl site to remove the pair. As the surveys described above anticipate three visits, the cost of removing barred owls (a single visit) represents about one-third the effort required for a complete barred owl survey.

To estimate the cost of removal, we need to know the number of barred owls we anticipate removing each year. Section 3.2 of this Final EIS describes the estimated number of barred owls removed by year under each alternative. In the first year, for study areas with moderate to high barred owl populations we anticipate that most sites will be occupied by a pair of barred owls. Removal of a pair of barred owls would cost 0.33 times the cost of spotted owl surveys, thus the cost for each barred owl removed is one-half of this cost, or 0.17 times the cost of spotted owl surveys.

As removal continues and the number of sites recolonized by a pair of barred owls drops, the number of sites with only a single bird would increase, and the distance between sites would also increase. Therefore, to compensate we used a slightly higher estimate of cost per barred owl removed in the second year of removal of 0.21 times the cost of spotted owl surveys and a higher estimate for the third and later years of 0.26 times the cost of spotted owl surveys.

We described the number of barred owls removed on each study area each year in Appendix F of this Final EIS (Table F-2). Therefore, to get the cost of removal we multiplied the number of barred owls by the cost per site per year described above and totaled the values for all years of removal during the experiment.

3.9.2 Environmental Consequences

3.9.2.1 Effects under the No Action Alternative

Under the No Action Alternative, no experiment would be conducted, thus there would be no experiment costs.

3.9.2.2 Effects under the Preferred Alternative

The Preferred Alternative involves a demography study approach on four study areas. To provide for regional distribution of results, study areas were selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California).

A demography experiment would be conducted on four study areas distributed across the range of the northern spotted owl: Cle Elum, Oregon Coast Range/Veneta (half), Union/Myrtle

(Klamath), and Hoopa (Willow Creek). To ensure that this experiment represents the various conditions across the species' range, at least one study area is included from each of the three regions described in Section 2.1.2 of this Final EIS. In the southern Oregon/northwestern California region, an area of more recent barred owl invasion, we included two study areas.

In the Cle Elum Study Area (Washington) barred owl removal would occur on up to one-half of the ongoing spotted owl demography study area. The remaining portion of the Cle Elum Study Area would function as the experimental control.

The northern Oregon region is represented by the combination of the Oregon Coast Ranges Spotted Owl Demography Study Area and Veneta Study Area in the northern Oregon region. Since the combined study area is larger than necessary for this experiment, we have limited the study to one-half of this combined area. Removal would occur on up to one-half of this smaller study area, resulting in removal on up to one-quarter of the total combined study area. For the purposes of this analysis, the removal may occur anywhere on the study area, including the ongoing spotted owl demography study area.

The southern Oregon/California region is represented by two study areas, the Union/Myrtle (Klamath) and the Hoopa (Willow Creek). The Union/Myrtle portion of the Union/Myrtle (Klamath) Study Area includes long-term monitoring data that is adequate to model past spotted owl demographic performance for most sites and includes a population of banded spotted owls. Union/Myrtle will be used as the treatment (removal) portion of the study area, paired with experimental control (non-removal) areas on the Klamath spotted owl demography study area. The Hoopa (Willow Creek) Study Area would involve treatment (removal) on the Hoopa spotted owl demography study area paired with experimental control (non-removal) on the Willow Creek Spotted Owl Demography Study Area.

Given the number of spotted owl sites in the combined study areas, this alternative would involve removal of barred owls for an estimated duration of 4 years to acquire statistically significant results. We would apply a combined removal approach. The total cost for this experiment is $2,910,000 (Table 3-89).

Table 3-89. Cost of experiment implementation for Preferred Alternative.

Study Areas	Years of Barred Owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys [1]	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Cle Elum, Oregon Coast Ranges/Veneta (half), Union/Myrtle (Klamath), Hoopa (Willow Creek)	4	612	530,000	1,559	1,247,000	3,603	1,133,000	2,910,000

[1] Costs do not include spotted owl surveys conducted by ongoing spotted owl demography studies.

3.9.2.3 Effects under Alternative 1

Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

The total experiment costs range from $ 457,000 on the Tyee Study Area to $ 1,266,000 on the Oregon Coast Ranges (Table 3-90).

Table 3-90. Cost of experiment implementation for Alternative 1.

Potential Study Areas	Years of Barred Owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys [1]	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Cle Elum	7	99	0	257	353,000	943	320,000	673,000
Rainier	6	77	0	266	236,000	868	289,000	524,000
Olympic Peninsula	5	126	0	689	321,000	1,975	642,000	963,000
Oregon Coast Ranges	4	275	0	909	561,000	2,242	705,000	1,266,000
Tyee	4	141	0	219	288,000	540	170,000	457,000
HJ Andrews	4	189	0	402	386,000	992	312,000	697,000
Klamath	4	151	0	392	308,000	967	304,000	612,000
South Cascades	4	206	0	747	420,000	1,842	579,000	1,000,000
Hoopa (Willow Creek)	5	115	0	107	293,000	321	104,000	398,000

[1] Costs do not include spotted owl surveys conducted by ongoing spotted owl demography studies.

3.9.2.4 Effects under Alternative 2

Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years.

Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

To simplify this analysis, yet provide clear disclosure on the range of costs anticipated to implement Alternative 2, we include estimated costs from the three study areas meeting the distribution requirements with the highest cost, the lowest costs, and the three study areas approach developed by the Barred Owl Work Group. The costs of all 27 possible combinations of study areas fall within this range.

The total costs of the experiment ranges from $1,135,000 for the least cost study areas to $3,057,000 for the highest cost (Table 3-91).

Table 3-91. Cost of experiment implementation for Alternative 2.

Study Area Groupings	Years of Barred owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys [1]	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Highest Cost – Olympic Peninsula, Oregon Coast Ranges, South Cascades	4	607	0	2,345	1,238,000	5,748	1,819,000	3,057,000
Barred Owl Work Group – Cle Elum, Oregon Coast Ranges, Klamath	4	535	0	1,558	1,091,000	3,843	1,208,000	2,300,000
Lowest Cost – Rainier, Tyee, Hoopa (Willow Creek)	4	333	0	583	679,000	1,450	456,000	1,135,000

[1] Costs do not include spotted owl surveys conducted by ongoing spotted owl demography studies.

3.9.2.5 Effects under Alternative 3

Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. Alternative 3 has a total cost of $2,227,000 (Table 3-92).

Table 3-92. Cost of experiment implementation for Alternative 3.

Study Areas	Years of Barred Owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys [1]	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Veneta (Oregon Coast Ranges/ Tyee) and Union/Myrtle (Klamath)	4	330	982,000	914	665,000	2,003	630,000	2,277,000
[1] Costs do not include spotted owl surveys conducted by ongoing spotted owl demography studies.								

3.9.2.6 Effects under Alternative 4

Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a pre-removal demographic data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Sub-Alternative 4a has an estimated total experiment cost of $7,028,000. Sub-Alternative 4b has an estimated total experiment cost of $6,233,000 (Table 3-93).

Table 3-93. Cost of experiment implementation for Alternative 4.

Study Areas: Columbia Gorge, McKenzie	Years of Pre-Removal Surveys	Years of Barred Owl Removal	Years of Experiment	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Sub-Alt. 4a	5	5	10	265	4,969,000	768	1,351,000	2,183	708,000	7,028,000
Sub-Alt. 4b	2	6	8	265	4,174,000	768	1,0810200	2,509	978,000	6,233,000

3.9.2.7 Effects under Alternative 5

Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

A simple occupancy experiment (Option 1) on the three study areas has an estimated cost of $2,774,000. An occupancy plus reproduction experiment (Option 2) has an estimated cost of $4,246,000 (Table 3-94).

Table 3-94. Cost of experiment implementation for Alternative 5.

Study Areas: Cowlitz Valley, Veneta (Tyee/Oregon Coast Ranges), Union/Myrtle (Klamath)	Years of Barred Owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Occupancy only (Option 1)	3	499	1,263,000	1,310	763,000	2,494	747,000	2,774,000
Occupancy and reproduction (Option 2)	5	499	1,894,000	1,310	1,226,000	3,463	1,125,000	4,246,000

3.9.2.8 Effects under Alternative 6

Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years of barred owl removal for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 4 years for simple occupancy data or 6 years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods.

Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

For the purpose of this comparison, we analyzed the cost of a simple occupancy experiment. Sub-Alternative 6a has an estimated total experiment cost of $3,819,000 for simple occupancy. Sub-Alternative 6b has an estimated total experiment cost of $2,736,000 for simple occupancy (Table 3-95).

Table 3-95. Cost of experiment implementation for Alternative 6.

Study Areas: Olympic Revised (Olympic Peninsula, McKenzie, Horse/Beaver	Years of Pre-Removal Surveys	Years of Barred Owl Removal	Years of Experiment	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Sub-Alt. 6a	3	3	6	448	1,804,000	1,433	1,414,000	2,007	601,000	3,819,000
Sub-Alt. 6b	1	4	5	448	1,300,000	1,433	942,000	2,397	494,000	2,736,000

3.9.2.9 Effects under Alternative 7

Alternative 7 involves a combination of demography and occupancy studies on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of experiment. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area. The estimated total cost for the experiment would be $ 11,831,000 (Table 3-96). Given the differing durations for some of the study areas, the annual cost will also vary.

Table 3-96. Cost of experiment implementation for Alternative 7.

Alternative 7 Study Areas	Type of Study [1]	Years of Barred owl Removal	Number of Spotted Owl Sites	Total Cost ($$) for Spotted Owl Surveys [2]	Number of Barred Owl Sites	Total Cost ($$) of Barred Owl Surveys	Total Number of Barred Owls Removed	Total Cost ($$) of Barred Owl Removal	Total Experiment Costs ($$)
Ross Lake	OS	10	78	1,989,000	304	398,000	1,479	520,000	2,907,000
Wenatchee	OS	3	188	159,000	917	337,0000	1,125	354,000	849,000
Olympic revised (Olympic Peninsula)	OS	4	179	0	266	236,000	869	248,000	483,000
Rainier	D	6	77	705,000	479	288,000	991	297,000	1,209,000
Veneta (Oregon Coast Ranges/ Tyee)	D	10	88	726,000	232	449,000	1,129	397,000	1,572,000
HJ Andrews	D	4	189	0	402	386,000	992	312,000	697,000
Rogue Cascades (South Cascades)	OS	4	130	585,000	1,087	685,000	1,159	364,000	1,635,000
Horse/Beaver	OS	4	120	540,000	126	245,000	311	98,000	882,000
Goosenest	OS	10	25	225,000	14	128,000	68	24,000	376,000
Hoopa (Willow Creek)	D	10	115	0	107	586,000	545	192,000	778,000
Corral	OS	10	17	153,000	46	86,700	224	79,000	318,000
TOTAL			1,192	5,082,000	3,980	3,823,000	8,892	2,926,000	11,831,000

[1] Type of experiment: OS = occupancy experiment, D = demography experiment.
[2] Costs do not include spotted owl surveys conducted by ongoing spotted owl demography studies.

3.10 Affected Environment and Environmental Consequences—Cultural Resources

3.10.0 Changes between Draft and Final EIS

- No substantial changes.

3.10.1 Background and Affected Environment

As a Federal agency, the Service is responsible for complying with numerous laws and regulations designed to protect cultural resources. In general, the majority of these efforts focus on the protection of historic and prehistoric artifacts, structures, and landscapes through compliance with section 106 of the National Historic Preservation Act of 1966. Under section 106, the Service must determine whether a proposed action meets the definition of an undertaking that could result in changes in the character or use of historic resources (i.e., districts, sites, structures, or objects) that are eligible for listing on the National Register of Historic Places. The issuance of a Federal permit is an undertaking as defined by the National Historic Preservation Act that triggers consideration of section 106 review. However, because the proposed activities (conducting research and the experimental removal of barred owls that involves no ground disturbance) are considered to be activities of the type that have limited potential to impact significant cultural resources, the steps of section 106 do not apply.

In addition to complying with section 106, the Service is responsible for protecting and complying with the treaty rights and statutes that concern Native American tribes. This includes the American Indian Religious Freedom Act of 1978, which protects the Native American right to practice religious beliefs. As part of the ongoing commitment to government-to-government relations with Native American Tribal Governments, the Service sent a scoping letter to the members and/or tribal decision makers of Native American groups potentially affected by the proposed action. The purpose of the scoping letter was to reaffirm the Service's intention to work cooperatively with affected and interested tribes, and to seek tribal input for preparation of the Draft EIS.

During public scoping, the Confederated Tribes of the Colville Reservation (Colville Confederated Tribes) responded to the Service's request for comments. In their letter, dated January 4, 2010, they indicated their reverence for wildlife, and provided comments regarding their specific cultural values. The Colville Confederated Tribes have a long and deep spiritual connection with owls dating back 10,000 years, as evidenced by an owl's foot talisman found on the floodplain adjacent to the Marmes Rockshelter. The Marmes Rockshelter site complex is associated with the Palus Tribe, a constituent of the Colville Confederated Tribes. Owls figure significantly in legends and oral traditions. It is against tribal code to hunt or kill any owls. While there are species of owls with which the tribes have an unambiguous connection, they do not include either the spotted owl or barred owl. They do not have any specific traditions concerning either species, as the spotted owl's historical range only marginally includes the traditional territories of the Colville Confederated Tribes. Therefore, the Colville Confederated Tribes refrained from offering a specific recommendation or embracing a particular alternative, leaving those decisions to tribes with a closer relationship to the spotted owl and barred owl.

The Hoopa Valley Tribe, in a letter from Tribal Chairman Leonard Masten to Arcata Fish and Wildlife Office Field Supervisor Nancy Finley, dated June 17, 2011, provided information to the Service regarding the cultural and economic significance of barred and spotted owls to the tribe and its membership. Significant points in that correspondence include:

- Traditionally, owls have been messengers of bad news or death among some native cultures. In particular for the Hoopa Valley Tribe, the western screech-owl has strong significance as a messenger of death.
- Mida:n'-sa'a:n ("it's hoarded food lies there, it is stingy") is the name of the spotted owl or "timber owl" in the Hupa language. The species is not a prevalent feature within the Hoopa Valley Tribe's culture. However, one basket of significant age in the tribal museum is adorned with spotted owl feathers. Therefore, the species is included on the tribe's list of "Traditional Species."
- Management measures included in the Hoopa Valley Tribe's current Forest Management Plan to protect cultural resources and culturally significant species provide significant benefits to the spotted owl.
- Forest management changes outside the reservation to conserve the spotted owl have been detrimental to logging and the local economy in timber communities.
- In their letter, the Hoopa Valley Tribe encouraged the Service to move forward with the barred owl removal experiment to determine whether barred owl management can be used for spotted owl conservation into the future, to address the continued decline of the species, and reduce impacts to timber communities.

The Hoopa Valley Tribe is in support of experimental removal of barred owls, and has requested to be part of the project, for the following reasons:

- The tribe believes that the barred owl is an invasive nonnative species that may be impacting native species important to the Hupa people, including the spotted owl.
- The spotted owl continues to decline, and it is important to determine whether barred owl management can be used as a conservation tool into the future.
- The tribe believes that their forest management practices would be compatible with spotted owl conservation if it were not for the barred owl. Therefore, determining the cause and effect of the decline of spotted owls on the reservation is important to the tribe, Bureau of Indian Affairs, and the Service for determining management impacts.

Implementation of the removal experiment would require funding beyond what the Hoopa Valley Tribe currently receives from the Bureau of Indian Affairs. Therefore, in order to move forward with any removal experiment on the Hoopa Valley Indian Reservation, the tribe and the Service would have to arrange for funding for the duration of the experiment.

3.10.2 Environmental Consequences

The No Action Alternative and all action alternatives would have no direct or indirect effects on cultural resources given that no ground disturbance or potential impacts to section 106 resources would occur. In addition, under the proposed alternatives, rights reserved by Native Americans in existing treaties and statutes, and access to those areas where said rights are exercised, would remain unchanged.

Action Alternatives 1, 2, 7 and the Preferred Alternative include the Hoopa Valley Indian Reservation as a potential treatment area for barred owl removal under the experiment. These alternatives would be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

3.11 Cumulative Impacts

3.11.0 Changes between Draft and Final EIS

- No substantial changes.

3.11.1 Analysis

The Council on Environmental Quality's regulations for implementing NEPA define cumulative effects as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions" (40 CFR § 1508.7).

There are currently no new barred owl removal efforts proposed in the action areas. There have been no past barred owl removal efforts in all but one of the study areas. A few barred owls were removed from the Goosenest Study Area in 2005. There is no remaining residual effect from this removal as barred owls removed from the population were quickly replaced by barred owls.

The experiment proposed in this Final EIS is temporary, with a maximum duration of 10 years. Based on the rate at which we anticipate barred owls would reoccupy the removal portion of the study area, we estimate barred owl populations and their effects would recover to pre-removal levels within 3 to 5 years of the cessation of removal.

One of the primary purposes of the action is to provide information on the effectiveness and feasibility of barred owl removal for future barred owl management decisions. Any future decision could range from no active management of barred owls to a mix of strategies, including barred owl removal, other methods to reduce barred owl populations, or methods to change the competitive advantage of barred owls. Thus, future barred owl removal efforts are not reasonably foreseeable.

Any other additional actions that may affect barred owls are not reasonably foreseeable. Actions detrimental to barred owls are not likely to occur without a permit, given that barred owls are protected under the Migratory Bird Treaty Act, and any such actions would require a permit under this law. It is possible that other research or management projects will be initiated and will apply for a permit during the implementation of this action. However, no such proposals have been advanced at this time.

Therefore, we find that there are no cumulative effects from the barred owl removal experiment that are reasonably foreseeable.

3.12 Summary of Effects

3.12.0 Changes between Draft and Final EIS

- Added summary of effects table for the Preferred Alternative.
- Updated information on estimated number of barred owls removed, effect of removing barred owls on ongoing spotted owl demography studies, and estimated experiment costs.

3.12.1 Summary of Effects

The following tables (3-97 to 3-104) summarize the potential effects of each of the eight action alternatives on each of the resources or issues analyzed in this document. Each table summarizes the effects of an individual alternative. A brief description of the action alternative is found in the table caption. For more complete alternative descriptions, see Section 2.2 of this Final EIS.

Table 3-97. Summary of effects under the Preferred Alternative. The Preferred Alternative involves a demography study approach on four study areas with pre-treatment spotted owl demographic data. Barred owls would be removed from a portion of three ongoing spotted owl demography study areas (Cle Elum, Oregon Coast Range, Hoopa); removal on the fourth study areas would occur on an adjacent area with comparable data (Union/Myrtle). Removal on the Oregon Coast Ranges/Veneta (half) Study Area could involve some removal on the adjacent Veneta area. Barred owls would be removed from up to one-half of the study area using a combination of lethal and nonlethal methods. We estimate 4 years of barred owl removal will be needed to gather sufficient data for a statistically significant result. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Preferred Alternative Area of effect (resource or issue)	Effect of Alternative
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	Depending on the study area chosen: 1. An estimated 3,603 barred owls removed during the 4 years of barred owl removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from 1.72 percent of the habitat within the range of the northern spotted owl (an estimated 0.05 percent of the entire range of the barred owl).

Preferred Alternative Area of effect (resource or issue)	Effect of Alternative
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	Depending on the study area chosen: 1. Percent of spotted owl habitat from which barred owls would be removed is 1.72 percent. 2. Approximately 363 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. Magnitude of positive effect would vary based on current barred owl population level. Approximately 42 percent of spotted owl territories currently have barred owl detections. 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Current spotted owl site occupancy is approximately 48 percent.

Preferred Alternative	
Area of effect (resource or issue)	**Effect of Alternative**
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	Three of the study areas include some removal of barred owls on long-term, ongoing spotted owl demography study areas. One of these, the Hoopa study area, is not part of the Northwest Forest Plan Effectiveness Monitoring for the northern spotted owl. 1. Reduces sample size of spotted owls for the Cle Elum Study Area by up to 50 percent and the Oregon Coast Ranges Study Area by up to 33 percent. It would include removal on all of the Hoopa Study Area. 2. Increases variance of estimates of demographic rates for both treatment and control areas. If up to 50 percent of the Cle Elum Study Area, 33 percent of the Oregon Coast Ranges Study Area, and the entire Hoopa Study Area were used as treatment areas, the standard error (a precision measure) of the rate of population growth (lambda) for the region-wide meta-analysis would remain at 0.006. 3. Once removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). 4. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.

Preferred Alternative	
Area of effect (resource or issue)	**Effect of Alternative**
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable to impacts are those that are already threatened or endangered. Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: The treatment areas would potentially provide temporary relief from predation and competition for 15 State- or federally listed species. Marbled Murrelet Disturbance: A portion of the Cle Elum and the Union portion of the Union/Myrtle (Klamath) Study Areas lie within the inland range of the marbled murrelet. The Oregon Coast Ranges/Veneta (half) Study Area is fully within the inland range of the marbled murrelet. Some late-nesting marbled murrelets may be disturbed in the fall removal period on these areas. Removal will occur on the Hoopa portion of the Hoopa (Willow Creek) Study Area, which lies within the potential inland range of the marbled murrelet. However, extensive surveys of the Hoopa portion of the Hoopa (Willow Creek) Study Area have not verified any marbled murrelet use.
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	1. No study area including National Parks is included in this alternative. 2. These four study areas have no significant effect on recreation or visitor use as these Federal lands, nonfederal lands, and wilderness areas are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.

Preferred Alternative **Area of effect (resource or issue)**	**Effect of Alternative**
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington and California. 2. For the Oregon study areas (Oregon Coast Ranges/Veneta (half) and Union/Myrtle (Klamath)), the potential economic effect is between zero and the value of the timber on 2,400 acres of land, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment.	Total experiment costs are estimated at $2,910,000.
3.10 Cultural Primary effect: none identified.	1. No cultural effects identified 2. The inclusion of Hoopa (Willow Creek) is the selected study area, would be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-98. Summary of effects under Alternative 1. Alternative 1 involves a demography study approach on one of the nine ongoing spotted owl demography study areas. Barred owls would be removed from up to one-half of the study area using lethal removal methods for a period of from 4 to 7 years, depending on the study area chosen. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 1	
Area of effect (resource or issue)	**Effect of Alternative**
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	Depending on the study area chosen: 1. Number of barred owls removed ranges from 321 to 2,242 over the duration of the barred owl removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from between 0.31 percent of the habitat within the range of the northern spotted owl (and estimated 0.01 percent of the entire range of the barred owl) and 1.59 percent of the habitat within the range of the northern spotted owl (an estimated 0.05 percent of the entire range of the barred owl).

Alternative 1 **Area of effect (resource or issue)**	**Effect of Alternative**
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	Depending on the study area chosen: 1. Percent of spotted owl habitat from which barred owls would be removed ranges from 0.31 percent to 1.59 percent. 2. Between 33 and 137 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level, likely being greatest where barred owl densities are low enough to have allowed some spotted owls to persist on the treatment area. The proportion of spotted owl sites with barred owl detections is highest at Oregon Coast Ranges (0.71) and lowest at South Cascades (0.18). 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Higher current site occupancy allows spotted owls to reoccupy sites from which barred owls are removed more quickly. Current spotted owl site occupancy varies from 22 percent of the sites occupied on the Olympic Peninsula Study Area to 67 percent occupancy on the Klamath Study Area.

Area of effect (resource or issue)	Alternative 1 Effect of Alternative
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	All study areas are long-term, ongoing spotted owl demography study areas. 1. Reduces sample size of spotted owls for the demography analysis on the study area by up to 50 percent. 2. Increase variance of estimates of demographic rates for both treatment and control areas. This would likely result in an increase in the standard error (precision measure) of the rate of population growth (lambda) of between 0.04 and 0.08 for individual study areas and up to 0.001 for the rangewide meta-analysis. 3. Once removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). 4. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable to impacts are those that are already threatened or endangered	Predation and Competition Reduction: Depending on the study area chosen, the treatment area would potentially provide temporary relief from predation and competition for from 4 to 13 State- or federally listed species.
Primary effect: marbled murrelet may be disturbed by the removal activities.	Marbled Murrelet Disturbance: Seven of the nine potential study areas are within the likely inland range of the marbled murrelet: Olympic Peninsula, Cle Elum, Rainier, Oregon Coast Ranges, Tyee, Klamath, and Hoopa (Willow Creek). If any of these are chosen, some late-nesting marbled murrelets may be disturbed in the fall removal period.

Alternative 1 Area of effect (resource or issue)	Effect of Alternative
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	1. Selecting one of the two potential study area including National Parks, Rainier or Olympic Peninsula could result in impacts to the visitor experience. 2. Selecting any of the other study areas would have no significant effect on recreation or visitor use as these Federal lands, nonfederal lands, and wilderness areas are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington and California. 2. For Oregon study areas (Oregon Coast Ranges, Tyee, HJ Andrews, Klamath, or South Cascades), the potential economic effect is between zero and the value of the timber on 895 acres of land, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	Experiment costs range from a total of $ 457,000 on the Tyee Study Area to $ 1,266,000 on the Oregon Coast Ranges Study Area.
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. If Hoopa (Willow Creek) is the selected study area, would be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-99. Summary of effects under Alternative 2. Alternative 2 involves a demography study approach on three of the nine ongoing spotted owl demography study areas. To provide for regional distribution of results, one study area would be selected from each of three subregions (Washington, northern Oregon, and southern Oregon/northern California). Barred owls would be removed from up to one-half of the study areas using a combination of lethal and nonlethal removal methods for a period of 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 2	
Area of effect (resource or issue)	**Effect of Alternative**
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	Depending on the study areas chosen: 1. Number of barred owls removed ranges from 1,450 to 5,784 over the duration of the removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from between 1.33 percent of the habitat within the range of the northern spotted owl (and estimated 0.04 percent of the entire range of the barred owl) and 3.90 percent of the habitat within the range of the northern spotted owl (an estimated 0.12 percent of the entire range of the barred owl).

Area of effect (resource or issue)	**Alternative 2** Effect of Alternative
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	Depending on the study areas chosen: 1. Percent of spotted owl habitat from which barred owls would be removed ranges from 1.35 percent to 3.9 percent. 2. Between 161 and 275 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level, likely being greatest where barred owl densities are low enough to have allowed some spotted owls to persist on the treatment area. The proportion of spotted owl sites with barred owl detections is highest for the Olympic Peninsula/Oregon Coast Ranges/Klamath combination (0.49) and lowest for the Rainier/Tyee/Hoopa (Willow Creek) combination (0.40). 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Higher current site occupancy allows spotted owls to reoccupy sites from which barred owls are removed more quickly. Current spotted owl site occupancy varies from 43 percent of the sites occupied on the Olympic Peninsula/Oregon Coast Ranges/Klamath areas to 52 percent occupancy for the Rainier/Tyee/Hoopa (Willow Creek) Study Areas.

Area of effect (resource or issue)	**Alternative 2** **Effect of Alternative**
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	All study areas are long-term, ongoing spotted owl demography study areas. 1. Reduces sample size of spotted owls for the demography analysis on the study area by up to 50 percent. 2. Increase variance of estimates of demographic rates for both treatment and control areas. If up to 50 percent of the three largest study areas were used as treatment areas, the standard error (a precision measurement) of the rate of population growth (lambda) for the region-wide meta-analysis would increase from 0.006 to 0.007. The 95 percent confident interval (estimate +/- 1.96*standard error) around the estimate of population growth rate (0.972) for the meta analysis without a removal experiment was 0.960 to 0.984, while the 95 percent confidence interval for Alternative 2 using the three largest study areas would be 0.958 to 0.986, indicating a very slight increase in variation. 3. Once removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). 4. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.

Area of effect (resource or issue)	**Alternative 2** Effect of Alternative
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: Depending on the study area chosen, the treatment area would potentially provide temporary relief from predation and competition for from 9 to 16 State- or federally listed species. Marbled Murrelet Disturbance: Seven of the nine potential study areas are within the likely inland range of the marbled murrelet: Olympic Peninsula, Cle Elum, Rainier, Oregon Coast Ranges, Tyee, Klamath, and Hoopa (Willow Creek). If any of these are chosen, some late-nesting marbled murrelets may be disturbed in the fall removal period.
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	1. Selecting a combination that incorporates one of the two potential study areas including National Parks, Rainier or Olympic Peninsula, could result in impacts to the visitor experience. 2. Selecting a combination that does not include National Park lands would have no significant effect on recreation or visitor use as these Federal lands, nonfederal lands, and wilderness areas are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.

Area of effect (resource or issue)	Alternative 2 Effect of Alternative
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington and California. 2. Under this alternative the potential economic effect is between zero and the value of the timber on 1,775 acres of land over the 4 years of the removal experiment, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	The total costs range from $ 1,135,000 for the three smallest study areas to $ 3,057,000 for the three largest study areas.
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. If Hoopa (Willow Creek) is the selected study area, would be responsive to the Hoopa Valley Tribe’s concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-100. Summary of effects under Alternative 3. Alternative 3 involves a demography study approach on the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, areas with current or recent data on banded spotted owls but not part of the spotted owl demographic meta-analysis. Barred owls would be removed from the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas using a combination of lethal and nonlethal removal methods for a period of from 4 years. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 3	
Area of effect (resource or issue)	**Effect of Alternative**
3.2 Barred Owls Primary effect: the removal of barred owls from the wild.	1. Number of barred owls removed would be approximately 2,003 over the 4 years of barred owl removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from approximately 1.13 percent of the habitat within the range of the northern spotted owl (an estimated 0.04 percent of the entire range of the barred owl).
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	1. Percent of spotted owl habitat from which barred owls would be removed is approximately 1.13 percent. 2. Approximately 128 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level. Approximately 45 percent of spotted owl territories currently have barred owl detections. 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Current spotted owl site occupancy is approximately 67 percent.

Area of effect (resource or issue)	**Alternative 3** Effect of Alternative
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	Ongoing spotted owl demography study areas would be used as control areas, but not as treatment areas. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: The treatment area would potentially provide temporary relief from predation and competition for as many as nine State- or federally listed species. Marbled Murrelet Disturbance: All of the Veneta (Oregon Coast Ranges/Tyee) and a portion of the Union/Myrtle (Klamath) Study Areas are within the likely inland range of the marbled murrelet. Some late-nesting marbled murrelets may be disturbed in the fall removal period.
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.

Alternative 3 Area of effect (resource or issue)	Effect of Alternative
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	This alternative would not include any of the National Park study areas. Therefore, Alternative 3 would have no significant effect on recreation or visitor use as these Federal and nonfederal lands are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. The potential economic effect is between zero and the value of the timber on 1,515 acres for the 4 years of the experiment, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 2. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	Total experiment costs are estimated at $ 2,277,000.
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. Because the Hoopa (Willow Creek) Study Area is not part of this alternative, it would not be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-101. Summary of effects under Alternative 4. Alternative 4 involves initiating an experiment using a demography study approach on the Columbia Gorge and McKenzie Study Areas. Under sub-Alternative 4a pre-removal demography data would be collected for 5 years, followed by 5 years of barred owl removal. Under sub-Alternative 4b barred owl removal would begin in year 3, immediately after establishing a population of banded spotted owls, and continue for 6 years. Barred owls would be removed on up to one-half of each study area using a combination of lethal and nonlethal removal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Area of effect (resource or issue)	Alternative 4 Effect of Alternative
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	1. Number of barred owls removed would be between 2,183 and 2,509 over the 5 to 6 years of barred owl removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from approximately 1.42 percent of the habitat within the range of the northern spotted owl (an estimated 0.05 percent of the entire range of the barred owl).
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	1. Percent of spotted owl habitat from which barred owls would be removed is approximately 1.42 percent. 2. Approximately 133 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level. Approximately 43 percent of spotted owl territories currently have barred owl detections. 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Current spotted owl site occupancy is approximately 49 percent.

Area of effect (resource or issue)	**Alternative 4** Effect of Alternative
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	Ongoing spotted owl demography study areas would not be used in this alternative.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: The treatment area would potentially provide temporary relief from predation and competition for as many as 14 State- or federally listed species. Marbled Murrelet Disturbance: Neither study area is within the likely inland range of the marbled murrelet. There are no effects to murrelets
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.

Area of effect (resource or issue)	**Alternative 4** Effect of Alternative
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	This alternative would not include any of the National Park study areas. Therefore, Alternative 4 would have no significant effect on recreation or visitor use as these Federal and nonfederal lands are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington. 2. For the McKenzie Study Area the potential economic effect is between zero and the value of the timber on the 2,106 acres of land for the 5 years of the removal component of the experiment, depending on the study area, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	Sub-Alternative 4a has an estimated total experiment cost of $ 7,028,000. Sub-Alternative 4b has an estimated total experiment cost of $ 6,233,000.
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. Because the Hoopa (Willow Creek) Study Area is not part of this alternative, it would not be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-102. Summary of effects under Alternative 5. Alternative 5 involves an occupancy study approach on the Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath) Study Areas, area with current or recent spotted owl occupancy data. Barred owls would be removed from up to one-half of the Cowlitz Valley Study Area and from the Veneta and Union/Myrtle portions of the Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas, using lethal removal methods for 3 years for simple occupancy data (Option 1) or 5 years for occupancy and reproductive data (Option 2). Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Alternative 5	
Area of effect (resource or issue)	**Effect of Alternative**
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	1. Number of barred owls removed would be approximately 2,494 for the occupancy-only design or 3,463 barred owls for the occupancy and reproduction survey over the duration of the barred owl removal. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from approximately 2.05 percent of the habitat within the range of the northern spotted owl (an estimated 0.07 percent of the entire range of the barred owl).
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	1. Percent of spotted owl habitat from which barred owls would be removed is approximately 2.050 percent. 2. Approximately 208 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level. Approximately 49 percent of spotted owl territories currently have barred owl detections. 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Current spotted owl site occupancy is approximately 53 percent.

Alternative 5 Area of effect (resource or issue)	Effect of Alternative
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	Ongoing spotted owl demography study areas would be used as control areas, but not as treatment areas. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: The treatment area would potentially provide temporary relief from predation and competition for as many as 16 State- or federally listed species. Marbled Murrelet Disturbance: All of the Cowlitz Valley and Veneta (Oregon Coast Ranges/Tyee) Study Areas, as well as a portion of the Union/Myrtle (Klamath) Study Area, are within the likely inland range of the marbled murrelet. Some late-nesting marbled murrelets may be disturbed in the fall removal period.
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below.
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	This alternative would not include any of the National Park study areas. Therefore, Alternative 5 would have no significant effect on recreation or visitor use as these Federal and nonfederal lands are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.

Alternative 5 **Area of effect (resource or issue)**	**Effect of Alternative**
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington. 2. For Oregon study areas (Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath)), the potential economic effect is between zero and the value of the timber on the 1,818 acres for the 5 years of the removal component of the experiment, depending on the selected option, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	1. A simple occupancy experiment on the three study areas has an estimated cost of $ 2,774,000. 2. An occupancy plus reproduction experiment has an estimated cost of $ 4,246,000.
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. Because the Hoopa (Willow Creek) Study Area is not part of this alternative, it would not be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-103. Summary of effects under Alternative 6. Alternative 6 involves initiating an experiment using as occupancy study approach on the Olympic Revised (Olympic Peninsula), McKenzie, and Horse/Beaver Study Areas. Under sub-Alternative 6a pre-removal occupancy data would be collected for 3 years, followed by 3 years of barred owl removal for simple occupancy data or 5 years for occupancy and reproductive data. Under sub-Alternative 6b barred owls would be removed starting after the first year and continuing for 3 years for simple occupancy data or 5years for occupancy and reproductive data. Barred owl removal would occur on the Olympic Revised portion of the Olympic Revised (Olympic Peninsula) Study Area and on up to one-half of the McKenzie, and Horse/Beaver Study Areas using a combination of lethal and nonlethal removal lethal methods. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area.

Area of effect (resource or issue)	Alternative 6 Effect of Alternative
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	1. Number of barred owls removed ranges from approximately 2,007 for simple occupancy to 2,787 for occupancy and reproduction for sub-Alternative 6a over the duration of the removal. Number of barred owls removed ranges from approximately 2,398 for simple occupancy to 3,174 for occupancy and reproduction for sub-Alternative 6b over the duration of the experiment. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from approximately 2.08 percent of the habitat within the range of the northern spotted owl (an estimated 0.10 percent of the entire range of the barred owl).

Area of effect (resource or issue)	**Alternative 6** Effect of Alternative
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	1. Percent of spotted owl habitat from which barred owls would be removed is approximately 2.08 percent. 2. Approximately 195 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary based on current barred owl population level. Approximately 41 percent of spotted owl territories currently have barred owl detections. 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Current spotted owl site occupancy is approximately 43 percent.
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	Ongoing spotted owl demography study areas (Olympic Peninsula) would be used as control areas, but not as treatment areas. Barred owl surveys would be conducted on ongoing spotted owl demography study areas.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered	Predation and Competition Reduction: The treatment area would potentially provide temporary relief from predation and competition for as many as 19 State- or federally listed species.

Area of effect (resource or issue)	**Alternative 6** Effect of Alternative
Primary effect: marbled murrelet may be disturbed by the removal activities.	Marbled Murrelet Disturbance: The Olympic Revised (Olympic Peninsula) Study Area is within the likely inland range of the marbled murrelet. Some late-nesting marbled murrelets may be disturbed in the fall removal period.
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	This alternative would not include any of the National Park study areas for the treatment portion of the experiment. Therefore, Alternative 6 would have no significant effect on recreation or visitor use as these Federal and nonfederal lands are all open to hunting. The sound of firearms would not significantly change the soundscape of the area.
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington and California. 2. For Oregon study areas (McKenzie and Horse/Beaver), the potential economic effect is between zero and the value of the timber on the 2,812 acres for the 3 to 6 years of the removal component of the experiment, depending on the selected sub-alternative, habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	Sub-Alternative 6a has an estimated total experiment cost of $ 3,819,000. Sub-Alternative 6b has an estimated total experiment cost of $ 2,736,000.

Area of effect (resource or issue)	Alternative 6 Effect of Alternative
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. Because the Hoopa (Willow Creek) Study Area is not part of this alternative, it would not be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Table 3-104. Summary of effects under Alternative 7. Alternative 7 involves a combination of demography and occupancy studies on 11 study areas across the range of the northern spotted owl. Barred owl removal would last from 3 to 10 years, depending on the study area and type of experiment. Barred owl surveys, spotted owl surveys, and spotted owl banding would be conducted on the entire area

Area of effect (resource or issue)	Alternative 7 Effect of Alternative
3.2 Barred Owls Primary effect: the removal of barred owls from the wild	1. Number of barred owls removed would be approximately 8,892 over the duration of the removal effort. Barred owl populations are anticipated to return to starting levels within 3 to 5 years of the end of barred owl removal. 2. Barred owls would be removed from approximately 6.53 percent of the habitat within the range of the northern spotted owl (an estimated 0.2 percent of the entire range of the barred owl).
3.3 Northern Spotted Owls Primary effect: positive changes in spotted owl demographic performance on the treatment (removal) portions of the study areas. Some limited negative effects from capture and banding of spotted owls, and removal of barred owls.	1. Percent of spotted owl habitat from which barred owls would be removed is approximately 6.53. 2. Approximately 536 potential spotted owl sites within the treatment (removal) area may be reoccupied during the experiment. 3. Magnitude of positive effect would vary across individual areas within this alternative based on current barred owl population level, likely being greatest where barred owl densities are low enough to have allowed some spotted owls to persist on the treatment area. The proportion of spotted owl sites with barred owl detections is highest at HJ Andrews (0.55) and lowest at Goosenest (0.18). 4. Magnitude of positive effect would vary based on current spotted owl site occupancy. Higher current occupancy allows spotted owls to reoccupy sites from which barred owls are removed more quickly. Current spotted owl site occupancy varies from 22 percent of the sites occupied on the Olympic Peninsula Study Area to 67 percent occupancy on the Veneta (Oregon Coast Ranges/Tyee) Study Area.

Alternative 7 **Area of effect (resource or issue)**	**Effect of Alternative**
3.4 Ongoing Spotted Owl Demography Studies Primary effect: increase in spotted owl survival, reproductive success, and population growth rate on the treatment (removal) portion of the study area and no change in spotted owl demographic rates on the control portion.	The Rainier, HJ Andrews, and Hoopa (Willow Creek) Study Areas are ongoing spotted owl demography study areas that would be used as treatment areas. Effects on ongoing spotted owl demography studies are as follows: 1. Reduces sample size of spotted owls for the experiment by up to 50 percent for the Rainier and HJ Andrews Study Areas. The entire Hoopa portion of the Hoopa (Willow Creek) Study Area would be affected. 2. Increase variance of estimates of demographic rates for both treatment and control areas. 3. Once removal experiment is concluded and barred owl populations recover to levels comparable to the control areas, the treatment area(s) can be recombined with control area(s). 4. Barred owl surveys would be conducted on Olympic Peninsula, Rainier, Oregon Coast Ranges, Tyee, HJ Andrews, South Cascades, Willow Creek, and Hoopa ongoing spotted owl demography study areas.
3.5 Other Wildlife Species Primary effect: reduced predation and competition on treatment area. Species most vulnerable impacts are those that are already threatened or endangered Primary effect: marbled murrelet may be disturbed by the removal activities.	Predation and Competition Reduction: The treatment area would potentially provide temporary relief from predation and competition for 24 State or federally listed species. Marbled Murrelet Disturbance: Six of the 11 study areas in this alternative are entirely or partially located within the likely inland range of the marbled murrelet: Ross Lake, Olympic Revised (Olympic Peninsula), Wenatchee, Rainier, Veneta (Oregon Coast Ranges/Tyee), and Hoopa (Willow Creek). If any of these are chosen, some late-nesting marbled murrelets may be disturbed in the fall removal period.

Area of effect (resource or issue)	**Alternative 7** Effect of Alternative
3.6 Social Primary effect: public health and safety, environmental justice, and economic (below).	No significant social effects were identified other than economic effects described below
3.7 Recreation and Visitor Use Primary effect: lethal removal on National Parks where visitors are not anticipating the sound of firearms.	Conducting the removal activities in the Rainier and North Cascades Study Areas would include National Park lands and could result in impacts to the visitor experience.
3.8 Economic Primary effect: potential restriction on timber harvest around newly reoccupied spotted owl sites in the treatment areas.	1. Due to State law and habitat conservation plans, there is no significant effect on timber harvest in study areas in Washington and California. 2. For Oregon study areas (Veneta (Oregon Coast Ranges/Tyee), HJ Andrews, Rogue Cascades (South Cascades), and Horse/Beaver), the potential economic effect is between zero and the value of the timber on the 2,893 acres of land for the 3 to 10 years of the experiment depending on habitat condition, flexibility of the landowner, and interest in a Safe Harbor Agreement. 3. Any effect would be temporary, and the acres would likely be available for harvest within 3 years after completion of the experiment.
3.9 Cost of Implementation Primary effect: estimated cost of implementing experiment	The estimated total cost for the experiment would be $ 11,831,000.

Alternative 7 Area of effect (resource or issue)	Effect of Alternative
3.10 Cultural Primary effect: none identified	1. No cultural effects identified 2. Within the Hoopa (Willow Creek) Study Area, this alternative would be responsive to the Hoopa Valley Tribe's concerns for maintaining the culturally significant spotted owl on their lands.

Glossary

Many of these terms have a long history and various meanings in regard to spotted owl biology and management. In this glossary, we define these terms in the context in which they are used in this Final EIS.

5-Year Status Review: A periodic analysis of a [listed] species' status conducted to ensure that the listing classification of a species as threatened or endangered on the List of Endangered and Threatened Wildlife and Plants (List) (50 CFR 17.11 – 17.12) is accurate. The 5-year review is required by section 4(c)(2) of the Endangered Species Act of 1973, as amended (ESA).

Action Area: All areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action 50 CFR 402.02.

Activity Center: Spotted owls have been characterized as central-place foragers, where individuals forage over a wide area and subsequently return to a nest or roost location that is often centrally located within the home range (Rosenberg and McKelvey 1999). Activity centers are location or point within the core use area that represent this central location. Nest sites are typically used to identify activity centers, or in cases where nests have not been identified, breeding season roost sites or areas of concentrated nighttime detections may be used to identify activity centers.

Adaptive Management: A systematic approach for improving resource management by learning from the results of explicit management policies and practices and applying that learning to future management decisions.

Adaptive Management Area (AMA): Within the framework of the Northwest Forest Plan, AMAs are landscape units designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. AMAs are managed under specific management objectives that may involve research, special management, or other guidelines.

Administratively Withdrawn: Lands under the jurisdiction of the Federal government withdrawn for special management or use, such as administrative sites, communication sites, locations with unique biological components, or other biological, social, or economic values, by the managing Federal agency (e.g., Forest Service, BLM, or National Park Service).

Affected Environment: A portion of the NEPA document that succinctly describes the environment of the area(s) to be affected or created by the alternatives under consideration. It includes the environmental and regulatory setting of the proposed action. The environmental setting includes the physical environmental conditions in the vicinity of proposed action, including all natural resources (wetlands, wildlife, etc.), and the built environment (cultural resources, socioeconomics, etc.). Within the regulatory setting, the affected environment would include all applicable laws, regulations, permits, and policies associated with the effects of the proposed action. [40 CFR §1502.15]

Before-After Control-Impact (BACI) Experimental Design: An experimental method involving a comparison of impact areas with control areas, usually with comparison information available prior to the potential impact, and often involving multiple study sites or time periods (Smith 2002, p. 141-148).

Birdwatching: The observation of birds as a recreational activity, pursued mainly for recreational or social reasons, unlike ornithologists, who engage in the study of birds using more formal scientific methods.

Barred Owl Work Group: A group of representatives from Federal, State, Tribal governments and non-governmental organizations. The Barred Owl Work Group was established as part of the 2008 Recovery Plan for the Northern Spotted Owl to coordinate actions related to barred owl research, management, monitoring, and public outreach (USFWS 2008, p. 30). Working with a group of scientists, the Barred Owl Work Group developed a framework for experimental removal of barred owls.

Barred Owl Stakeholder Group: In 2009, the Service established the Barred Owl Stakeholders Group as a recovery implementation team under ESA § 4(f)(2). The group included over 40 invited representatives from relevant government agencies, the forest products industry, Native American tribes, wildlife rehabilitators, environmental organizations, and animal welfare and protection groups.

Candidate Species: Plant and animal taxa considered for possible addition to the List of Endangered and Threatened Species. These are taxa for which the Fish and Wildlife Service has on file sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (61 FR 7596-7613, February 28, 1996).

Capture-Mark-Recapture: In capture-mark-recapture experiments, animals are captured, marked, released, and recaptured many times by repeated sampling. The result is a set of capture histories, one per observed animal, informative on survival, recruitment, and the size of the population (from Pradel 1996, entire).

Carrying Capacity: The average population density or population size of a species below which its numbers tend to increase and above which its numbers tend to decrease because of shortages of resources. The carrying capacity is different for each species in a habitat because of that species' particular food, shelter, and social requirements [Encyclopedia Britannica Online].

Checkerboard Ownership: A interspersed pattern of land ownership whereby staggered sections of land are controlled by separate (usually two, one being an agency of the Federal government) land owners, usually on a section (square mile) by section basis, as a result of public land dispersal by the Federal government during the 19th century, such as for BLM lands in western Oregon.

Chitinous: Having a tough, protective, semitransparent substance, primarily a nitrogen-containing polysaccharide, forming the principal component of arthropod exoskeletons or other body parts of invertebrates.

Congressionally Reserved Lands: Lands under the jurisdiction of the Federal governmental that have been reserved by Congress for their unique natural or historical characteristics, including wild and scenic rivers, national parks and monuments, national recreation areas, designated wilderness, and similar lands.

Conservation: The terms "conserve," "conserving" and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking (ESA §3(3).

Control (Experimental Control): In an experimental design, a study area or sample not subject to an experimental treatment, against which treatments may be compared. Under experimental conditions, the control is assumed to remain unchanged, since it is not subject to any treatment. For this proposed action, a control would be an area within which no barred owls would be removed, although barred owls within control areas may be monitored for occupancy or other biological parameters. *See also* **Treatment**.

Core Area: *See* ***Core Use Area.***

Core Use Area: An area of concentrated use within a home range that receives disproportionally high use (Bingham and Noon 1997, pp. 128-129), and commonly includes nest sites, roost sites, and foraging areas close to the activity center. Core use areas vary geographically, and in relation to habitat conditions. This is a biological definition of core use area and is neither the same as a 70-acre core as defined by the Oregon Forest Practices Act, nor is it equivalent to the 100-acre Late-Successional Reserves referred to as spotted owl cores on Federal lands.

Covariate: In statistics, a variable that is possibly predictive of the outcome under study. Statistical models used in analyses of spotted owl demography data commonly include variables (i.e., covariates) for data describing habitat and weather conditions to determine the effects those conditions may have on spotted owls survival, fecundity, etc. More recent models have included a covariate to assess the presence of barred owls on spotted owl vital rates.

Critical Habitat: For listed species consists of: (1) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 4 of the Act, on which are found those physical or biological features (constituent elements) (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of the Act, upon a determination by the Secretary that such areas are essential for the conservation of the species. (ESA §3 (5)(A)) Designated critical habitats are described in 50 CFR §17 and 226.

Cryptogenic Species: A species not demonstrably native or introduced (Carlton 1996, p. 1653). For purposes of this Final EIS, the Service includes the barred owl as a “cryptogenic species”. Please see Appendix A in this Final EIS for a full discussion of the appropriate classification of the barred owl regarding its recent range expansion into the western U.S. and Canada.

Cumulative Impacts: Under NEPA, the effects of an action that are added to or interact with other effects in a particular place and within a particular time. Cumulative effects include the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource no matter what entity (Federal, non-federal, or private) is taking the actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Demographic Study or Experiment: A field study that is designed to estimate vital rates (e.g. annual survival or reproductive rates). For spotted owls, such studies typically involve tracking individually marked owls over time.

Demographic Study Area: *See* ***Spotted Owl Demographic Study Area****.*

Demography: The study of characteristics of populations including population size, growth rates, density, distribution, and vital statistics.

Direct Effects: In a NEPA analysis, direct effects are caused by the action, and occur at the same time and place (40 CFR 1508.8). *See also* **Indirect Effects**.

Dispersal Habitat: Juvenile spotted owls often must disperse through a range of forest types prior to finding NRF habitat on which to establish a territory. These forest types include nesting, roosting, and foraging habitat in addition to forest that meets the definition of dispersal habitat. The Interagency Scientific Committee (ISC) defined dispersal habitat as forest stands with average tree diameters greater than 11 inches and conifer overstory trees with closed canopies (greater than 40 percent canopy closure in moist forests and greater than 30 percent in dry forests) and with open space beneath the canopy to allow spotted owls to fly can provide the minimum conditions needed for successful dispersal (Thomas *et al*. 1990, p. 310). We acknowledge that this definition primarily applies to moist forests in Oregon and Washington and may not capture the full range of dispersal habitat conditions in Northern California or drier forests across the range of the spotted owl. Early-seral Forest: Stage of forest development that includes seedling, sapling, and pole-sized trees.

Distinct Population Segment: A listable entity under the Endangered Species Act that encompasses that portion of a vertebrate species population that is discrete from the rest of the population and significant to the species (61 FR 4722, February 7, 1996).

Ecological Barrier: Any natural barrier, such as a large water body (for terrestrial species) or other unfavorable habitat, which may preclude a species from dispersing to other areas of otherwise suitable habitat, due to the species' inability to survive in or move across the unfavorable habitat. For the barred owl, the essentially treeless Great Plains of the central U.S and Canada may have been an ecological barrier to their range expansion into western North America, until settlement activities in the late 19th century created forest patch "stepping stones" through the northern plains.

Effectiveness Monitoring Program: A process under the Northwest Forest Plan to monitor the long-term status and trends of the northern spotted owl, and evaluate the success of the Plan in arresting downward population trends, and maintain and restore the habitat conditions necessary to support viable owl populations on Federal lands. The purpose of the northern spotted owl effectiveness monitoring plan is to assess trends in spotted owl populations and habitat.

Endangered Species: Any species which is in danger of extinction throughout all or a significant portion of its range, as defined in section 3(6) of the ESA.

Endangered Species Act: The Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). Also referred to within this document as ESA.

Exotic Species: Includes: (1) "any species introduced by man from a foreign land" (McCann 1984, p. 2); (2) "an organism introduced from a foreign country (i.e., one whose entire native range is outside the country where found) (a subcategory of introduced)" (Shafland and Lewis 1984, p. 18); (3) "a species not native to a given watershed" (Holcik 1991, p. 14); (4) one that came from "historical invasions, including both natural range expansions and human-mediated introductions" (Carlton 1996, p. 1653); and (5) "an organism introduced from a foreign country; a species native to an area outside of, or foreign to, the national geographic area under discussion, used synonymously with foreign" (Fuller *et al*. 1999, p. 565).

Extirpate: To cause the extinction of a species on a landscape of interest.

Fecundity: The average annual number of female young produced per territorial female owl (Forsman *et al.* 2011a, p. 13).

Floater: Some Spotted Owls are not territorial but either remain as residents within the territory of a pair or move among territories. These birds are referred to as "floaters." Floaters have special significance in spotted owl populations because they may buffer the territorial population from decline (Franklin 1992, p. 824). Little is known about floaters other than that they exist. Since they are non-territorial they typically do not respond to hooting as vigorously as territorial birds (Gutiérrez 1996, p. 4). A non-territorial, unpaired subadult or adult owl that may reside within a forest landscape, who does not breed and may be substantially undetectable on field surveys (Bart 1995, p. 662). Floater owls may eventually become territorial as other paired individuals die, and a potential territory and mate become available.

Foraging Habitat: Lands that provide foraging opportunities for spotted owls, but without the structure to support nesting and roosting (USFWS 1992, pp. 22-26). Spotted owls often forage in forest conditions that meet the definition of nesting/roosting habitat, but also use a broader range of forest types for foraging. This definition identifies habitat that functions as foraging habitat, but does not meet requirements for nesting or roosting. Habitat-capable Area: Forests below the elevation limits of occupancy by territorial spotted owls that are capable of growing and sustaining structural (Davis and Lint 2005, pp. 30-32) and ecological conditions of spotted owl habitat. High-Quality Habitat: Older, multi-layered structurally complex forests that are characterized as having large diameter trees, high amounts of canopy cover, and decadence components such as broken-topped live trees, mistletoe, cavities, large snags, and fallen trees. This is a subset of spotted owl habitat and specific characteristics may vary due to climatic gradients and abiotic factors across the range.

Fragmentation (as in habitat fragmentation): The creation of smaller habitat patches from a landscape formerly including large habitat patches, as a result of management activities or natural disturbance, resulting in both an net decrease in total habitat as well as a reduction in average patch size. For the spotted owl, past and ongoing timber harvest and wildfire have decreased the number and acreage of large patches of older forest, reducing its suitability as nesting, roosting and foraging habitat.

Generalist Species: A species whose ecological strategy relies on adaptation to a relatively wide range of ecological conditions. The barred owl is considered to be a generalist species (especially as compared to the spotted owl), since it is adapted to a wide range of forest habitats and seral stages. The barred owl utilizes a wide range of mammal, bird, mollusk, crustacean, and other animal species as their primary prey. *See also* **Specialist Species**.

Habitat Conservation Plan: Under section 10(a)(2)(A) of the Act, a planning document that is a mandatory component of an incidental take permit application.

Historical Site: Sites that contained spotted owls in the past. These may be currently unoccupied or sites where spotted owls were detected in the past, but not surveyed more recently.

Home Range: The area in which a spotted owl conducts its activities during a defined period of time (USFWS 1992, p. 479) that provides important habitat elements for nesting, roosting, and foraging. Home range sizes vary generally increase from south to north and vary in relation to habitat conditions and prey availability and composition.

Indigenous Species: Species "occurring or found naturally in a particular area or ecosystem; historically occurring in geographic range previous to the arrival of the first European settlers; a species that is a member of the native natural community" (Fuller *et al.* 1999, p. 565). "Nonindigenous" is "any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country into another" (Aquatic Nuisance Prevention and Control Act of 1990, as amended) or "an individual, group, or population of a species that is introduced into an area or ecosystem outside its historic or native geographic range, used synonymously with alien and nonnative" (Fuller *et al.* 1999, p. 565).

Indirect Effects: In an NEPA analysis of effects, indirect effects "… are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable" and may include "… effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on … ecosystems" (40 CFR 1508.8).

Invasive Species: An exotic species whose introduction into an ecosystem in which the species is not native causes or is likely to cause environmental or economic harm or harm to human health. It is important to note that when we talk about a species being invasive, we are talking about ecosystem or environmental boundaries, not political ones. In addition to the many invasive species from outside the U.S., there are many species from within the U.S. that are invasive in other parts of the country because they are not native to the ecosystem in which they have become established (http://www.fws.gov/invasives/faq.html#q1).

Jeopardy (or Jeopardize the continued existence of): To engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Known Spotted Owl Site: An occupied spotted owl site or a spotted owl site where spotted owls were documented to be present in the past.

Lambda: In wildlife demography studies, the annual rate of population change, usually indicated by the symbol λ. A lambda value of 1 indicates a stable population, $\lambda > 1$ indicates an increasing population, and $\lambda < 1$ indicates a declining population.

Late-seral Forest: Stage in forest development that includes mature and old-growth forest (USDA *et al*. 1993, p. IX-18). The appearance and structure of these forests will vary across the range of the spotted owl, particularly in the dry forest provinces.

Late-Successional Reserve: A major land management allocation established under the Northwest Forest Plan to protect and enhance conditions of late-successional and old-growth forest ecosystems, and serve as habitat for late-successional and old-growth related species including the spotted owl. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem.

Local Colonization Rate (γ): The probability that an owl territory that is not occupied in year t will become occupied in year t+1 (the following year) (MacKenzie *et al*. 2006, pp. 40-41).

Local Extinction Rate (ε): The probability that an owl territory that is occupied in year t will become unoccupied in year t+1 (the following year) (MacKenzie *et al*. 2006, pp. 40-41).

Long-term: For the purposes of planning and managing the spotted owl and its forest habitat, a time frame estimated to be greater than 30 years at a minimum and usually referring to time periods ranging from 50 years to several centuries. Use of this term can be context dependent and relative, for example, when referring to gradual demographic changes in a spotted owl population or the development of late-successional habitat conditions.

Manage: To make and act upon decisions about which actions to take, if any, regarding a particular issue, area of land, etc. This may include a decision to take no action.

Matrix: Under the Northwest Forest Plan, those lands under the jurisdiction of the Forest Service or BLM within the range of the northern spotted owl not otherwise included within a Late Successional Reserve or Adaptive Management Area land status, or otherwise Congressionally or Administratively Withdrawn. Matrix land may, however, include Riparian Reserves.

Mature Forest: Forests where the annual net rate of growth has peaked. Stand age, diameter of dominant trees, and stand structure at maturity vary by forest types and local site conditions. Mature stands generally contain trees with a smaller average diameter, less age-class variation and less structural complexity than old growth stands of the same forest type (USDA *et al*. 1993, p. IX-20). The appearance and structure of these forests will vary across the range of the spotted owl, particularly in the dry forest provinces. Mature stages of some forests provide NRF habitat for spotted owls. However, mature forests are not always spotted owl habitat, and spotted owl habitat is not always mature forest.

Meta-analysis: A statistical technique in which the results of two or more studies are mathematically combined in order to improve the reliability of the results. Studies chosen for inclusion in a meta-analysis must be sufficiently similar in a number of characteristics in order to accurately combine their results. Northern spotted owl researchers have completed several meta-analyses of demography and occupancy data on a minimum of eight demography study areas, with results reported in major research publications in 1996, 2000, 2006 and 2011.

Mid-seral Forest: Intermediate stages of tree growth between early-seral and late-seral. The appearance and structure of these forests will vary across the range of the spotted owl, particularly in the dry forest provinces.

Native Species: Includes: (1) species that were "present aboriginally" (Cohen and Carlton 1995, p. 4); (2) "indigenous or endemic taxa, including prehistorical invasions" (Carlton 1996, p. 1653); and (3) "with respect to a particular ecosystem, [a] species that, other than as a result of an introduction, historically occurred or currently occur[s] in that ecosystem" (Executive Order 13112 on Invasive Species 1999). A "nonnative" organism is described as "any species introduced by man into an ecosystem outside its native range" (includes exotic plus transplanted species) (McCann 1984, p. 2).

Nest Patch: The patch of forest containing the nest tree (as of a spotted owl); the size of the nest patch varies by the habitat type associated with a particular nest, but generally includes up to several hundred acres of older forest.

Nesting and Roosting Habitat: Habitat that provides nesting and roosting opportunities for spotted owls. Important stand elements may include high canopy closure, a multi-layered, multi-species canopy with larger overstory trees and a presence of broken-topped trees or other nesting platforms (e.g., mistletoe clumps (USFWS 1992, p. 23). The appearance and structure of these forests will vary across the range of the spotted owl, particularly in the dry forest provinces.

Nonfederal Lands: Tribal, State, municipal, or private lands.

Nonindigenous Species: *See **Indigenous Species**.*

Northwest Forest Plan: In 1993, President Clinton directed the Forest Ecosystem Management Assessment Team to develop long-term management alternatives for maintaining and restoring habitat conditions to maintain well-distributed and viable populations of late-successional- and old-growth-related species. The analysis of the FEMAT alternatives in a final supplemental environmental impact statement (USDA and USDI 1994a, entire) led to adoption of the land-allocation strategy contained in the record of decision (USDA and USDI 1994b, entire), commonly known as the Northwest Forest Plan.

Occupancy: The proportion of sites occupied by the species of interest within a study area. In this EIS, spotted owl site occupancy is defined as the proportion of known sites that are occupied at a specific time.

Occupancy Study or Experiment: A field study design that compares changes in occupancy of spotted owl territories between treatment and control areas. Occupancy models use repeated sampling to estimate the probability that the areas surveyed are occupied by the species of interest (MacKenzie *et al*. 2006, entire). For our purposes, occupancy is defined as the proportion of sites occupied by spotted owls on each area. For this type of study, surveyors can record simple presence/absence of spotted owls or they may gather additional data on reproductive success at owl sites.

Occupied Site: Any location where territorial spotted owls are known to be present.

Old-growth Forest: Old-growth forests are forests that have accumulated specific characteristics related to tree size, canopy structure, snags and woody debris and plant associations. Ecological characteristics of old-growth forests emerge through the processes of succession. Certain features – presence of large, old trees, multilayered canopies, forest gaps, snags, woody debris, and a particular set of species that occur primarily in old-growth forests – do not appear simultaneously, or at a fixed time in stand development. Old-growth forests support assemblages of plants and animals, environmental conditions, and ecological processes that are not found in younger forests (younger than 150- 250 years) or in small patches of large, old trees. Specific attributes of old-growth forests develop through forest succession until the collective properties of an older forest are evident.

Owl Estimation Methodology (OEM): A methodology for estimating the number of spotted owl sites that are likely to occur within an area based on the amount and distribution of owl habitat and best available information on known owl sites and their spacing patterns for that area. In particular, the methodology relies upon known spotted owl locations derived from surveys as the foundation for developing a “spotted owl site occupancy” map.

Park Resources: Within the National Parks and Monuments, wildlife and the processes and conditions that sustain them (NPS 2006, section 1.4.6:11).

Physiographic Province: The Northwest Forest Plan established twelve landscapes (provinces) that allow differentiation among areas of common biological resources and physical processes when assessing appropriate forest and wildlife management strategies. The characteristics of the natural structure and composition of late-successional and old-growth forests also vary among the provinces.

Presence (or Presence/Absence): In wildlife surveys, data collection may be limited to recording only whether at least one individual of the subject species was detected (present) at the survey site, and generally does not include a count of individual found there. Surveys that include criteria or standards for determining that the species of interest does not occupy the sample area may be referred to as presence/absence surveys.

PROGRAM MARK: A computer software package that estimates demographic rates (e.g., annual survival, recruitment, rate of population growth) for tagged, banded, or otherwise-marked animals that are re-observed at later times.

Provincial: This is a qualifying term used with home range and core use area to reflect the fact that both vary in size according to latitude, amount of available habitat, prey availability, and forest structure and composition. Typically, home range and core use area sizes increase from south to north, and decrease as amount of high-quality habitat available to spotted owls increases.

Range (as in Native Range): In biology, the geographical area within which a species can be found. The term is often qualified: sometimes a distinction is made between a species' native range and the places to which it has been introduced by human agency (deliberately or accidentally), as well as where it has been re-introduced following extirpation [Wikipedia].

Range (as in Home Range): The area of suitable habitat used by an animal to meet its life needs, often determined over an annual period, and may be determined for an individual or a mated pair. For species such as the spotted owl, the annual home range may be substantially larger than the area used in the vicinity of the nest patch during the breeding season.

Recovery: Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA (50 CFR §402.02).

Recovery Action: Each recovery plan prepared for a listed species describes the recovery actions found to be necessary to achieve the plan's goal(s) and objectives and the monitoring actions necessary to track the effectiveness of these actions and the status of the species. Recovery actions, when implemented, alleviate known threats and restore the species to long term sustainability. These actions might include (but are not limited to) habitat protection, limitations on take, outreach, research, control of disease, control of invasive species, controlled (including captive) propagation, reintroduction or augmentation of populations, and monitoring actions. The Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011, pp. III-62 to

III-68) identifies nine recovery actions specific to addressing the threat that barred owls represent to conservation and recovery of the northern spotted owl.

Recovery Plan: Section 4(f) of the ESA directs the U.S. Fish and Wildlife Service to develop and implement recovery plans for threatened and endangered species, unless such a plan would not promote conservation of the species. According to the statute, these plans must incorporate, at a minimum, a description of site-specific management actions necessary to achieve recovery of the species; objective, measurable criteria which, when met, would result in a determination that the species be removed from the list; and estimates of the time and costs required to achieve the plan's goal. The Service completed a recovery plan for the northern spotted owl in 2008 (USFWS 2008, entire), and revised that plan in May, 2011 (USFWS 2011, entire). That recovery plan identified several recovery actions involving barred owl management deemed necessary to conserve, recover and delist the northern spotted owl.

Recruitment: In spotted owl biology, the addition of individuals into the territorial spotted owl population at the start of each breeding season. An individual owl is considered recruited into the population if it is alive at the beginning of the first breeding season *after* its year of birth (i.e., it is nearly one year old).

Removal (or Experimental Removal): For purposes of this proposed action, we define removal (or experimental removal) as the nonlethal or lethal removal of a barred owl from the wild within the experimental treatment areas on proposed study areas. All removal approaches are focused on reducing barred owl populations in treatment areas through the removal of territorial barred owls.

Risk Management: The information available rarely addresses all of the questions at hand, meaning there is usually some degree of uncertainty. Hence, recovery plans include an element of risk management (especially for wide-ranging species which face a multitude of threats) because the Service must make recommendations and decisions in the face of incomplete information and uncertainty. For the spotted owl, risk management includes reliance on adaptive management to facilitate appropriate change in management following what we learn from ongoing research and monitoring.

Safe Harbor Agreement: A voluntary agreement involving private or other non-Federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the Endangered Species Act. In exchange for actions that contribute to the recovery of listed species on non- Federal lands, participating property owners receive formal assurances from the Service that if they fulfill the conditions of the SHA, the Service will not require any additional or different management activities by the participants without their consent, and may return the enrolled property to the baseline conditions that existed at the beginning of the SHA.

Scansorial: Capable of or adapted for climbing, as the feet of certain birds, lizards, etc.

Section 7: The section of the Endangered Species Act of 1973, as amended, outlines procedures for interagency cooperation to conserve Federally listed species and designated critical habitats.

Section 7(a)(1) requires Federal agencies to use their authorities to further the conservation of listed species. Section 7(a)(2) requires Federal agencies to consult with the Services to ensure that they are not undertaking, funding, permitting, or authorizing actions likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. Other paragraphs of this section establish the requirement to conduct conferences on proposed species; allow applicants to initiate early consultation; require USFWS and NMFS to prepare biological opinions and issue incidental take statements. Section 7 also establishes procedures for seeking exemptions from the requirements of section 7(a)(2) from the Endangered Species Committee (16 U.S.C. 1531 *et seq.*).

Section 7 Consultation: The various section 7 processes, including both consultation and conference if proposed species are involved (50 CFR §402).

Section 106: Section 106 of the National Historic Preservation Act of 1966.

Sensitive Species: In this document, we will generally refer to sensitive species, a term we use to encompass the variety of at-risk species in the study areas. This term includes various State and Federal designations such as species of concern, special status species, and sensitive species.

Short-term: For the purposes of planning and managing the spotted owl and its forest habitat, a time frame estimated to be less than a few decades and usually between one to ten years. Use of this term can be context dependent and relative, for example, when referring to immediate changes in a forest stand due to a wildfire or vegetation treatment, or the behavioral response of individual spotted owls to habitat alteration or the removal of barred owls from a spotted owl territory.

Specialist Species: A species whose ecological strategy relies on adaptation to a relatively narrow range of often stable ecological conditions. The spotted owl is considered to be somewhat of a specialist species, as it is adapted to late-seral forest habitats, and substantial reliance on a few rodent species as their primary prey. *See also* **Generalist Species**.

Species of Concern: Federal species of concern is an informal term, not defined in the ESA, and commonly refers to species that are declining or appear to be in need of conservation. States may also use this term.

Spotted Owl Demographic Study Area: Study areas that are part of a long-term monitoring program "to assess temporal and spatial patterns in fecundity, apparent survival, recruitment, and annual finite rate of population change" of northern spotted owls (Forsman *et al.* 2011a, p. 1). Study areas are located across the owl range and have relatively large sample sizes of spotted owl sites. Ongoing spotted owl demographic study areas used in this Final EIS are the Cle Elum, Rainier, Olympic Peninsula, Oregon Coast Ranges, Tyee, HJ Andrews, Klamath, South Cascades, Hoopa, and Willow Creek (part of the NW California study area). These areas are considered ongoing spotted owl demographic study areas because annual monitoring continues to occur and has occurred on all of these areas since at least 1990, with some sites having been monitored since 1988. The Wenatchee and Olympic Revised Study Areas are former spotted owl demography study areas that are no longer being monitored and are considered inactive in this Final EIS.

Spotted Owl Site: Any location where territorial spotted owls are known to be present, were historically present, or may be present in unsurveyed habitat. Spotted owl sites can be identified through surveys where spotted owls were detected (USFWS 2012, entire). In cases where survey data are unavailable, spotted owl sites can be identified by 1) conducting surveys, or 2) using a modeling approach that uses habitat and landscape characteristics to identify areas with a high probability of being occupied by spotted owls.

Standard Error: In statistical analysis, the standard error is the standard deviation of the sampling distribution of a statistic. The standard error of the mean value is usually estimated by the sample estimate of the population standard deviation (sample standard deviation) divided by the square root of the sample size.

Statistical Power: The probability that an experiment will correctly lead to the rejection of a false null hypothesis (Greene 2000, p. 156), or in other words, the ability of a test to detect an effect, given that the effect actually exists (High 2000, pp. 1-2). Studies with larger sample sizes will have higher power to detect effects (such as from barred owl removal). Thus, study areas with more owl territories or owls will have higher power to detect changes in occupancy or demographic rates than areas with fewer owls, other experimental factors being equivalent.

Strength of Inference: The likelihood that an observed difference between groups within an experiment or study represents a real difference rather than mere chance or the influence of confounding factors.

Survey Protocol: A standardized and often specialized survey method designed for application to certain species, to ensure efficient and scientifically credible results from data collected during those surveys. The U.S. Fish and Wildlife Service has adopted and revised as needed a detailed survey protocol to detect the spotted owl (USFWS 2012). This survey protocol was revised in 2010 to address the reduced response rate of spotted owls following colonization of their territories by barred owls.

Survival: Annual survival (or "apparent survival") is probability that an owl survives and stays on the study area from year t to year $t+1$, given that it is alive and on the study area at the beginning of year t (Williams *et al*. 2001, p. 478). A less technical definition is the probability that a spotted owl will live for at least one more year, following the time it is located as a live animal, and be relocated at that site.

Synergism (or Synergistic Effect): An environmental impact whose scale or extent may increase or decrease as a result of other, similar impacts on a resource, and therefore would not be directly additive. In an analysis of effects, synergistic effects would result from impacts that are not independent of one another.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct, per section 3(19) of the ESA. Harm is further defined by USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Harass is defined by USFWS as actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering (50 CFR §17.3).

Territory (often referred to as a "Site"): In spotted owl ecology, an area used by a mated pair of spotted owls or an unmated territorial individual, within which the spotted owl(s) obtain the necessary resources (e.g., prey, shelter, nest sites) to survive and (for pairs) reproduce. A territory is usually defended against conspecifics, resulting (for spotted owls) in territories of up to several thousand acres. A home range, usually somewhat larger than a territory, may include areas of overlap with adjacent owl territories. For regulatory purposes, a spotted owl territory is approximated by a mapped circle, centered at a recent nest or other biologically significant location for a territorial owl or owl pair, unless detailed data are available for the spotted owl site in question. The area of the mapped circle corresponds to the approximate territory acreage determined through radio-telemetry monitoring of well-studied owls. *See also* **Floater**.

Threatened Species: Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as defined in section 3(20) of the ESA.

Translocation: The movement of an animal to new areas for release into the wild. This proposed project has considered various methods for translocation of barred owls into other locations within the species native range.

Treatment (Experimental Treatment): In an experimental design, a study area or sample subject to some form of experimental manipulation, for comparison with study areas or samples not subject to manipulation, to test a hypothesis regarding the treatment (manipulation) applied. For this proposed action, barred owls would be removed from treatment areas to test the response of spotted owls following this removal. *See also* **Control**.

Turnover: The replacement of territorial owls with new individuals of the same species at a given spotted owl territory.

Unacceptable Impacts: Within the National Parks and Monuments, unreasonable interference with an atmosphere of peace and tranquility or the natural soundscape (NPS 2006, section 1.4.7:12).

Unoccupied Site: Site where spotted owls were detected in the past, but more recent surveys have not detected owls. Surveys are required to establish unoccupied status, and criteria for determining unoccupied status are presented in the 2012 Revised Northern Spotted Owl Survey Protocol (USFWS 2012).

UTM (Universal Transverse Mercator): A geographic coordinate system that uses a 2-dimensional Cartesian coordinate system to give locations on the surface of the Earth, and commonly used to identify specific locations during wildlife studies.

Viable Population: A self-sustaining population with a high probability of survival despite the foreseeable effects of demographic, environmental and genetic stochasticity and of natural catastrophes.

Vital Rates: In wildlife ecology, the rates of reproduction and survival of a species of interest over a period of time, used in the estimation of lambda. For demography studies of the spotted owl, vital rates include survival and recruitment.

List of Acronyms

BLM: USDI Bureau of Land Management
DPS: Distinct Population Segment
EIS: Environmental Impact Statement
ESA: Endangered Species Act of 1973, as amended
GIS: geographic information system
NEPA: National Environmental Policy Act
MBTA: Migratory Bird Treaty Act
SOC: Species of Concern
USFWS: United States Fish and Wildlife Service

Scientific Names

Birds

Band-tailed pigeon	*Patagioenas fasciata*
Barred owl	*Strix varia*
Black-backed woodpecker	*Picoides arcticus*
Brown-headed cowbird	*Molothrus ater*
California condor	*Gymnogyps californianus*
California spotted owl	*Strix occidentalis occidentalis*
Flammulated owl	*Otus flammeolus*
Golden eagle	*Aquila chrysaetos*
Great gray owl	*Strix nebulosa*
Great horned owls	*Bubo virginianus*
Lewis' woodpecker	*Melanerpes lewis*
Marbled murrelet	*Brachyramphus marmoratus*
Mexican spotted owl	*Strix occidentalis lucida*
Northern barred owl	*Strix varia varia*
Northern goshawk	*Accipiter gentilis*
Northern pygmy-owl	*Glaucidium gnoma*
Northern saw-whet owl	*Aegolius acadicus*
Northern spotted owl	*Strix occidentalis caurina*
Olive-sided flycatcher	*Contopus cooperi*
Pileated woodpecker	*Dryocopus pileatus*
Purple martin	*Progne subis*
Tawny owl	*Strix aluco*
Varied thrush	*Ixoreus naevius*
Vaux’s swift	*Chaetura vauxi*
Western screech-owl	*Megascops kennicotti*
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*
White-headed woodpecker	*Picoides albolarvatus*
Whooping crane	*Grus americana*

Mammals

American marten	*Martes americana*
Axis deer	*Axis axis*
Black-footed ferret	*Mustela nigripes*
Bushy-tailed woodrat	*Neotoma cinera*
Camas pocket gopher	*Thomomys bulbivorus*
Coyote	*Canis latrans*
Destruction Island shrew	*Sorex trowbridgii destruction*
Domestic dog	*Canis familiaris*
Douglas’ squirrel	*Tamiasciurus douglasii*
Dusky-footed woodrat	*Neotoma fuscipes*
Fallow deer	*Dama dama*

Feral hogs	*Sus scrofa*
Fisher	*Martes pennanti*
Fringed myotis bat	*Myotis thysanodes*
Gray wolf	*Canis lupus*
Grizzly bear	*Ursus arctos*
Hoary bat	*Lasiurus cinereus*
Keen's myotis bat	*Myotis keenii*
Long-eared myotis bat	*Myotis evotis*
Long-legged myotis bat	*Myotis volans*
Mazama pocket gopher	*Thomomys mazama*
Marten (see American marten)	
Mountain goat	*Oreamnos americanus*
Mule deer	*Odocoileus hemionus*
Northern flying squirrel	*Glaucomys sabrinus*
Pacific water shrew	*Sorex bendirii*
Pallid bat	*Antrozous pallidus*
Pygmy rabbit	*Brachylagus idahoensis*
Raccoon	*Procyon lotor*
Red tree vole	*Arborimus longicaudus*
Roosevelt elk	*Cervus elaphus roosevelti*
Shrew	*Sorex* spp.
Silver-haired bat	*Lasionycteris noctivagans*
Small-footed myotis bat	*Myotis leibii*
Snowshoe hare	*Lepus americanus*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Plecotus townsendii*
Townsend's ground squirrel	*Spermophilus townsendii*
Trowbridge's shrew	*Sorex trowbridgii*
Western gray squirrel	*Sciurus griseus*
Western pocket gopher (see Mazama pocket gopher)	
White-footed vole	*Arborimus albipes*
Yuma myotis bat	*Myotis yumanensis*

Reptiles and Amphibians

Black salamander	*Aneides flavipunctatus*
Burmese pythons	*Python molurus bivittatus*
California mountain kingsnake	*Lampropeltis zonata*
California red-legged frog	*Rana draytonii*
Cascade torrent salamander	*Rhyacotriton cascadae*
Cascades frog	*Rana cascadae*
Clouded salamander	*Aneides ferreus*
Coastal tailed frog	*Ascaphus truei*
Columbia torrent salamander	*Rhyacotriton kezeri*
Common kingsnake	*Lampropeltis getula*
Cope's giant salamander	*Dicamptodon copei*
Del Norte salamander	*Plethodon elongatus*

Foothill yellow-legged frog	*Rana boylii*
Larch Mountain salamander	*Plethodon larselli*
Northern red-legged frog	*Rana aurora*
Olympic torrent salamander	*Rhyacotriton olympicus*
Oregon slender salamander	*Batrachoseps wrighti*
Oregon spotted frog	*Rana pretiosa*
Pacific pond turtle (see Western pond turtle)	
Scott Bar Salamander	*Plethodon asupak*
Sharptail snake	*Contia tenuis*
Siskiyou Mountains salamander	*Plethodon stormi*
Southern torrent (seep) salamander	*Rhyacotriton variegatus*
Van Dyke's salamander	*Plethodon vandykei*
Western pond turtle	*Actinemys marmorata*
Western toad	*Anaxyrus boreas*
Wood frog	*Rana sylvatica*

Fish

Bull trout	*Salvelinus confluentus*
Chinook salmon	*Oncorhynchus tshawytscha*
Chum salmon	*Oncorhynchus keta*
Coastal cutthroat trout	*Onchorhynchus clarki clarki*
Coho salmon	*Oncorhynchus kisutch*
Eulachon	*Thaleichthys pacificus*
Jenny Creek sucker	*Catostomus rimiculus* ssp.
Klamath largescale sucker	*Catostomus snyderi*
Malheur mottled sculpin	*Cottus bendirei* ssp.
Millicoma dace	*Rhinichthys cataractae* ssp.
Oregon chub	*Oregonichthys crameri*
Pacific lamprey	*Lampetra tridentata*
Redband trout	*Oncorhynchus mykiss*
River lamprey	*Lampetra ayresii*
Slender sculpin	*Cottus tenuis*
Steelhead	*Oncorhynchus mykiss*
Umpqua chub	*Oregonichthys kalawatseti*
Western brook lamprey	*Lampetra richardsoni*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*

Invertebrates

Giant Columbia spire snail (also called Columbia pebblesnail)	*Fluminicola columbiana*
Oregon giant earthworm	*Driloleirus macelfreshi*
Pacific sideband snail	*Monadenia fidelis*
Roth's blind ground beetle	*Pterostichus rothi*
Shasta Crayfish	*Pacifastacus fortis*
Signal crayfish	*Pacifastacus leniusculus*
Siskiyou carabid beetle	*Nebria gebleri siskiyouensis*

Trinity Bristle Snail	*Monadenia setosa*

Plants

Balsam poplar	*Populus balsamifera*
Bigleaf maple	*Acer macrophyllum*
Black cottonwoods	*Populus trichorcarpa*
Cottonwoods	*Populus* spp
Douglas-fir	*Pseudotsuga menziesii*
Golden chinquapin	*Chrysolepis chrysophylla*
Grand fir	*Abies grandis*
Incense-cedar	*Calocedrus decurrens*
Juniper	*Juniperus* spp.
Lodgepole pine	*Pinus contorta*
Oak	*Quercus* spp.
Oregon white oak	*Quercus garryana*
Pacific madrone	*Arbutus menziesii*
Ponderosa pine	*Pinus ponderosa*
Red alder	*Alnus rubra*
Red fir	*Abies magnifica*
Pacific silver fir	*Abies amabilis*
Sitka spruce	*Picea sitchensis*
Subalpine fir	*Abies lasiocarpa*
Sugar pine	*Pinus lambertiana*
Tanoak	*Lithocarpus densiflorus*
Western hemlock	*Tsuga heterophylla*
Western redcedar	*Thuja plicata*
White fir	*Abies concolor*

Metric Equivalents

When you know:	Multiply by:	To find:
Inches	2.54	Centimeters
Feet	0.305	Meters
Miles	1.609	Kilometers
Square miles	2.59	Square kilometers
Acres	0.405	Hectares
Ounces	28.35	Grams

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Appendix A

Barred Owl History and Effects on Northern Spotted Owls: Why the U.S. Fish and Wildlife Service is Contemplating Barred Owl Removal Experiments

A.0 Changes between Draft and Final EIS

- Added clarification on climate change and hybridization.

A.1 Introduction

The Revised Recovery Plan for the Northern Spotted Owl (Recovery Plan) (USFWS 2011, entire) attributes the declining status of northern spotted owls (spotted owl) to past and current habitat loss, as well as competition from barred owls. While habitat protection is vital, the Recovery Plan indicates that securing suitable habitat alone will not be enough to ensure recovery, and recommends a series of recovery actions intended to address the barred owl threat to spotted owls. The impetus for the proposed barred owl removal experiment lies in the Recovery Plan, which describes Recovery Action 29 as follows: "design and implement large scale control experiments in key spotted owl areas to assess the effects of barred owl removal on spotted owl site occupancy, reproduction and survival."

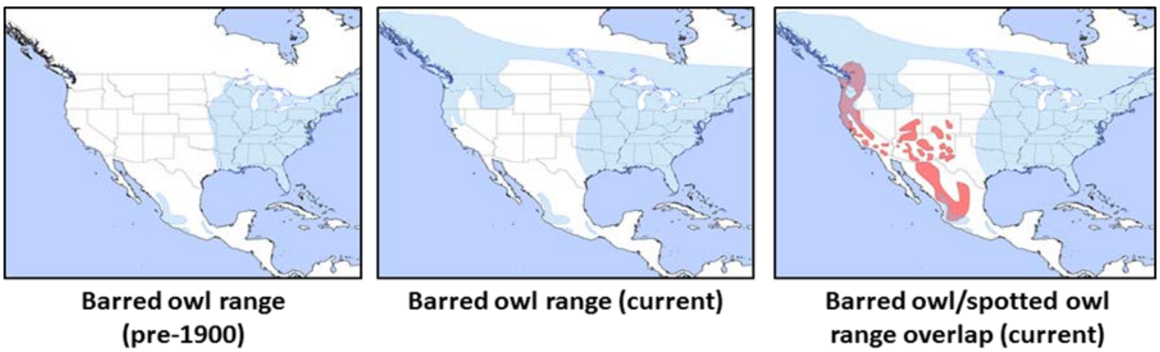
This white paper summarizes that background information that led the USFWS (Service) and its partners to develop Recovery Action 29. This paper describes the history of the barred owl invasion, the data behind the hypothesis that barred owls are a major threat to spotted owls, and the decision that removal experiments are the next indicated step. We also review the risks, uncertainties, and implications of barred owl removal on northern spotted owl recovery.

A.2 History of the Barred Owl Expansion

A.2.1 Barred Owl Expansion Routes across North America

The barred owl historically ranged, and still occurs, throughout southeastern Canada, eastern United States, and eastern Mexico (Figure A-1). The scientific community has developed—and disputed—various theories explaining the timing and the route that barred owls took to expand across North America and ultimately into the Pacific Northwest and the range of the northern spotted owl. There are two proposed routes for the westward expansion of barred owls.

Figure A-1. Barred owl range expansion and current overlap with spotted owls (Wiens 2012, unpubl. data).



A.2.1.1 Boreal Forest Route

This theory states that during the last century barred owls spread northward and westward from their historical range across the boreal forest in Canada to reach British Columbia (Grant 1966, p. 42; Houston and McGowan 1999, pp. 191–193). Grant (1966, p. 43), one of the originators of this theory, presented observations of barred owls in southeastern British Columbia during the 1950s and 60s. Grant believed that barred owls were recent invaders (20th century) to that province and argued that if they had been present in the 1800s they would have been identified by fur traders, who described many other species of owls but did not mention barred owls (Grant 1966, p. 42).

Houston and McGowan (1999, p. 193) also believed that barred owls were recent (post-1900) arrivals to Canada, because experienced ornithologists had not described them before that time, nor did they show up in weasel traps prior to the mid-20th century. Houston and McGowan (1999, p. 190) argued that even if barred owls had occupied Saskatchewan and Alberta in the 1800s, they must have been so extremely rare that they were overlooked.

Through records of barred owl occurrence in Alberta from 1912 through 1999, Priestley (2004, p. 215) attributed increased incidence of barred owl observations to an increased number of naturalists. He did not believe the birds had expanded their range in Alberta, but rather had maintained it.

A.2.1.2 Great Plains Route

This theory states that barred owls moved west across the northern Great Plains via forested riparian corridors of the Missouri, Yellowstone, and Musselshell Rivers, or other forest patches, arriving in eastern Montana in 1873. From there they expanded to southwest Montana, north to Alberta, and east into Saskatchewan, where they met barred owls expanding west from Manitoba (Livezey 2009a, p. 49). The theory that barred owls crossed the Great Plains in their expansion westward relies on the validity of earlier records of barred owl observations. However, the accuracy of observations of barred owl in eastern Montana in 1873, 1909, and 1921 (Holt *et al.* 2001, p. 103) and in the Great Plains in 1897 is disputed (Livezey 2009a, p. 50). However, Holt *et al.* (2001, p. 102) believed that in the mid-1920s barred owls had entered western Montana from Alberta and British Columbia and, from there, spread south and west into southwest Montana and Idaho, a more northerly route.

The Great Plains route theory relies on the assumption that barred owls invade new territories by first colonizing riparian corridors, which has some basis in the literature. Houston and McGowan (1999, p. 191) showed evidence that barred owls moved into Saskatchewan from the Pas River, Manitoba, via the riparian forest of the Saskatchewan River. Early records of barred owl occurrence in Alberta from 1912 through 1999 show barred owls were associated with older forests and had a clumped distribution, predominantly along water, where larger balsam poplar trees provided nesting sites (Priestley 2004, p. 215).

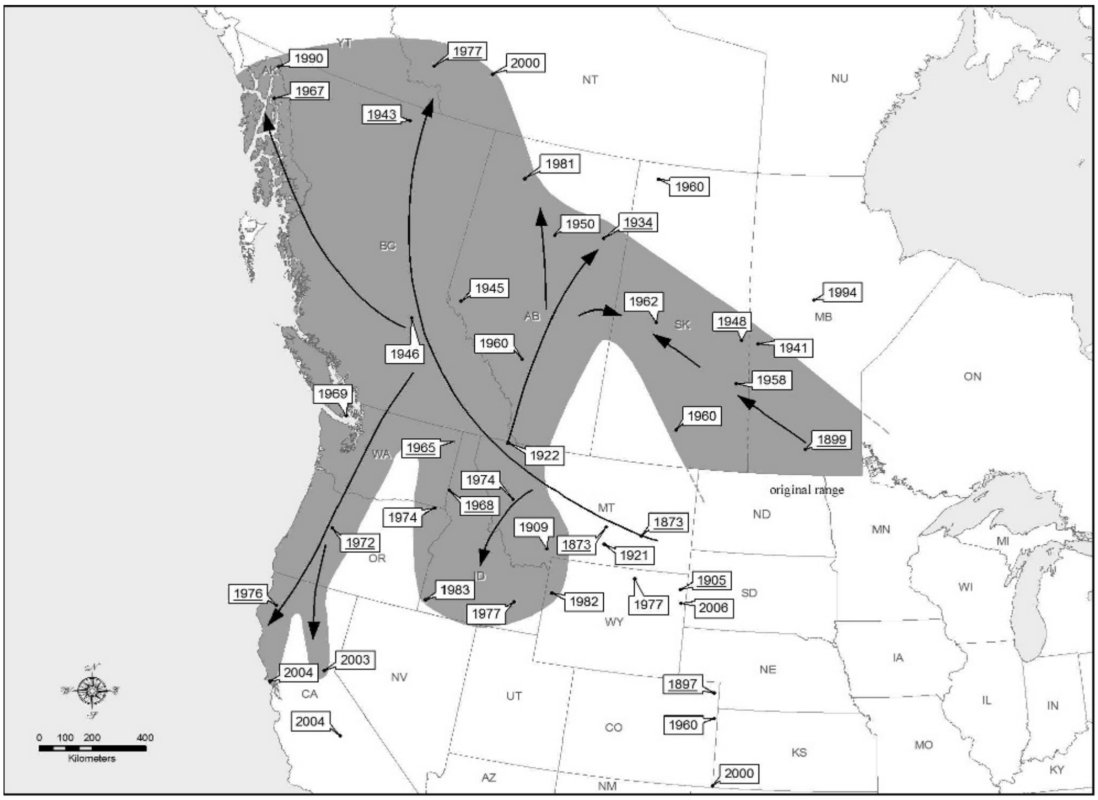
Barred owls often nest close to water or in riparian areas (Buchanan *et al.* 2004, p. 231), which often have larger trees because of decreased frequency of fires (Hinam and Duncan 2002, p. 157). Cottonwoods provide attractive nest sites because they grow rapidly, frequently have large trunks with weak wood, are relatively short lived, and consequently produce cavities and broken limbs used by barred owls (Livezey 2009b, p. 333). Livezey (2007, p. 183) reports that one-fourth of barred owl nests documented in North America were found in cottonwoods, which are associated with riparian or wet areas.

Large trees provide not only nesting habitat, but also cover from predators and protection from weather. Barred owls forage on a wide variety of prey, including amphibians, snails, and fish (Hamer *et al.* 2001, p. 224), which are more prevalent in riparian areas.

Despite the prevalence of barred owl use of riparian areas, there is some question about colonization via riparian corridors in the Great Plains. Eastern Montana and the Missouri River are not part of the current barred owl range, yet this is posited as the corridor by which they expanded into the Rocky Mountains. If this were a viable route, we would anticipate finding barred owls still present in these areas. However, this assumes that conditions from around 1900 to 1930 are still present today. Riparian areas in the Great Plains may contain fewer forested areas now than in the time of barred owl westward expansion; thus, though barred owls are not currently found in these areas, they may have used these riparian areas in the past to colonize and facilitate their expansion.

Whether barred owls expanded west via the Canadian boreal forest or up riparian corridors through the Great Plains, there appears to be little dispute that barred owls spread into western Washington from British Columbia (Hamer *et al.* 1989, p. 2) (Figure A-2). From British Columbia, barred owls expanded south and were first sighted in western Washington in 1973 (Taylor and Forsman 1976, p. 560), Oregon in 1974 (Taylor and Forsman 1976, p. 560), and California in 1976 (Livezey 2009a, p. 51), all within the range of the northern spotted owl. Barred owls were first detected in eastern Washington in 1973 (Rogers 1974, p. 927), and most likely came from southwest Montana and Idaho.

Figure A-2. Barred owl invasion (Livezey 2009a, p. 53, Figure 2)



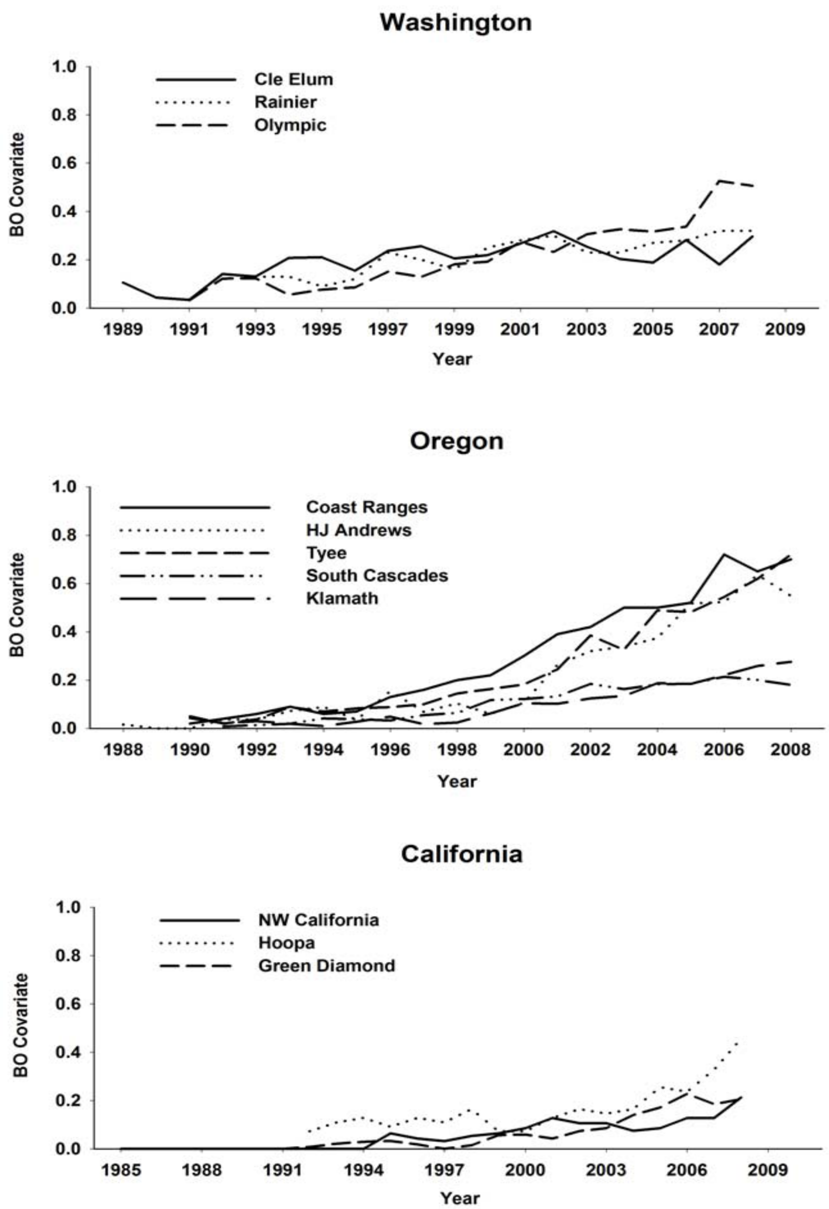
A.2.2 Barred Owl Expansion into the Range of the Northern Spotted Owl

Our understanding of barred owl expansion in the Pacific Northwest is largely based on data gathered incidental to spotted owl surveys in spotted owl demographic study areas. These surveys involve using spotted owl calls to elicit responses from spotted owls. However, sometimes barred owls also respond to these similar calls and this information is recorded. Barred owl expansion data is therefore most available in areas with extensive spotted owl surveys. Unfortunately, the number of barred owl detections cannot be used to track their populations. While barred owl responses are recorded, in most cases no attempt was made to determine the site centers or locations of the barred owls. Because these are not barred owl-specific surveys, we do not know what percentage of the population is responding to the spotted owl calls and whether this is a consistent portion of the population. In the absence of this type of information, the data is reported as the percentage of spotted owl territories with barred owl detections. A "detection" could mean one barred owl or five. Therefore, this information is likely an underestimate of the actual increase in barred owls.

Based on the detections of barred owls in spotted owl territories, we do know that once barred owls arrive in an area, their numbers increase and the edge of their range expands over time. For example, in less than 10 years, barred owls expanded from western Washington to northern California (Gutiérrez *et al.* 2004, p. 7–13). In the Baker Lake area of the North Cascades in Washington, surveys in 1988 documented barred owls at twice the abundance of spotted owls within only 17 years of barred owls first being detected in the area (Hamer *et al.* 1989, p. 52). On the Olympic Peninsula in Washington, barred owls were detected at four sites in 1985, 15 in 1992, and 60 in 2003 (Gremel 2005, p. 9). Between 1989 and 1998 in Oregon, an average of 60 new barred owl territories were detected each year (Kelly *et al.* 2003, p. 50). In the Oregon Cascades, barred owl sightings increased from a single initial sighting in 1979 to 706 in 1998 (Kelly 2001, p. 21). Surveys for spotted owls in the Coos Bay area found one barred owl in 1990, none in 1991, 12 in 1992, and 11 in 1993 (Zabel *et al.* 1996, p. 80). Surveys in Northern California found one barred owl site per 50 new spotted owl territories when barred owls were first detected in 1981. By 1994, scientists were detecting 1 barred owl per 10 to 20 new spotted owl territories (Dark *et al.* 1998, p. 53).

A report on the status and trends of the spotted owls released in 2011 showed that the proportion of spotted owl territories with barred owl presence increased from 1985 to 2008 throughout the range of the northern spotted owl (Forsman *et al.* 2011a, Appendix B) (Figure A-3). The numbers are especially dramatic considering that these are presence-absence detections, and that barred owl numbers are most likely underestimated by these data. We note that the increases in detections are not as steep in California as they are in Washington. This is consistent with the expected barred owl expansion pattern—that is, a gradient of increased detections where they have been present for the longest time (in the north near British Columbia) and fewer detections where they have been present only a short time (southern edge, California).

Figure A-3. Proportion of spotted owl territories with barred owl detections (BO Covariate) over time on study areas in Washington, Oregon, and California (Forsman *et al.* 2011a, Appendix B).



A.3 Factors That May Have Facilitated Barred Owl Range Expansion

Many authors have described factors that may have assisted the expansion of barred owls across North America and into the Pacific Northwest. Holt *et al.* (2001, p. 105) organized these factors into three categories: (1) habitat change due to human activities, (2) breakdown of ecological barriers, and (3) natural causes.

A.3.1 Habitat Change due to Human Activities

Anthropogenic activities, such as clearcut logging and forest management in the boreal forest (Root and Weckstein 1994, p. 194; Dark *et al.* 1998, p. 54) may have changed habitat in a way that favored the expansion of barred owls across the boreal forest. Hamer *et al.* (1989, p. 56) theorized that high-grading (harvesting the largest trees) and clearcut timber harvesting may have contributed to barred owl expansion south from Canada into Washington because barred owls are habitat generalists and can thrive in habitats that are only marginal for spotted owls. However, areas that have never been harvested, such as Olympic National Park, have large populations of barred owls (Gutiérrez *et al.* 2004, p. 7–35), indicating that habitat alteration may not be much of a factor. Wright and Hayward (1998, p. 80) additionally suggested that fire suppression in forested areas has resulted in increased tree density and closed-canopy forests, allowing barred owls to better hide from predators such as great horned owls and Northern goshawks, which may also use forest habitats.

A.3.2 Breakdown of Ecological Barriers

Grant (1966, p. 42) first suggested the idea of an ecological barrier to barred owl expansion (e.g., the Rocky Mountains or barriers farther east) that was later bridged to allow these birds to expand their range. Grant's focus was the boreal forests in Canada; however, the idea of a breached ecological barrier has been used to explain barred owl expansion in the Great Plains as well.

Historical records from early European explorers and settlers described the Great Plains as a vast grassland interrupted by only narrow bands of deciduous forest along lakes, creeks, and rivers, with topological breaks where trees could get adequate moisture (Livezey 2009b, p. 324). The largely treeless expanse of the Great Plains may have been a barrier to movement as barred owls likely lack the ability to disperse long distances between forested areas. For example, Livezey (2009b, p. 327) showed that the median dispersal distance of barred owls, using data based on movements of 327 owls, was 13.7 miles.

Livezey (2009b, p. 323) suggested that the lack of trees on the Great Plains constituted an ecological barrier to barred owl expansion until European settlers inadvertently allowed bridging of that barrier by establishing or increasing riparian forests, developing urban parks and woodlands, and planting shelterbelts (Droze 1977, p. 16; Dark *et al.* 1998, p. 54), all of which increased forest cover. Most of the trees planted were cottonwoods which are commonly used by barred owls (Livezey 2009b, p. 333). In addition, during the mid to late 1800s, homesteaders on the Great Plains were able to secure tax exemptions and more land if they planted trees (Droze 1977, p. 22). Early homesteaders raised and stored grains in primitive conditions, leading to a likely increase in the population of rodents around farms. Combined with shelterbelts and orchards, and some local riparian areas, this food supply could provide enough habitat to support barred owl dispersal.

A.3.2.1 Fire Suppression and Fire Management in the Great Plains

Livezey (2009b, p. 328, summarizing Houghton *et al.* 2000), estimated that prior to European settlement, approximately 33 percent of grasslands in the Great Plains burned annually, contributing to the lack of trees on the Great Plains. Some of these fires came from lightning strikes. In addition, Native Americans often burned grasslands to clear trees for ease of travel, to help crops, and create pasturage.

Once Europeans settled the Great Plains, many Native American populations were extirpated, and their absence may have resulted in a reduction in fire frequency. Although fires from natural causes continued to occur, and some fires were started by settlers or railroads, settlers practiced fire prevention and fire suppression to protect buildings, crops, livestock, and human lives (Abrams 1986, p. 29). The reduced incidence of prairie fires is believed to have resulted in an increase in the distribution and density of woody vegetation (Pyne 1982, p. 84-103), potentially facilitating barred owl expansion in these areas (Livezey 2009b, p. 328).

A.3.2.2 Changes in Natural Fauna

An estimated 20 to 30 million bison historically occupied the Great Plains. Through grazing, browsing, and trampling of young trees, they helped prevent trees from establishing (Soper 1941, p. 388; England and DeVos 1969, p. 87). From the mid-1700s to the 1800s, bison numbers declined due to disease and hunting by Europeans for meat and hides, competition with livestock, severe winters and droughts, and continued slaughter by Europeans to eliminate resources for Native Americans. By 1888, bison were nearly extirpated in the United States. This disappearance of the great bison herds may have allowed more trees to grow in riparian areas, allowing wooded areas to expand (Campbell *et al.* 1994, p. 360; Grant and Murphy 2005, p. 359).

Elk herds of hundreds to thousands of animals were common in river valleys of the Great Plains during the early 1800s (Murie 1951, pp. 25-39). Historically, deer were even more common than elk. While elk graze on grass, they will, like deer, browse on bark, cambium, leaves, and shoots of woody vegetation. They also scrape branches and trunks of small trees with their antlers. This behavior may have reduced the prevalence of woody plants on the Great Plains (Andersen and Cooper 2000, p. 1384; Heinen and Currey 2000, p. 243; Russell *et al.* 2001, p. 1; McCain *et al.* 2003, p. 129). During the early 1800s, deer and elk populations were reduced or locally extirpated as a result of overhunting for meat and trade in hides. Livezey (2009b, p. 330) suggested that the reduction in the numbers of grazers and browsers and associated increase in woody vegetation facilitated the expansion of barred owls.

Beaver exert a powerful force on woody riparian vegetation, particularly when that vegetation is limited. In recent years, beaver have removed the remaining large cottonwoods along miles of the Missouri River in eastern Montana. Beaver were likely common along the rivers and streams of the Great Plains until the advent of widespread trapping for the European market. The Lewis and Clark expedition of 1804 to 1806 was chartered, in part, to establish an American claim to the fur trade in the area. Rivers were the primary travel routes for trappers to move their hides to markets in the East. The trappers undoubtedly set traps if they found beaver sign where they camped, as described in the Lewis and Clark Journals. The beaver population along the major rivers was likely decimated by the early to mid-1800s. This could have contributed to the increase in woody vegetation along rivers and streams.

A.3.3 Natural Causes

Although they did not explore potential mechanisms, Boxall and Stepney (1982, p. 49) suggested that barred owls may have adapted to coniferous forests, which allowed their expansion through the boreal forest from Manitoba to British Columbia. Hobbs and Cannings (2007, p. 104) suggested that the short summers and cold temperatures in the boreal forests may have acted as barriers to barred owl movement; these barriers were subsequently bridged by a warming climate starting in the mid-1800s. Monahan and Hijmans (2007, p. 61) indicated that increases in mean summer temperature in south-central Canada may have decreased metabolic energy requirements during the breeding season, allowing barred owls to expand their range. Wright and Hayward (1998, p. 80) also suggested that changes in climate may have allowed barred owls to use the Canadian boreal forest as an expansion route.

Whether climate change is believed to be a natural or a human-induced process, it can increase the success of introduced or invasive species in colonizing new territory (Dale *et al.* 2001, p. 723). Generalist species are commonly able to adapt more successfully to a new climate than specialists (Dukes and Mooney 1999, p. 138). Barred owls are considered generalists in their use of habitat and prey, while spotted owls are considered specialists. While we might expect from this that barred owls would adapt more readily to changing conditions than spotted owls, the implication of climate change on species is highly uncertain, especially within the timeframe of this experiment (approximately10 years).

A.4 Are Barred Owls Native, and Does it Matter?

One of the driving questions for many people is whether the barred owl expansion is natural and the species should be considered native, indigenous, or exotic.

"Native" organisms are defined as: (1) species that were "present aboriginally" (Cohen and Carlton 1995, p. 4); (2) "indigenous or endemic taxa, including prehistorical invasions" (Carlton 1996, p. 1653); and (3) "with respect to a particular ecosystem, a species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem" (64 FR 6183, February 8, 1999). A "nonnative" organism is described as "any species introduced by man into an ecosystem outside its native range" (includes exotic plus transplanted species) (McCann 1984, p. 2).

"Indigenous" is defined as: "occurring or found naturally in a particular area or ecosystem; historically occurring in geographic range previous to the arrival of the first European settlers; a species that is a member of the native natural community" (Fuller *et al.* 1999, p. 565). "Nonindigenous" is "any species or other viable biological material that enters an ecosystem beyond its historic range, including any such organism transferred from one country into another" (Aquatic Nuisance Prevention and Control Act of 1990, as amended) or "an individual, group, or population of a species that is introduced into an area or ecosystem outside its historic or native geographic range, used synonymously with alien and nonnative" (Fuller *et al.* 1999, p. 565).

An "exotic species" is defined as: (1) "any species introduced by man from a foreign land" (McCann 1984, p. 2); (2) "an organism introduced from a foreign country (i.e., one whose entire native range is outside the country where found) (a subcategory of introduced)" (Shafland and Lewis 1984, p. 18); (3) "a species not native to a given watershed" (Holcik 1991, p. 14); (4) one that came from "historical invasions, including both natural range expansions and human-mediated introductions" (Carlton 1996, p. 1653); and (5) "an organism introduced from a foreign country; a species native to an area outside of, or foreign to, the national geographic area under discussion, used synonymously with foreign" (Fuller *et al.* 1999, p. 565).

Given the various definitions attributed to the terms, "native," "nonnative", "indigenous," "exotic," and "invasive," barred owls may be considered native or nonnative to the Pacific Northwest, depending on the literature cited and the source. Without a standardized definition and more specific data from the intermediate areas of central North America, data are insufficient to reach a definitive determination about the "native vs. nonnative" status of barred owls at this point.

Many people draw the line at active management based on whether the barred owl experienced a "natural" range expansion or an invasion facilitated by recent human activity. They believe that human-facilitated invasions lead to a responsibility to deal with the consequences. Evidence of human culpability in the barred owl expansion is also not definitive, but it does point to a human influence. Perhaps the important issue is not whether humans directly caused the barred owl expansion so much as whether humans have an obligation to address it.

Even if the barred owl expansion was not facilitated by human activities, humans bear some responsibility for the effect of barred owls on spotted owl populations. Spotted owl populations and habitat were significantly reduced by recent human activity before barred owls invaded their range. If spotted owl populations were healthy and living in pristine forest conditions, it is possible that they could better compete with barred owls or at least survive long enough to allow for co-existence to develop between the two species. The depressed condition of spotted owl populations in the 1970s is due to human-caused fragmentation and removal of habitat and movement corridors.

Whether the barred owl presence in the Pacific Northwest is considered "natural" or "unnatural," the consequences to the spotted owl are the same. We believe, therefore, that humans bear at least some responsibility to investigate and, if appropriate, mitigate the negative impacts of barred owl interactions on spotted owl, because this impact is exacerbating the decline of spotted owl populations.

A.5 Effects of Barred Owls on Spotted Owl Populations

A.5.1 Sources of Information and our Ability to Infer Cause and Effect

Until recently, barred owl detection data was obtained incidentally as part of spotted owl surveys. The observations led us to ask whether there is a cause and effect relationship between the increasing presence of barred owls and declining detections of spotted owls in historical spotted owl territories. The studies and data available about barred owl and spotted owl interactions can be organized into four categories, each of which provides a variable level of confidence that barred owls are negatively affecting spotted owls.

A.5.1.1 Level-1 Studies

This type of study poses an explicit question or hypothesis. The study is designed to collect the information necessary to answer the question or test the hypothesis. Such a study is a true, planned experiment closely following the scientific method with replication (i.e., comparing results across similar sites) in addition to treatments with controls (i.e., comparing results of a site that has been treated with a site that has not been treated). It is difficult to design level-1 studies that obtain robust data for answering ecological questions, given the natural variation in the environment and the added difficulty in finding comparable replicates. Using a treatment with control design without replication has a stronger inference than an observational study, but some uncertainty will still exist, mainly in the ability to extrapolate results beyond the area on which the study was conducted.

A level-1 study would give us the strongest ability to infer a cause and effect relationship, because this type of study would control other variables that could be causing a negative effect on spotted owls. Examples of level-1 studies include:

- Diller's (2012, pers. comm.) work removing barred owls at spotted owl territories in Northern California. This work has been ongoing since its initiation in 2006 with the cooperation of the California Academy of Sciences.
- The Service proposal to conduct a barred owl removal experiment, which is the subject of this Final Environmental Impact Statement (Final EIS). It is intended to determine the effect, the mechanism of effect, and the viability of management of barred owls on spotted owls.

A.5.1.2 Level-2 Studies

This type of analysis is intended to answer the question about whether barred owls are negatively affecting spotted owls, but it uses existing data that were not collected specifically to answer this question. The long-term research done in spotted owl demographic study areas to evaluate status and trends of the northern spotted owl throughout its range are examples of level-2 analyses. These studies have analyzed spotted owl data with various covariates, that is, variables that are possibly predictive of the outcome under study. The data, with covariates, have included the presence of barred owls in a spotted owl territory, to determine what influences spotted owl population trends. Examples of level-2 analyses include:

- Forsman *et al.* (2011a, entire), the most recent northern spotted owl demographic study. This study found that the presence of barred owls appears to have a negative effect on spotted owl recruitment, in turn affecting their survival and population trends. Of all the factors contributing to declines in the demographic rates of spotted owls, the presence of barred owls is the strongest and most consistent across study areas (Forsman *et al.* 2011a, p. 75).
- Kelly *et al.* (2003, entire) conducted a retrospective study (one that uses existing data) to determine if barred owls could be causing the declines in spotted owl populations. The authors examined spotted owl survey data, which included barred owl responses, and proved that the presence of barred owls at historical spotted owl sites reduced spotted owl site occupancy.
- Gremel (2005, entire) analyzed existing data to determine if barred owls affect spotted owl site occupancy, location of activity centers, or productivity in the Olympic National Park in western Washington State. The author determined that the presence of barred owls appeared to be reducing spotted owl site occupancy at their historical sites and increasing the detection distance between spotted owls and their original site centers.

A.5.1.3 Level-3 Studies

This type of study analyzes existing data originally collected to answer a question different from what we are currently asking. While such data may provide evidence of a barred owl effect on spotted owls, the effect could be from other causes. Our ability to infer a cause and effect relationship from level-3 studies is not strong. Examples of level-3 studies include:

- Crozier *et al.* (2006, entire) showed that spotted owls have a reduced response rate in the presence of barred owls. While not the focus of the study, this provides evidence that barred owls may disrupt certain behaviors important to spotted owls. Vocalizations are an important part of the spotted owl's territorial behavior.
- Bailey *et al.* (2009, entire) determined that detection of both barred owls and spotted owls was negatively influenced by the presence of other congeneric species, i.e., species belonging to the same genus.

A.5.1.4 Level-4 Studies (Observations)

This type of information comes from unanalyzed observations or data. Observations (i.e., recording barred owl responses during spotted owl surveys) originally alerted us that barred owls might be having a negative effect on spotted owls. Level-4 observations include observations by spotted owl surveyors of barred owls attacking, or even eating, spotted owls. Another type of level-4 observation includes the graphs prepared from raw data visually showing the upward trend of barred owl detections in spotted owl territories, and the concurrent downward trend of spotted owl populations and site occupancy, suggesting that barred owls may be the cause of spotted owl declines.

A.5.2 Hybridization

Although Hamer *et al.* (1994, p. 487) and others documented specific instances of hybridization between barred owls and northern spotted owls, it is rare (Herter and Hicks 2000, p. 279; Kelly 2001, p. 33). Kelly and Forsman (2004, p. 807) located 47 confirmed cases of hybrids (17 adults and 30 juveniles), including 16 second-generation hybrids. They confirmed six territories where male spotted owls were paired with female barred owls, 16 sites where hybrid adults were paired with barred owls, and one site where a hybrid was paired with a spotted owl. As with many owls, spotted owls and barred owls have reversed sexual dimorphism, e.g., males are smaller than females (Gutierrez *et al.* 1995, p. 2; Mazur and James 2000, p. 2), which may explain the observations. Pairings of male northern spotted owls and female barred owls would retain the smaller male and larger female pattern, making them more likely to breed, than a male barred owl and female northern spotted owl, which are approximately the same size (Kelly and Forsman 2004, p. 807). Given the hundreds of sites monitored each year, this is a small proportion of hybrid pairs.

Although increasing density of barred owls in spotted owl habitat might be assumed to increase the risk of hybridization, it may be that hybridization is more likely when barred owl populations are low. Individual barred owls may have trouble finding a conspecific mate and settle for a closely related spotted owl. Kelly and Forsman (2004, p. 808) believe that as barred owl numbers increase and they have more access to barred owls mates, hybridization will decrease. Gutierrez *et al.* (2007, p. 189) believes that as spotted owls continue to become more uncommon relative to barred owls, the incidence of hybridization will again increase.

Some have suggested that because barred and spotted owls interbreed, spotted owl genetics would remain through hybridization even if the species goes extinct. The high number of barred owls and the low number of spotted owls on the landscape, as well as the declining populations of spotted owls, would dilute any potential for genetic continuance. Furthermore, under the ESA, genetic continuation does not constitute conservation or recovery of a listed species.

A.5.3 Trends and Patterns for Increasing Barred Owl Numbers and Decreasing Spotted Owl Populations

Spotted owl populations are declining throughout the range (Table A-1). After the first decade of spotted owl surveys, researchers noted a pattern of increasing barred owl detections at historical spotted owl sites and decreasing spotted owl detections. To determine whether the decreasing spotted owl rates were, in fact, associated with barred owl presence, a barred owl covariate was added to the spotted owl demography meta-analysis for the Northwest Forest Plan monitoring in 2006. The barred owl covariate in effect compares spotted owl demographic results (survival, reproduction, occupancy) in territories both with and without barred owl detections. The data with the covariate shows that while spotted owl populations are declining or stable across much of their range, the decline is steeper where barred owls are present. This finding implies that the presence of barred owls is exacerbating the decline of spotted owls.

Table A-1. Population declines in survival in 11 of 12 ongoing spotted owl demographic study areas (Forsman *et al.* 2011a, p. 64, Table 22).

Study Area [1]	Fecundity	Survival	λ_{RJS} [2]	Population Change
Cle Elum	Stable	Declining	0.937	Declining
Rainier	Increasing	Declining	0.929	Declining
Olympic	Stable	Declining	0.957	Declining
Coast Ranges	Increasing	Declining since 1988	0.966	Declining
HJ Andrews	Increasing	Declining	0.977	Declining
Tyee	Stable	Declining since 2000	0.996	Stationary
Klamath	Declining	Stable	0.990	Stationary
South Cascades	Declining	Declining since 2000	0.982	Stationary
Northwest California	Declining	Declining	0.983	Declining
Hoopa Tribe	Stable	Declining since 2004	0.989	Stationary
Green Diamond	Declining	Declining	0.972	Declining

[1] Study areas are the ongoing spotted owl demographic study areas from Forsman *et al.* (2011a, p. 7, Table 1).
[2] Realized rate of population change, as described in Forsman *et al.* (2011a, p. 18). Values greater than 1 indicate an increasing population. Values less than 1 indicate a decreasing population. Values equal to 1 indicate a stationary population. Although all λ_{RJS} values are less than 1, the 95 percent confidence intervals for λ overlapped 1.0, so it could not be concluded that these populations were declining (Forsman *et al.* 2011a, p. 3).

A.5.3.1 Barred Owl Presence Appears to Reduce Spotted Owl Site Occupancy

In Oregon, Kelly *et al.* (2003, p. 51) showed that spotted owl site centers with barred owl detections within 0.5 mile were less likely to be occupied than sites with no barred owl detections (See Appendix A, Section A.7.2 of this Final EIS). This finding implies interspecific interactions, with spotted owls generally ceding occupancy of a site to barred owls (Gutiérrez *et al.* 2004, pp. 7-27 to 7-31).

Pearson and Livezey (2003, p. 274) showed that the presence of barred owls appears to have a greater influence on whether spotted owls occupy a territory than whether an area is within a reserve. This barred owl effect on spotted owl site occupancy became apparent in Olympic National Park, an area that had never been logged. Barred owls were first detected in the park in 1985. From 1992 to 2003, the number of barred owl detections per team day in spotted owl sites increased at a rate of 15 percent per year (Gremel 2005, p. 9). During the same period, the rate of spotted owl site occupancy where barred owls were present declined overall from a mean of 60.6 to 41.6 percent (Gremel 2005, p. 11).

Over the same period at Olympic National Park, in territories with barred owl presence, the sites where spotted owls were detected were twice as far away from their original locations as in territories without barred owl presence (Gremel 2005, p. 11). This implies that spotted owls shift their activity centers away from the presence of barred owls even if they do not abandon their territories altogether. Spotted owl site centers that remained occupied despite the presence of barred owls tended to be at higher elevations. These findings are consistent with the hypothesis that interference competition may be occurring, and that barred owls may be displacing spotted owls (Gremel 2005, p. 16).

Data from 1982 to 2000 in the South Cascades in Washington showed the percentage of barred owl detections relative to all owl detections increased by about 8.6 percent annually (Pearson and Livezey 2003, p. 270). Occupied spotted owl sites were significantly steeper in slope and higher in elevation than barred owl sites (Pearson and Livezey 2003, p. 271)

A.5.3.2 Gradient in Barred Owl Numbers Supports a Picture of a North to South Invasion

Every 5 years the Service holds workshops with spotted owl researchers to analyze data relative to northern spotted owl population trends across the species' range. The Service has held four workshops since 1993, resulting in four published meta-analyses (Burnham *et al.* 1994, entire; Forsman *et al.* 1996a, entire; Anthony *et al.* 2006, entire; Forsman *et al.* 2011a, entire). The most recent workshop was held in January 2009.

The meta-analysis released in 2006 showed evidence of declines in spotted owl survival and populations in 5 out of 14 study areas. This included the four study areas in Washington State (Anthony *et al.* 2006, p. 7), where barred owls were most abundant and had been present the longest. In California, barred owl detections were relatively rare (less than 5 percent of spotted owl territories), and spotted owl survival and population trends were stable (Anthony *et al.* 2006,

p. 32). The authors noted the southward expansion and growing abundance of barred owls in the southern part of the northern spotted owl range and cautioned that this should be monitored carefully.

The most recent meta-analysis (Forsman *et al.* 2011a, entire), shows this north to south gradient of increasing barred owl and decreasing spotted owl detections even more strongly. This analysis shows spotted owl apparent (i.e., adult) survival declined in 10 of 11 study areas, with the sharpest declines in Washington and northern Oregon (Forsman *et al.* 2011a, p. 2). The decline in survival of northern spotted owls in California is more gradual (Forsman *et al.* 2011a, p. 64). Populations overall declined in 7 of 11 study areas, with the steepest declines in Washington and northern Oregon (Forsman *et al.* 2011a, p. 65).

Spotted owl numbers are extremely low in the northern end of their range in British Columbia. Scientists estimated that prior to European settlement; spotted owl populations may have numbered 500 breeding pairs (Blackburn *et al.* 2002, p. 2). By 1991, Dunbar *et al.* (1991, p. 467) estimated fewer than 100 breeding pairs, and by 2002, fewer than 50 breeding pairs (Blackburn *et al.* 2002, p. 12). Barred owls have been detected in British Columbia since 1943 (Grant 1966, p. 39). Barred owl populations rose sharply until the late 1980s, when their detections outnumbered spotted owl detections by four to one (Dunbar *et al.* 1991, p. 466).

A.5.4 Implications of Data

For several reasons most of the barred owl response data cannot be used to determine or even estimate barred owl population size (See Table A-2 for a summary of biases and their implications). In the early years, barred owl detections were based on incidental responses of barred owls to extensive calling surveys for spotted owls. From 1980 to 2008, these incidental detections accounted for 89 percent of all records reported for barred owls in British Columbia, Washington, Oregon, and northern California (Livezey 2009a, p. 54). Incidental detections of barred owls are likely to underestimate their actual numbers. In 1992, a protocol was developed requiring surveyors to record all owl responses to spotted owl calls. Before this, surveyors may or may not have recorded other owl species responses, which also likely underestimated barred owl presence.

Other factors have also contributed to what we believe is a significant underestimation of barred owl numbers. The areas from which barred owl response data have been collected likely represent only a small proportion of the land occupied by barred owls in the west. Data was not widely collected on private land, and spotted owl surveys on Federal land were focused on spotted owl habitat in study areas and areas where potential timber sales or specific management activities were being proposed. Finally, barred owls have a wider habitat tolerance than spotted owls and likely occur in places where spotted owl surveys are not conducted, for example, woodlots in the valleys and the City of Portland. We assume these observations are tracking only a small proportion of the actual numbers of barred owl individuals.

Where data is reported as the number of spotted owl sites with barred owls present, there is often no information on the number of likely barred owl sites involved. The data is recorded as "barred owl presence," which could represent one barred owl site or numerous. This is yet another source of underestimation of barred owl numbers.

Informal estimates have suggested that spotted owl surveyors can detect between one-half and two-thirds of the barred owls present (Gutiérrez *et al.* 2004, p. 7–16). Wiens *et al.* (2011, pp. 534–5) estimated the numbers of barred owls on his study area near Veneta, Oregon, based on detections during spotted owl surveys. When he specifically surveyed for barred owls, Wiens found that barred owl-specific surveys detected almost twice as many barred owls as those detected in spotted owl surveys. D. Rock (2010, pers. comm.) found a 25 to 35 percent increase in responses when surveying specifically for barred owls versus recording incidental barred owl responses while surveying for spotted owls (i.e., using standard spotted owl calls) in north central Washington State.

Table A-2. Potential biases associated with determining the number of barred owls and their impact on spotted owls in the Pacific Northwest. The potential effect on estimating numbers of both barred owls and spotted owls are indicated. The direction of the bias is denoted by "+" (would result in an overestimate) or "–" (would result in an underestimate). The category of "Knowledge" is used here to denote that there is either knowledge that the bias exists or that the potential bias has occurred but its effect has not been ascertained. A 1 or 0 indicates whether we have scientific knowledge of this bias (i.e., do we have information that supports the basis for estimating bias), and the 1/0 indicates that there is anecdotal or correlative information or support for the presence of the bias (but the scale is unknown). The letter "N" denotes that the bias or effect is neutral or is not an issue for the species. A superscript asterisk indicates that the extant data indicate a response has been measured that is opposite to the predication. Table from Gutiérrez *et al.* (2004, p. 7-49, Table 7.4).

	Direction		Knowledge	
Bias	Barred Owl	Spotted Owl	Barred Owl	Spotted Owl
Behavioral Influence:				
Barred owls do not respond to spotted owl calls	-	N	0	N
Barred owls investigate spotted owl hoots by arriving silently	-	N	1/0	N
Barred owls affect the response rate of spotted owls	N	-	1/0	1*
Barred owls have the ability to disperse long distances	+	N	1	N
Barred owls move among spotted owl territories	+	N	1/0	N
Variation in barred owl vocalizations results in missed or unrecognized detections	-	N	1/0	N
Ecological Influence:				
Small barred owl home range size lowers detection probability due to spotted owl survey point distribution across study areas	-	N	0	N

Bias	Direction		Knowledge	
	Barred Owl	Spotted Owl	Barred Owl	Spotted Owl
Survey Extent:				
Barred owls are not surveyed in most areas	-	N	1	N
Barred owl Survey locations restricted to spotted owl habitat	-	N	1	N
Barred owls are detected incidentally during spotted owl surveys	-	N	1	N
Biologists are reluctant to survey for barred owls	-	N?	1/0	N
Procedural Inconsistency:				
Few studies are designed specific to barred owls	-	N	1	N
Inconsistent barred owl survey effort	-	N?	1/0	N
Barred owl detections are reported as cumulative detections	+	-	1	1
Nighttime responses are reported as barred owls detections	+	N	1	0
Data on barred owl detections not consistently reported	-	N	1	N

A.6 Effects of Barred Owls on Other Species

In British Columbia, barred owls are thought to be one of the primary causes of a precipitous decline in western screech-owl populations (Elliot 2006, p. 8). From 1998 to 2002 in lower mainland British Columbia, western screech-owls disappeared from 22 locations where they formerly occurred. The decline of screech-owls was linked to the timing of barred owl expansion, predation by barred owls, competition for nest cavities, and habitat loss (Elliott 2006, p. 8). During screech-owl surveys, Elliott attracted barred owls in 27 out of 215 surveys, and was attacked 11 times (Elliott 2006, p. 9).

Jamie Acker, a birder on Bainbridge Island in Washington State, conducted 358 owl surveys from 1995 to 2010. Bainbridge Island is 72 miles^2 in size and 3 miles west of Seattle. Barred owls were first detected on the island in 1993, and 90 barred owls detected in July 2008. In 1995, Acker detected western screech-owls at 11 locations on the island. Declines in western screech-owl detections in lower mainland British Columbia (Elliott 2006, p. 8) and Bainbridge Island in Washington coincided with an increase in barred owl detections (Acker, undated, unpubl. data).

Barred owls prey on other northwest owl species. In Oregon, northern saw-whet owls and western screech-owls were identified as barred owl prey items (Graham, 2011, unpubl. data), although they comprised a very small proportion of the total diet (less than 1 percent). Barred owls are thought to be a predator of northern pygmy-owls in British Columbia, but with little specific evidence (Darling 2003, p. 5) aside from an observation of an attack. There are also fewer observations of northern pygmy-owls with increases in barred owl observations in southwest British Columbia.

Elsewhere in the barred owl's range, owls do show up in barred owl diets, though they are not commonly found in barred owl pellets or prey remains, and are not a large proportion of the diet. In data compiled from barred owl diet studies throughout North America (north of Mexico), only 13 out of a total of 7,077 samples contained owl remains (Livezey 2007, p. 188). A barred owl was observed carrying a great gray owl in St. Louis County, Minnesota, in 2005, which led to speculation that barred owls prey on this species (Graves 2006, p. 175).

Mammals, birds, reptiles, amphibians, fish, earthworms, snails, slugs, insects, and crayfish are known to be barred owl prey items through analyses of pellets, direct observation, and location of prey remains in the United States and Canada (Livezey 2007, p. 188). Although there is geographic variation of prey species in the barred owl diet, mammals consistently make up the largest portion. Among the mammals recorded as prey remains, small mammals such as cricetid (voles) and sciurid (squirrels) rodents predominate (Mazur and James 2000, p. 5; Livezey 2007, p. 188). Snowshoe hare was the largest item (35 ounces) recorded in the barred owl diet. Known birds in the diet include ducks, hawks, other owls, grouse, woodpeckers, and songbirds. Amphibian, reptile, and invertebrate prey represent a large portion of the diet (Mazur and James 2000, p. 5).

The barred owl's ability to take advantage of rare or opportunistic food sources may be underestimated, given that many diet studies are based on an analysis of pellets, which yield hard body parts, such as skeletal remains, and not soft body parts, which decompose quickly (Forsman *et al.* 2004, p. 222; Livezey 2007, p. 190). Pellet analysis underdetects soft-bodied prey including earthworms and slugs that have no hair, bones, teeth, feathers, shells, or conspicuous chitinous material (Yom-Tov and Wool 1997, entire; Marchesi *et al.* 2002, p. 11). Pellet analysis may also underestimate amphibian, because pellets consisting solely of amphibians break up rapidly (Frith, pers. comm., as cited in Mazur and James 2000, p. 5). Conversely, Graham (2011, pers. comm.) reported skeletal remains of frogs and salamanders were clearly detected in pellets collected from his study area.

Since barred owls will eat most anything in their environment, species with special management emphasis (e.g., species listed under Federal or State Endangered Species Acts, Species of Concern identified by resource management agencies) may be potential prey. While many of these species have not been documented in pellets or prey remains, their rarity makes it likely that we simply missed them. The presence of similar species in barred owl diets leads us to believe that rare species are vulnerable. For example, the Pacific sideband snail was found in a barred owl diet study, which indicates that barred owls may also be taking the related Trinity bristle snail listed as threatened in the State of California and found within barred owl study areas.

The size of prey item seems to limit whether or not barred owls will prey on a species. For example, Graham (2011, unpubl. data) found minute amounts of fish (Class Osteichthyes), bats of the *Myotis* genus, and frogs in barred owl prey remains in western North America. Although these remains could not be identified to the species level, it is possible they contain Species of Concern, such as coastal cutthroat trout and various frog species of the genus *Rana*, including the Oregon spotted frog, a candidate species. Three small *Myotis* bat species were found, indicating that at least one of the three is prey for barred owls. The Yuma myotis is a Species of Concern. Some salamanders cannot be identified to species from skeletal remains, but are grouped into large, medium, and small size classes. Unidentified small Plethodons, possibly including the Van Dyke's salamander, a Species of Concern, were found in samples from Olympic National Park. Unidentified shrews occurred in barred owl pellets at a rate of 37.5 percent in the Olympic National Park study, where the Destruction Island shrew, a Species of Concern, is found (Graham 2011, unpubl. data).

Invertebrates appear to be an important part of the barred owl's summer diet (Mazur and James 2000, p. 5) and, in some areas, crayfish comprise a large portion (Jackson 1987, pers. comm., as cited by Allen 1987, p. 1). In an analysis of 700 barred owl pellets over 20 years (1949 to 1968) on upland and bottomland woodlots in Missouri, crayfish occurred in 13.6 percent of all samples, and 3 percent of the total volume. By year, the average volume of crayfish in the diet was 5 percent, and rated as high as 31 percent (in 1960, n=21) (Korschgen and Stuart 1972, pp. 270, 276). Gronau (2005, p. 82) found a barred owl pellet containing crayfish remnants on Cortes Island in British Columbia. The Shasta crayfish, found in only a few locations in the Pit River drainage in northern California, is listed as endangered under the ESA. There is concern that a single barred owl could deplete an area of Shasta crayfish in a relatively short period of time (USFWS 2009, unpublished data).

A.7 Potential Mechanisms for the Observed Population Trends of Northern Spotted Owls and Barred Owls

A.7.1 Can Barred Owls Coexist With Northern Spotted Owls?

Based on patters of coexistence with other owls, some question whether barred owls and spotted owls could coexist (Gutiérrez *et al.* 2004, p. 7-7). This issue was raised as early as 1976 (Taylor and Forsman 1976, p. 560), "It seems doubtful that two species so similar in food habits and habitat requirements could coexist for long, but this relationship remains to be investigated."

As mentioned earlier, barred owls and spotted owls are congeneric (*Strix*). Owls that coexist in the same habitat generally belong to different genera, and may be able to coexist because of their inherent differences in hunting modes, diet, or other behaviors (Gutiérrez *et al.* 2004, p. 7-7). Congeneric owls usually occupy different ranges or habitats; this is known as resource partitioning. When congeneric owls use the same habitat, they are apt to be very different in size, which influences the type of prey they eat (Gutiérrez *et al.* 2004, p. 7-7). An analysis of body mass in *Strix* owls (Gutiérrez *et al.* 2004, p. 7–12), although preliminary, implies that body mass of these owls must be very different to allow coexistence. The barred owl's body mass is on average 17.5 percent larger than the spotted owl's, which Gutiérrez *et al.* (2004, p. 7–12) believe may be too slight of a difference to allow coexistence.

A.7.1.1 Diet and Foraging Patterns of Barred Owls and Spotted Owls

FOOD GENERALISTS VERSUS FOOD SPECIALISTS. The spotted owl is considered a food specialist, with a focus on four to six species of nocturnal mammals (Forsman *et al.* 2004, p. 214). Spotted owl diets vary by geographic regions and years, and while they do eat a variety of prey including birds, reptiles, amphibians, crayfish, insects, snails and insects (Forsman *et al.* 2004, p. 214), their primary prey are northern flying squirrels in western Washington and northwestern Oregon and woodrats in the southern part of the range (Forsman *et al.* 2004, p. 214).

In western Washington, Hamer *et al.* (2001, p. 224) analyzed prey in 265 pellets from 12 barred owls. The barred owl diet consisted of 74.5 percent mammals, 19.4 percent birds, and 6.1 percent combined fish, amphibians, mollusks, and insects by weight (biomass). Barred owl diets were dominated by terrestrial species and included a high proportion of diurnal prey (Hamer *et al.* 2001, pp. 225–226). Northern flying squirrels made up 20 percent of prey items (18.4 percent of biomass); shrews 9.8 percent of prey items (0.4 percent of biomass); snowshoe hares 8.3 percent of prey items (35 percent of biomass), and Douglas squirrels 8.3 percent of prey items (14.1 percent of biomass).

Although researchers consider barred owls to have a generalist diet, they do exhibit some individual variation. Takats (1998, p. 95) reported that 6.4 percent of a female barred owl prey items were invertebrates, whereas her mate had none. In Olympic National Park, Gremel (2011, pers. comm.) reported that one barred owl appeared to have a preference for fish in the pond near the visitor's center.

IMPLICATIONS OF FOOD GENERALISTS VS. FOOD SPECIALISTS. As food generalists, barred owls may be more resilient than spotted owls to fluctuations in small mammal populations. Densities of dusky-footed woodrats, a dominant spotted owl prey species in the southern part of its range, can vary from year to year (Forsman *et al.* 2004, p. 222), as well as between and within owl territories (Ward *et al.* 1998, p. 79). Densities of northern flying squirrels can also vary considerably (Carey *et al.* 1992, p. 233; Forsman *et al.* 2004, p. 222). If prey populations are reduced, the limited ability of spotted owls, a food specialist, to switch prey would require them to expand their territory in search of their limited food source or move to areas with better prey populations. As generalists, barred owls can forage in a wider variety of habitats than spotted owls. Barred owls can move into open areas outside of forested habitats to forage (Holt and Bitter 2007, p. 10), and are more apt to forage in meadow and riparian areas than spotted owls (Hamer *et al.* 2001, pp. 255–226). In western Montana, the winter diet of barred owls was mostly small mammals with a heavy emphasis on vole species more common in open country (97.6 percent) (Holt and Bitter 2007, p. 7), suggesting the ability to seasonally adapt to food availability.

There may be some difference between winter and summer diet for barred owls. Elderkin (1987, p. 122) describes barred owls as "opportunistic prey generalists" in the breeding season, with the diet becoming more restricted to small mammals and birds in the winter months. In a review of literature on barred owls in North America (north of Mexico), Livezey (2007, p. 189) found mammals comprised 98.4 percent of the barred owl diet during the winter months, and 58.9 percent in non-winter months. Birds (11.9 percent), insects or spiders (11.4 percent), amphibians (10.7 percent), earthworms (2.3 percent), fish (2.0 percent), and crayfish (2.0 percent) were eaten in non-winter months.

Barred owls have diverse methods for capturing food and are highly variable and adaptive hunters, which may help them capture diverse species and types of prey. Barred owls often hunt from perches, waiting for potential prey and pouncing. Barred owls will perch over water to catch fish, or wade in shallow water for crayfish or fish. Barred owls can hunt from the ground, running and pouncing on prey such as amphibians, and likely plunge into snow for small animals (Mazur and James 2000, p. 5).

Barred owls are mostly considered nocturnal or semi-nocturnal hunters, but will also hunt during the day (Mazur and James 2000, p. 5). Elderkin (1987, p. 61) documented a breeding pair of barred owls making prey deliveries to young at night, with peak times just after sunset and right before sunrise. While spotted owls may hunt in open areas or during crepuscular (low light or twilight) or daytime hours, Forsman *et al.* (2004, p. 214) found that 91.9 percent of spotted owl prey animals in Oregon were nocturnal, and that 69.2 percent were either arboreal or scansorial (adapted to climbing).

EVIDENCE OF BARRED OWLS AS OPPORTUNISTIC PREDATORS. Takats (1998, entire) reported two events demonstrating the barred owl's ability to opportunistically take advantage of diverse food sources in the Foothills Model Forest in Alberta. In early May 1996, varied thrushes migrated into the area from the south. An unseasonably cold period after their arrival drew birds onto open roads and cutlines (i.e., straight lines cut in forests for various purposes such as denoting land ownership borders) where snow had melted. Barred owls targeted this food source for 1 week. When the varied thrush became less available to the barred owl, wood frogs became more common in the pellets. The barred owls appeared to be opportunistically feeding on wood frogs in May and early June when the adult wood frogs were dispersing from their breeding ponds. As a result of these events, a total of 10 varied thrushes and 38 wood frogs out of 155 prey items were found in a sample of 89 pellets (Takats 1998, pp. 93–94). This is consistent with observations that barred owls feed on frogs and salamanders traveling to wetlands and roadside ditches to breed (Livezey *et al.* 2008, p. 186). Earthworms were common in May when the owls were also feeding on frogs and salamanders traveling to wetlands and roadside ditches to breed (Livezey *et al.* 2008, p. 186).

After eliminating the species (varied thrush and wood frogs) taken during opportunistic feeding events from the diet analysis, Takats (1998, p. 103) reported that barred owls in Alberta were specialists on microtines (including voles) and sciurids (squirrels) (56.9 percent of diet items), with 68.1 percent of their overall diet being mammals. In western Montana, 37 pellets collected from two barred owl territories in winter included mostly microtines associated with meadows and riparian areas; which may have been due to a period of microtine abundance (Marks *et al.* 1984, pp. 27–28). In a study in Saskatchewan, frogs made up 63.6 percent of the barred owl diet (Mazur *et al.* 1997, p. 68).

The proportions of food items in the diet can change from year to year. For example, the volume of crayfish eaten over a 20-year period in Missouri ranged from 3 percent to as high as 31 percent (Korschgen and Stuart 1972, pp. 270, 276). This is yet another example of the way in which barred owls can respond to changes in prey availability by switching to other species.

Elderkin (1987, p. 101) reported that barred owls hunted for earthworms on rainy nights, possibly when other prey are difficult to find. A Nova Scotia study documented parental deliveries of prey to nestlings in a nest box by camera in 1986; of the 232 prey items brought to 1 nest, 64 (27.6 percent) were earthworms (Elderkin 1987, pp. 101–102). This prey item was confirmed because it was observed on camera, not by pellet analysis.

ARE BARRED OWLS AND SPOTTED OWLS COMPETING FOR FOOD? A comparison of prey from the analysis of spotted owl and barred owl pellets in western Washington showed that spotted owl and barred owl diets overlap by 76 percent, indicating they likely compete for food (Hamer *et al*. 2001, p. 221). Of the spotted owl diet, 98.6 percent (by biomass) comprised mammals; the primary mammal species were northern flying squirrels (58.1 percent), snowshoe hares (13.4 percent), and bushy-tailed woodrats (11.6 percent). For comparison, 74.5 percent of the barred owl diet was mammals (mostly snowshoe hare (45 percent), Douglas' squirrel (14.1 percent), and northern flying squirrel (18.4 percent) (Hamer *et al*. 2001, p. 224).

Barred owls and spotted owls are roughly the same size, and eat the same amount of food. Because spotted owls are more specialized in their prey selection, and therefore are at greater risk if their prey populations are low, they may be vulnerable to food limitations. Hamer *et al.* (1989, p. 60) suggested that the spotted owl in northern Washington exhibits the behavior of a food stressed population, i.e., large home range, low sporadic reproductive rates, low population densities, and nomadic tendencies during the winter.

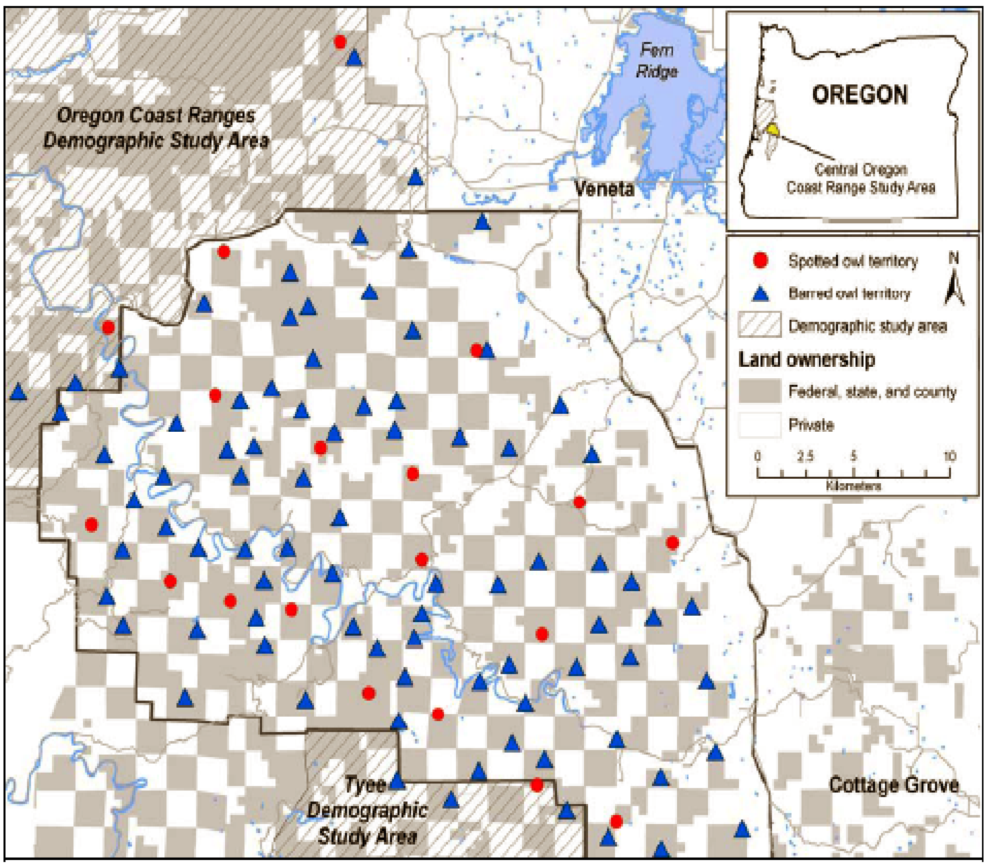
A.7.1.2 Barred Owl and Spotted Owl Density

Barred owls and spotted owls often use the same areas in overlapping territories, although Hamer *et al.* (2007, p. 750) found little overlap of home ranges during the breeding season. Spotted owls have home ranges that are three to four times larger than those of barred owls (Hamer *et al.* 2007, p. 750), which suggests that spotted owl preference for a relatively narrow range of nocturnal mammals means they must range farther to gather sufficient prey. Conversely, barred owls can forage on a broad range of prey, including diurnal and aquatic species (Hamer *et al.* 2007, p. 750), consistent with their apparent ability to meet their food needs within a smaller range.

Northern spotted owls have larger home ranges in the northern part of their range than in the southern part (Carey *et al.* 1992, p. 223), which may be due to lower prey density, habitat fragmentation, or the lower availability of their preferred prey, especially flying squirrels.

Because spotted owl habitat can support many more barred owls than spotted owls, barred owl densities are higher in these areas (Pearson and Livezey 2003, p. 272). A study near Eugene, Oregon, showed 82 pairs of barred owls and 19 pairs of spotted owls on the same landscape (Wiens *et al.* 2009, unpubl. data) (Figure A-4). Considering the dietary overlap between the two species, increased density of barred owls could result in less prey available to spotted owls (Gremel 2005, p.16), and increase the frequency of potentially aggressive interactions (Kelly *et al.* 2003, p. 45; Pearson and Livezey 2007, p. 159).

Figure A-4. Distribution of spotted owl (n=19) and barred owl (n=82) territories within the Veneta Study Area in 2009 (Wiens *et al.* 2009, unpubl. data).



A.7.1.3 Barred Owl and Spotted Owl Reproduction

The ability of barred owls to forage on a wider diversity of prey species and in a wider diversity of habitats may explain their reproductive success in comparison with spotted owls. In many owls, reproductive success is dependent upon availability or size of principal prey. Tawny owls and great horned owls, for example, do not breed in years when prey is scarce (Southern 1970, as cited in Thomas *et al.* 1990, p. 204). Prey abundance has a strong effect on fecundity (the number of female offspring produced per adult female owl) in other owl and raptor species (multiple sources cited in Forsman *et al.* 2011a, p. 61). Forsman *et al.* (1984, p. 33) suggested that the variation in reproductive behavior of spotted owls may be tied to the availability and abundance of preferred prey, but Rosenburg *et al.* (2003, p. 1715) did not find such a clear relationship.

Barred owls have a larger range of clutch sizes (one to five) than spotted owls (one to three) (Gutierrez *et al.* 1995, p. 12; Gutierrez *et al.* 2007, p. 186). Additionally, while barred owls and spotted owls can produce young every year (Gutierrez *et al.* 2007, p. 186), studies in Oregon found only 62 percent of spotted owl pairs attempted to breed each year (Forsman *et al.* 1984, p. 33), and reproductive success fluctuated markedly in even and odd years (Rosenburg *et al.* 2003, p. 1720; Forsman *et al.* 2011a, p. 1). Barred owls typically lay one clutch per season, but a second or even third clutch may be laid if the first is lost (Mazur and James 2000, p. 9).

Hamer (1988, pp. 65-66) suggested that a group of barred owls in Washington produced more young than a group of spotted owls occupying the same habitat. However, it is not clear that barred owls are necessarily more productive than spotted owls (Gutiérrez *et al.* 2004, p. 7–18). Estimates of barred owl productivity range from 1 to 2.4 young per successful nest (Mazur and James 2000, p. 11), as compared with 1.5 to 2.1 young per successful nest for the spotted owl (Forsman *et al.* 1984, p. 34). The reproductive output of the spotted owl population as a whole is low, at 0.744 young per female over all the years of study, regardless of breeding status, averaged over all study areas.

Barred owls may have other effects on spotted owl reproduction and the methods by which we determine spotted owl reproductive success. The meta-analyses suggest a weak or mixed relationship between barred owl presence and spotted owl fecundity. Anthony *et al.* (2006, p. 55) did not find a clear effect of barred owls on spotted owl fecundity, and Forsman *et al.* (2011a, p. 60) found a weak or mixed effect. Forsman *et al.* (2011a, p. 60) propose that barred owls may be displacing spotted owls from their territories, causing the spotted owls to become nonbreeders and more difficult to detect using calling surveys, which focus on territorial (breeding) owls. Spotted owls that remain in their territories continue to breed at historical levels, which the surveys capture as fecundity. However, the reduced number of occupied territories produces fewer young spotted owls overall which explains the low reproductive output of spotted owl populations. This explanation is consistent with the fact that observed spotted owl fecundity rates are not so different from barred owl rates and yet overall downward trends occur in spotted owl populations wherever barred owls are present at densities high enough to displace spotted owls from their territories.

A.7.1.4 Habitat Use by Barred Owls and Spotted Owls

Within the northern spotted owl's range, most barred owls have been located during surveys for spotted owls in historical spotted owl habitats. Therefore, data may not accurately represent the breadth of barred owl habitat use. Based on a review of literature on barred owl habitat use in North America, Livezey (2007, p. 177) indicated that barred owls prefer old or mature mixed deciduous-coniferous forests with high canopy closure. However, they also use varied habitats, including suburban woodlots. The relatively open understory and low density of trees in old mixed forests may contribute to the success of barred owls in capturing prey (Nicholls and Warner 1972, p. 222; Mazur *et al.* 1998, p. 752).

In a study in the dry eastern Cascades, radio-tracked barred owls were observed using habitats similar to spotted owls in terms of canopy closure and tree size, although the home range sizes of barred owls were smaller and concentrated in gentle slopes in valley bottoms (Singleton *et al.* 2010, p. 285). Buchanan *et al.* (2004, p. 231) also found that, compared to spotted owl sites in the eastern Cascades, barred owl nest sites were located on gentle slopes or flat ground, closer to water, and included more hardwoods and a greater richness of tree species. Barred owls nested in black cottonwoods, which are often found in riparian areas and rarely used by spotted owls for nesting.

In western Washington, spotted owl sites tend to be located on steeper slopes and higher elevation areas when barred owls are present compared to when barred owls are absent (Pearson and Livezey 2003, p. 274). Similarly, Gremel (2005, p. 17) found this to be the case in Olympic National Park, where forests had never been logged. Barred owl nests were found in low elevation forests with relatively level slopes, with some proportion of deciduous trees, with wetlands (Gremel 2005, p. 17), and alongside reservoirs or tributaries (Hamer *et al.* 2007, p. 759). Herter and Hicks (2000, p. 283) found that barred owl sites in central Washington contained more deciduous and young forests than did spotted owl sites. While spotted owls may occur in landscapes where young forests predominate, they persist there at low densities and generally nest in patches of old forest (Forsman 1988, p. 67).

In addition to the barred owls known to occupy spotted owl territories, other barred owls undoubtedly produce young in areas outside of currently occupied spotted owl habitat. We expect that as these mature, they would take over more spotted owl territories. Having the ability to use various habitats means barred owls can not only successfully compete for the same habitat that spotted owls use, but can also live in adjacent habitats. This allows barred owls to have a large source population in close proximity to spotted owls.

A.7.1.5 Barred Owl Aggression toward Spotted Owls

Barred owls are on average 18 percent larger than spotted owls (Hamer *et al.* 1989, p. 58) and may attack and kill spotted owls. Gutiérrez *et al.* (2004, p. 7-25) reported that spotted owl surveyors observed barred owls physically attacking spotted owls, and, in one instance, deduced that a barred owl killed a spotted owl (Leskiw and Gutiérrez 1998, entire). Gutiérrez *et al.* (2004, p. 7-25) reported that barred owls have attacked surveyors imitating spotted owls.

As mentioned previously, barred owls have been observed preying on smaller owls, so it is possible that they prey on spotted owls. There are relatively few observations of spotted owls aggressively chasing or physically attacking a barred owl. Those that exist include a nesting spotted owl pair aggressively confronting barred owls, a male spotted owl in a family group pursuing a barred owl out of an area, and a spotted owl pair responding in an agitated manner to a barred owl (Gutiérrez *et al.* 2004, p. 7-25). Gutiérrez *et al.* (2004, p. 7-25) also suggested that barred owl predation on a juvenile spotted owl may have occurred.

There is little overlap between barred owl sites, and barred owl territories are small, well defined, and easily defended, characteristics consistent with the aggressive territorial behavior reported for barred owls (Singleton *et al.* 2010, p. 291). Barred owls are very territorial to other barred owls, even outside their breeding season (Mazur and James 2000, p. 7). When surveyors record barred owl calls, they often hear barred owls crash through branches of the lower forest canopy, behavior apparently meant to intimidate intruders (Wiens *et al.* 2011, p. 536). Spotted owl territories, in comparison, tend to have broadly overlapping foraging areas (Hamer *et al.* 2007, p. 763).

A.7.2 Are Barred Owls Displacing Northern Spotted Owls?

Once barred owls move into an area, spotted owls are less likely to occupy sites in lower elevation or flatter areas (Gutiérrez *et al.* 2004, p. 7-28). Spotted owls may be avoiding barred owls, or barred owls may be displacing spotted owl on nest sites and habitat areas (Gutiérrez *et al.* 2004, p. 7-26).

From the time they were first observed in Olympic National Park in 1985, barred owls appeared to first colonize the floodplain forests and riparian areas. Then, once they were established there, barred owls moved into high-elevation areas and apparently reproduced there as well (Gremel 2005, p. 10). In the Olympic National Park, the presence of barred owls appears to be associated with relocation of northern spotted owl territories to higher elevation areas. Pearson and Livezey (2003, p. 274) also implied that spotted owls are more likely to abandon a site if barred owls take up residence close to that site. Gremel (2005, p. 12) suggests that spotted owls may relocate their nest sites away from barred owl presence even if they don't abandon their territories altogether.

Kelly (2001, p. 31) showed that when barred owls are detected within 0.5 mile of a northern spotted owl territory site center, the spotted owls are more likely to move their site center or disappear entirely than when barred owls were absent or detected at a greater distance away from the site center (Table A-3). This suggests that proximity to barred owls may influence northern spotted owl exclusion from their historical sites.

Table A-3. Influence of proximity of barred owl presence on movement of northern spotted owl territories (data from Kelly 2001, p. 31).

Spotted Owl Site Center Fate	Spotted Owl Territories With Barred Owl Presence Within 0.5 Mile	Spotted Owl Territories Without Barred Owl Presence or Outside of 0.5 Mile
Moved greater than 0.5 mile	46 percent	21 percent
Disappeared entirely	39 percent	11 percent

Herter and Hicks (2000, p. 279) suggested that in the eastside of the Cascades at least, the northern spotted owl and barred owl could be exhibiting some early signs of habitat separation. In comparison to the spotted owl, barred owl sites tend to be found in moister areas of wetlands or mixed riparian stands, and in high-elevation moist coniferous forests.

A.7.2.1 Are Spotted Owls Abandoning Sites or Just Hiding From Barred Owls?

The larger size of the barred owl and its aggressive behavior towards spotted owls may cause spotted owls to alter their use of certain historical sites, abandon their territories, or possibly hide and quit responding to even spotted owl calls (lay low approach). This is supported by Crozier (2006, p. 765), who found that when barred owls are present, spotted owls are less responsive to calls. It could be that spotted owls have abandoned their territories for other areas. Conversely, spotted owls may still be present, but hiding (not calling).

Lack of calling by spotted owls could have significant consequences for reproduction. Spotted owls use calls to communicate during both the nonbreeding and breeding seasons. They use calling to announce territoriality, defend their territory, locate mates, and announce prey deliveries (La Haye 2004, p. 2-4). Calling is especially important in the pair-bonding phase when spotted owls begin to roost together in February and early March and call regularly to one another (La Haye 2004, p. 2-8).

Calling is also important for filling in vacancies that may exist in established owl territories when one mate dies. Dispersing spotted owls, or floaters, call and get responses from established owls that are defending their territories. Based on the type of response, the floater can apparently tell if there is a vacancy of the right gender. If the established owls are not responding because they hear barred owls, it would diminish the ability of dispersing owls to find mates. Additionally, if spotted owls fail to respond to calls during surveys, they could be assumed to have abandoned their territories, and their habitats could be lost to harvesting.

A.7.2.2 If Barred Owls are Removed, Will Spotted Owls Return?

There is some evidence that spotted owls will reoccupy a site when barred owls disappear. Diller (2012, pers. comm.) conducted limited barred owl removal experiments on Green Diamond lands near Humboldt, California, in areas well-documented to have long-term spotted owl site occupancy and reproduction. Once barred owls were detected, the resident spotted owls were no longer detected. When barred owls were removed, the spotted owls came back within a relatively short period of time (2 days to a week). .

Other observations are consistent with the hypothesis that spotted owls may return to their territories if barred owls are removed. Two unoccupied spotted owl sites in Olympic National Park were occupied by barred owls. After the barred owls abandoned the area, the spotted owls returned (Gremel 2003, pers. comm.).

A.8 Why are Barred Owl Removal Experiments the Next Logical Step?

We have heard and engaged in arguments for and against conducting a barred owl removal experiment. Many researchers and biologists argue for moving straight to management control of barred owls. They point to the preponderance of evidence indicating that barred owls are associated with the decline of spotted owls, and the need to take urgent action. Waiting for the results of an experiment could have dire consequences.

Others are more cautious, saying the science has not proven that barred owls are causing the precipitous declines in spotted owl populations, and that more certainty is necessary before taking the management action of removing and potentially killing barred owls. Some stakeholders have voiced ethical concerns about killing one species to benefit another. Others believe that it is too late to try and control the barred owl invasion, even if barred owl management is indicated. We understand and respect all of these arguments. Ultimately, any future decisions on the management of barred owls needs to be backed up by scientifically based information.

The Service is mandated to recover threatened and endangered species. Our agency frequently needs to take action to protect a species without having the level of scientific certainty desired, and we frequently need to take management action against the proliferation of one species to protect another that is threatened or endangered. Specific to this situation, Service managers are understandably reluctant to take management action without knowing whether the task would be effective; that is, would spotted owls return if barred owls are removed? Managers need to know whether management of barred owls is feasible in terms of effort, likelihood of success, and cost. They need to understand the range of options, the least costly way of getting the desired results, and the risk of doing nothing or of delaying action.

People both within and outside of the scientific community have raised other questions, such as:

- What percentage of barred owls in a spotted owl territory would need to be removed before we would see a positive effect on the spotted owl?
- How large of an area would we need to conduct the removal to see a positive effect?
- Is it better to remove barred owls from an area where they are just starting to invade, or would it also be effective to remove barred owls in areas where spotted owls have already been largely extirpated?

These questions are of interest to stakeholder groups, the scientific community, and the Service in attempting to ensure that management, if it is indicated, is both efficient and humane.

A.8.1 The Data: What We Know and What We Don't Know

While research has not yet definitively proven that barred owls are causing declines in spotted owl populations, the preponderance of evidence indicates that they are having a major influence. The data indicate that barred owls now occupy spotted owl territories throughout the range of the northern spotted owl, data that likely grossly underestimates barred owl abundance. We know little about the actual population numbers and trends of barred owls, and the timing of effects on spotted owls. But we do know that when barred owls are present, spotted owls tend to abandon their territories, move to apparently less suitable habitat, or become silent, all of which have negative implications for the ability of spotted owls to reproduce and maintain their populations.

The evidence indicates that barred owls may outcompete spotted owls in the area of foraging, ability to densely occupy habitat, reproduction, and physical aggression. Where barred owls have been detected for the longest time and are the most abundant (Washington), we see the most severe declines of spotted owl populations. The numbers of barred owls are lowest in the southern part of the range, where spotted owl populations are doing better.

Based on a pilot project in California and observations in British Columbia, evidence indicates that if we remove barred owls, spotted owls will return. A removal experiment would also provide us with better evidence of cause and effect. The current data suggest that barred owls are causing the steep declines of spotted owls, but they do not prove it. As Gutierrez *et al.* (2007, p. 181) indicated, barred owl removal experiments may be the best way to show an effect and mechanism on spotted owls.

A.8.2 Why Habitat Protection is not Enough to Recover Northern Spotted Owls

Some have worried that taking action on barred owls reduces the focus on habitat, and could undermine the progress made in protecting old growth habitat. The 1992 Draft Recovery Plan identified habitat loss as the primary threat to northern spotted owls. The 1994 Northwest Forest Plan established a Federal land reserve system to assist with the recovery of spotted owls through habitat protection.

Since 1994, the Northwest Forest Plan has largely succeeded in reducing the loss of habitat from timber harvest on Federal lands (Bigley and Franklin 2004, p. 6-32). The most recent literature and the 2011 Revised Recovery Plan for the Northern Spotted Owl indicate a range of threats, some of which were not discussed in depth in early documents, including barred owls, catastrophic wildfires, forest outbreaks of defoliating beetles, and forest management activities such as harvest and thinning for fuel reduction (Davis and Dugger 2011, pp. 43, 54-55; Forsman *et al.* 2011a, pp. 75-77). Habitat is still one of many issues challenging the recovery of the northern spotted owl.

Using habitat protection as the only or primary strategy for recovering the northern spotted owl has not worked in the past and is unlikely to work in the future because, with the barred owl invasion, reserves are not in and of themselves capable of conserving breeding populations of spotted owls (Pearson and Livezey 2003, p. 272; Gutiérrez *et al.* 2004, p. 7-39). Managing forests to benefit spotted owls over barred owls may not be possible because barred owls use the same old-growth habitat (Pearson and Livezey 2003, p. 272). Reserves appear to be supporting large populations of barred owls; in many cases there are more barred owls than spotted owls in reserves (Pearson and Livezey 2003, p. 274).

We acknowledge that habitat protection is important and critical to long-term recovery of the northern spotted owl, and the Revised Recovery Plan for the Northern Spotted Owl has a suite of recovery actions addressing this (USFWS 2011, pp. III-4 to III-54).

A.8.3 Risk of Doing Nothing

Even though some degree of scientific uncertainty remains, we believe the need to take action to recover species is urgent, and the risk from doing nothing is high (USFWS 2011, p. II-6). A mixture of risk, uncertainty, and feasibility are all involved in recovery planning. The Service and its recovery partners incorporate the best available science, but as with any complex issue, there is always an element of uncertainty. The Service does not always have the time or resources to reduce uncertainty to a comfortable level for all parties, but the agency still has a responsibility to produce a strategy for the recovery of the northern spotted owl.

As part of the 5-year status review process for the northern spotted owl, a panel of scientists helped the Service identify the best available science and most appropriate interpretations of the science with respect to the status of the northern spotted owl. This panel released a report in 2004 (Courtney *et al.* 2004, entire) that assessed the outcomes of the interaction between barred owls and spotted owls. Table A-4 lists the various outcomes and ranks the plausibility of each. The panel concluded that the biggest risk to northern spotted owls was in assuming that the first hypothesis (managing this issue as though the spotted owl could in some way persist throughout its range without intervention) was false (Gutiérrez *et al.* 2004, p. 7-41). It is with that understanding that we believe the barred owl removal experiment is a necessary next step.

Table A-4. Assessment of plausible outcomes of interactions between barred and spotted owls (Gutiérrez *et al.* 2004, pp. 7-41 through 7-43).

Clearly Plausible	Plausible	Not Plausible or Not Clear
• Barred owl will replace spotted owl throughout its range • Barred owl will replace spotted owl in northern, moist areas of its range • Barred owl will replace spotted owl (out-compete) in most but not all of spotted owl range	• Barred owl will replace spotted owl except in selected areas with management intervention • Barred owl will replace spotted owl in north part of range, but spotted owl will persist in areas where it has abundant and diverse prey	• Barred owl will replace spotted owl except in refugia • Barred owl will replace spotted owl except in certain habitats • Barred owl numbers will eventually stabilize or decline • Barred owl will only replace spotted owls where weather and habitat create synergistic effects on spotted owls

Appendix B

Scoping Summary Report for the Barred Owl Experimental Removal Environmental Impact Statement

B.0 Changes between Draft and Final EIS

- No substantial changes from draft

B.1 Introduction

This documents the results of scoping completed by the Service's Oregon Fish and Wildlife Office, in coordination with the Western Washington and Arcata Fish and Wildlife Offices, during the initial stages of development of a Draft EIS for the experimental removal of barred owls within a portion of the range of the threatened northern spotted owl. This provides a foundation of public comments and issues related to the proposed project, as mandated under the National Environmental Policy Act and its implementing regulations.

B.2 Public Scoping

B.2.1 Barred Owl Stakeholder Group

In 2009, we initiated early scoping to begin to identify and address concerns for public controversy surrounding the potential removal of barred owls. We were aware of public concerns regarding ethical considerations of removing barred owls, especially lethal removal that may be highly objectionable to some publics.

As part of the implementation of the 2008 Recovery Plan for the Northern Spotted Owl (USFWS 2008, entire), we established a Barred Owl Stakeholders Group to provide a forum for stakeholder discussion on the issue of barred owl removal experiments. We invited a broad range of environmental, animal welfare, and industry groups; Federal, State, and local governments; and Native American tribes. Meetings of the Barred Owl Stakeholder Group included some members of the Barred Owl Work Group. The Barred Owl Work Group was established as part of the 2008 Recovery Plan for the Northern Spotted Owl to coordinate actions related to barred owl research, management, monitoring, and public outreach (USFWS 2008, p.

30). The Barred Owl Stakeholder Group was specifically asked to provide perspectives on experimental removal of barred owls, the appropriate ethical and moral considerations of conducting such experiments, and other factors and issues that the Service should consider as we design the removal experiment and conduct the necessary environmental review on such a proposed action.

To assist the Service and the stakeholders in understanding the basis of ethical considerations of such experiments, we hired a professional ethicist, Dr. William Lynn, to meet with the Barred Owl Stakeholder Group. During a day-long meeting in Portland, Oregon on April 2, 2009, Dr. Lynn conducted a training session to assist the participants in their understanding of the history, development, classification, and application of the primary tenets of ethical reasoning. As a follow-up to the introductory session, Dr. Lynn conducted conference calls with subgroups of the larger stakeholder group, during which a set of focus questions was discussed that had been distributed prior to the call. The subgroups included agency and tribal representatives (May 6, 2009); industry representatives (May 13, 2009); and environmental and animal nongovernmental organizations (May 20, 2009).

Members of the Barred Owl Stakeholder Group and Barred Owl Work Group met in Eugene, Oregon on June 17 and 18, 2009. The first day of the meeting included a presentation about conflicts between barred owls and spotted owls and a field trip to a historically occupied spotted owl site in the Oregon Coast Ranges. The presentation and site visit were hosted by David Wiens, doctoral candidate at the Department of Fisheries and Wildlife, Oregon State University, Corvallis. During that site visit, participants saw an example of a spotted owl pair that had apparently been excluded from its historical site center, now occupied by barred owls. The spotted owl pair had failed to reproduce at an alternate site center, an areas with little habitat. The site visit also allowed participants to view habitat conditions. The second day of this meeting focused on group discussion of ethical issues specific to the Service's possible consideration of lethal and nonlethal removal of barred owls from one or more study areas. The approach presented to the stakeholder group was based on recommendations for the experiment from the Barred Owl Work Group, and included experimentation in areas with up to 2 decades of demographic data and monitoring spotted owls.

B.2.2 Publication of the Notice of Intent

On December 10, 2009, the Service published the Notice of Intent to Prepare an Environmental Impact Statement Related to Experimental Removal of Barred Owls for the Conservation Benefit of Threatened Northern Spotted Owls (Notice of Intent) in the Federal Register (74 FR 65546). The Notice of Intent advises the public that we intend to gather information necessary to prepare a Draft EIS for barred owl removal experiments designed to determine if the species' presence is affecting spotted owl population stability and growth, and to test the feasibility of removing barred owls from specific locations. We published the Notice of Intent to advise other agencies and the public of our intentions, and to obtain suggestions and information on the scope of issues to include in the Draft EIS.

We invited comments and suggestions from all interested parties to ensure consideration of a full range of alternatives consistent with the purpose and need, and the identification of all significant issues. We requested that comments be as specific as possible in regard to the above-mentioned purpose and need, and include information, issues, and concerns regarding:

- The direct, indirect, and cumulative effects that implementation of any of the potential alternatives could have on endangered and threatened species and their habitats.
- Other possible alternatives and their associated effects.
- Potential adaptive management or monitoring provisions.
- Baseline environmental conditions within the range of the northern spotted owl.
- Other plans or projects that might be relevant to this project.
- Measures that would minimize and mitigate potentially adverse effects of the proposed project.
- Considerations for the ethical and humane treatment of barred owls removed during the experiments.
- Any other information pertinent to evaluating the effects of this project on the human environment.

The public comment period remained open from the date of publication until January 11, 2010. The Service did not conduct any public scoping meetings as part of this process, instead relying on public comments, early scoping, and direct feedback from the Barred Owl Stakeholder Group and Barred Owl Work Group.

B.2.3 Summary of Public Participation

The Service received a total of 54 written comment letters, memos, and emails from 54 individual submitters (some documents were signed by multiple persons or organizations) within the public comment period for the Notice of Intent (Table B-1).

Table B-1. Summary of organizational representation in comment responses.

Respondent Category	Number of Respondents
Individuals	25
Environmental, Conservation, and Animal Welfare Organizations	13
Wildlife Rehabilitation Practitioners	5
Professional Societies or Chapters	4
Governmental Agencies	4
Tribes	1
Timber Industry Organizations	1
Zoological Gardens	1
Total Number of Respondents	**54**

B.2.4 Summary of Substantive Scoping Comments

In reviewing the 54 written comment letters and emails, several issues were commonly noted. This section summarizes those issues.

B.2.4.1 Suggestions for Improving Experimental Design.

Several commenters provided suggestions on the methods to be used in the design of the actual experiment, including (1) using sound recording devices rather than broadcast calls to monitor owls; (2) including measures of habitat fragmentation to describe the habitat; (3) addressing scientific uncertainty: (4) incorporating radio-telemetry to document behavioral interactions between the two species; (5) varying the number or proportion of barred owls removed to test levels of interaction based on population density; (6) documenting the factors that may have contributed to the barred owls initial invasion and current success; (7) including partial removal of barred owls, in addition to full removal, in the treatment areas; (8); using only trained professionals to conduct the removal; (9) incorporating long-term monitoring to assess the future effects of the removal; (10) ensuring the results apply across the range of the species; (11) determining the efficacy of lethal versus nonlethal removal; and (12) determining the natural checks and balances of barred owls.

B.2.4.2 Selection of Existing Versus New Study Areas.

Some commenters supported the use of existing study areas, while other commenters suggested that other study areas should be considered to avoid conflicts with existing spotted owl studies or monitoring.

B.2.4.3 Focus on California and Potential for Additional Legal Protections.

One commenter requested that northern California be given consideration for experimental removal to avoid the barred owl invading the range of the California spotted owl, the need to list the spotted owl under California State law, or the need to change the status of the northern spotted owl from threatened to endangered under Federal law.

B.2.4.4 Benefits of the Experiment to Ongoing Spotted Owl Recovery.

Commenters suggested the Service consider the benefits of particular study areas as source populations for future recovery as a criterion for study area selection. Those areas most likely to provide for strategically important future recovery should be given careful consideration.

B.2.4.5 Other Behavioral and Habitat Studies Should Precede Removal Studies.

One commenter requested that the Service pursue other studies documenting the interactions between spotted and barred owls that affect their habitat use and behavior prior to conducting any removal experiments. This group thought the Service should provide better justification for proceeding to removal (especially lethal removal) without having done other interactions studies first.

B.2.4.6 Habitat Effects as a Factor Influencing Barred Owl Effects.

Several commenters recommended that the experimental removal experiment include a means to determine the effects that various amounts of suitable habitat may have on the interactions between barred and spotted owls, and to determine if there was some level of habitat protection that would support spotted owls and barred owls where removal would be unnecessary.

B.2.4.7 Minimize Risk of Inadvertent Killing of Spotted Owls.

One commenter raised the question of the likelihood that one or more spotted owls would be killed during barred owl removal, given their similarity of appearance, and encouraged the Service to develop standards to minimize or avoid such risk to spotted owls.

B.2.4.8 Tribal Response.

Only the Confederated Tribes of the Colville Reservation provided written comments during the scoping period. These comments described the cultural significance of owls to some tribes: “Owls figure significantly in our legends and oral traditions. It is against tribal code to hunt or kill any owls.” However, these comments went on to conclude that neither the spotted owl nor barred owl has specific traditions, and that their tribe (which only marginally overlaps the range of the northern spotted owl) would “leave those decisions to tribes with a closer relationship to the species identified.”

B.2.4.9 Experiments Should be Completed as Soon as Possible to Address Increasing Risk.

Two commenters strongly recommended that the Service proceed as quickly as possible to implement this experimental removal, citing the recent, significant declines of northern spotted owls throughout their range, and the substantial evidence that barred owls are a direct cause of the spotted owl decline. One commenter recommended that the experimental approach be abandoned, and the Service should consider initiating management removal as soon as practical. The Service should “speed up the process”. Two commenters were complimentary of the Service for addressing this controversial issue, and taking on the task of an experimental removal project.

B.2.4.10 Consideration of Nonlethal Removal, and Other Ethical Concerns.

Several commenters recommended the Service employ only nonlethal removal methods, rather than lethal removal methods. Several commenters thought lethal removal methods to be too extreme, or unethical. Some commenters stated that the barred owl is a native species, and that their invasion into the range of the northern spotted owl was essentially a natural event that humans should not interfere with, and allow these two closely related species to "work it out". At least two commenters suggested that removal of barred owls would have unpredictable consequences to spotted owls or other species, or even to barred owls themselves. At least one commenter suggested the Service include a nonlethal removal alternative, even if the Service considers such an alternative to be impractical. One commenter offered to assist with trained wildlife rehabilitation professionals and drivers to move live barred owls to suitable locations. One commenter recommended no removal of barred owls due to their protections under the Migratory Bird Treaty Act). One commenter requested that the Service ensure that removal does not occur during the nesting season, when dependent young would be abandoned or otherwise harmed.

B.2.4.11 Public Relations and Disclosure of Future Management Intent.

Commenters suggested that the Service pursue a strong public relations effort, to inform the public of the need to conduct this experiment, to address concerns that this experiment will inevitably lead to widespread management removal of barred owls regardless of experimental outcome, and to disclose to the public its future intentions for a massive lethal barred owl management program.

B.2.4.12 Include Genetic Information in Experiment Needs.

Some commenters suggested the Service include in its removal experiment aspects of species genetics and bottlenecks that may be at least partially the cause of decline of spotted owls.

B.2.4.13 Long-term Ability of the Service to Fund and Conduct Removal

Commenters questioned the ability of the Service to remove sufficient numbers of barred owls to conduct a viable experiment or, more importantly, to be able to maintain areas devoid of barred owls in the long term as a feasible management activity with reasonable cost and effort. At least one commenter requested the Service disclose estimates of the cost of completing the experiments and costs of long-term removal; if long-term removal is too costly, why do the experiment? Some commenters suggested that the Service allow the two species to co-adapt, whereas others recommended the Service conduct removal experiments, or protect additional habitat, only until the spotted owl adapts to the invasive barred owl.

B.2.4.14 Barred Owl Control is Not a Substitute for Habitat Protection.

Several commenters provided clear opinions that the barred owl threat to the spotted owl should be considered as secondary to the threat of habitat loss, and should not become a scapegoat for the decline of the spotted owl. Several commenters considered past and ongoing habitat loss as the most important threat, and continued efforts to retain suitable habitat should be the Service's focus. Several commenters strongly recommended that additional habitat protections are needed to provide additional refugia and future recovery benefits to spotted owls. Retention of suitable habitat, or inclusion of additional suitable habitat, was of higher importance to conducting experimental removal of barred owls. Other commenters expressed that the sole reason for the decline of the spotted owl is the loss of old-growth forests, and the barred owl invasion was not a factor at all. Several commenters provided support to conducting the experimental removal, but cautioned against losing focus on the habitat issue.

None of the commenters identified significant issues related to vegetation, hydrology, noxious weeds, soil, water quality, air quality, recreation, transportation, land use, aesthetics, grazing, education, archaeology, public access, public health and safety, or national defense.

B.2.5 Incorporation of the Information Received During Scoping

All comments were fully considered in the development of the Draft EIS. As the Draft EIS was developed the 14 identified issues, plus others raised within the Service and other Federal agencies, were addressed through the consideration and development of action alternatives, within our analysis of effects, or otherwise within the Draft EIS.

Appendix C

Potential for Translocation of Captured Barred Owls: Summary of State and Zoo Responses to Our Questionnaire

C.0 Changes between Draft and Final EIS

- No substantial changes from draft

C.1 Background

In 2009, the Service established the Barred Owl Stakeholders Group, composed of over 40 invited representatives from relevant government agencies, the forest products industry, Native American tribes, wildlife rehabilitators, environmental organizations, and animal welfare and protection groups, to help identify ethical and humane concerns with the proposed barred owl removal experiment. Based on input from the stakeholder group and the Barred Owl Work Group, we identified methods of lethal and nonlethal (capture, handling, and transport) removal of barred owls.

Nonlethal removal is only possible to the extent we have a permanent location ready to accept the captured birds. We considered two general approaches: translocation and release to the wild, or captivity.

C.2 Translocation

Translocation, the movement of captured barred owls to new areas for release in the wild, sounds more humane to some people, but does not ensure that the individual birds will live. If individuals are relocated to areas where barred owls already saturate the habitat, leaving no empty territories, the translocated individuals will likely either die or displace an individual already established in that area which may well die. Translocated birds are often at a disadvantage in this situation, as they do not know the habitat and food as well as local owls. Thus, the likely outcome of translocation of barred owls in to saturated habitats is the death of a barred owls and this death is not necessarily humane (e.g., starvations, injury). Therefore, we only considered release areas where barred owl populations do not saturate the available habitat.

Because the expansion of barred owl populations is a concern for the conservation of northern spotted owls (spotted owl) and other native species, we are not considering release of barred owls within their expanded range. We do not want to increase the rate of barred owl population growth where they are not currently present. We also do not want to spread the effect of barred owl predation to other species that did not evolve with barred owl. We are also concerned that barred owls translocated within the northwest could return to their territories, reducing the effectiveness of the experiment.

This left us to consider translocation of captured birds to their pre-1900 historical range. We contacted States in the historical range of the northern barred owl, the subspecies of barred owls found in the northwest to determine if they were interested in receiving barred owls for relocation. We developed a questionnaire for States in the historical range of barred owls, the purpose of which was to determine the feasibility of nonlethal methods, specifically translocation. We wanted to determine whether translocating barred owls to unoccupied areas of their historical range was possible, and identify concerns about logistics for those States with an interest in receiving these owls.

C.2.1 Methods

On February 11, 2011 we sent a letter and questionnaire to 29 State wildlife agencies within the historical range of the barred owl. The letter discussed the threat that barred owls pose to spotted owl populations, the Revised Recovery Plan, the recovery action describing the experiment, and the development of the Draft EIS.

The information gathered by the questionnaire included the following: (1) Contact information; (2) the population status and management status of barred owls in that State; (3) whether sufficient unoccupied, yet suitable habitat exists to accommodate relocation of barred owls; (4) whether the state has any interest in receiving captured barred owls from the west for release in their State, and if so, the number of barred owls the State would be willing to receive; (5) any concerns they had with the potential relocation and whether research, funding, monitoring, and parasite screening would alleviate those concerns; (6) Whether the State, if willing to accept barred owls, was willing to pay for analyses to address genetic or disease concerns, or costs associated with treatment or transport; and (7) any recommendations of zoos, research institutions, or similar organizations that might be willing to receive translocated barred owls for educational or scientific purposes that they were aware of.

After a month, we called all States that had not responded and resent questionnaire to those that requested it. We made additional follow-up calls to remind our contacts about returning the questionnaires. Once we had contacted States three times, we ceased to do any more follow-up reminders.

C.2.2 Results

We sent letters and questionnaires to 29 States. Of those, 23 returned the questionnaires, two sent emails with some information but no questionnaire, two sent emails referring us to other people without any information, and two never replied.

In 22 States, barred owl populations are either stable or increasing. In one State, their status is unknown. One State (New Jersey) had decreasing populations because available habitat was disappearing. Barred owls have no special status in 18 states and a protected status in 6. Only one State (New Jersey) indicated that it has a management program for barred owls.

Eighteen states said they did not have sufficient unoccupied habitat to accept translocated barred owls. New Jersey indicated that it does not have any suitable unoccupied habitat to accept translocated barred owl. Four were unsure, and two did not answer the questionnaire. Twenty-four states were not willing to accept translocated barred owls. Only one (Wisconsin) said that this might be possible in the future, though not now.

Concerns about relocation of barred owls included, in order of prominence in the 23 responses: dilution of local genetic variation and potential conflicts with territorial barred owls (19), spreading of disease or parasites (18), cost (17), conflicts with other species (10), regulatory limitations (7), mixing of subspecies (6), and other (4). States gave mixed responses as to whether research, screening for disease and parasites, behavior monitoring and additional funds would help allay concerns about translocation. No State indicated a willingness, either with or without assistance, to accept relocated barred owls at this time. No State indicated a willingness or ability to pay costs for analysis or, for that matter, any other cost.

We received suggestions that we contact 31 zoos or other institutions that might be willing to take barred owls for educational or scientific purposes. We will pursue this before the Final EIS is complete.

C.2.3 Discussion and Implications

In responding to the questionnaire sent to the States, many States described their concerns about translocating barred owls and described the status of barred owls in their State, but in the end, none were willing to accept barred owls for release. In addition to their concerns about translocation in general (i.e., potential conflicts with other species, including territorial barred owls, disease and parasites, genetics and cost), all States indicated their concern about not having sufficient unoccupied barred owl habitat to receive additional, translocated owls. Sufficient suitable barred owl habitat, not already occupied by territorial barred owls, would need to be present to provide a release area for translocated barred owls. We were not able to locate any release sites for translocating barred owls to their historical range.

C.3 Permanent Captivity

The only remaining option for nonlethal removal was captive holding, temporary or permanent.

Temporary captivity would require that we locate or develop a holding facility for a large number of barred owls (between 250 and 8,950 owls). The barred owls would have to be maintained (housed, fed, and exercised) for the duration of the removal portion of the experiment, from 3 to 10 years depending on the alternative selected. Once the experiment is complete, the owls would be released back into the wild, hopefully in the area from which they were removed. Not all owls adjust well to captivity, and undoubtedly some would die from stress or disease. Some of the captured birds would already be several years old at the time of capture and would likely die of old age. Finally, animals maintained in captivity for several years lose their wildness and are not suitable for release back into the wild. They can easily lose their skills for hunting live prey, making it likely that they would not survive for long once released. Because of all these concerns and issues, we do not consider temporary captivity a viable option.

That left permanent captivity as our only option for placement of birds captured and removed from the study areas. Maintaining owls in captivity is not easy or inexpensive. We would only consider placing barred owls with organizations that have existing facilities adequate to provide a good quality of life for the barred owls. This requires large caging with room for flying, an adequate source of food, and the funds to continue this care for the life of the individual owl. In addition, any facility receiving barred owls would need to have any required State or Federal permits in possession before the barred owls were captured. We would require that any facility make the long-term commitment to maintain the barred owl for its lifetime, not release the bird to the wild, and not breed the birds.

We attempted to contact potential interested zoos and facilities with the help of Shawn St. Michael, Assistant Zoological Curator of the Birds/Jonsson Center for Wildlife Conservation at the Oregon Zoo. We sent a request for interest through the Association of Zoos and Aquariums, Raptor listserve, describing the situation and seeking interest. We asked interested parties to fill out a form that included information on how many barred owls they would be interested in accepting, whether they had the necessary permits, and whether they were willing or able to cover some of the associated costs. We received interest from three facilities, with interest in a total of five or six individual barred owls. We will continue to solicit interest from facilities for the Final EIS, including contacting zoos and zoological parks directly.

The following letter was sent to states requesting interest in translocation of captured barred owls from the Northwest.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oregon Fish and Wildlife Office
2600 SE 98th Avenue, Suite 100
Portland, Oregon 97266
Phone: (503)231-6179 FAX: (503)231-6195

Reply To: 8181.0764A
File Name: Translocation Letter
TS Number: 10-452

Dear:

Subject: Request for information regarding the status of the barred owl, and opportunity for translocation

The U.S. Fish and Wildlife Service (Service) requests a few minutes of your time to provide us with essential information concerning the status of the barred owl within your jurisdiction, and the potential interest your state may have in accepting live-captured barred owls (Strix varia) from the Pacific Northwest states of Washington, Oregon and California. We have attached a short information form to focus and simplify your response.

Background

In 1990, the Service listed the northern spotted owl (Strix occidentalis caurina) throughout its range in Washington, Oregon and California as a threatened species under the Endangered Species Act. The primary threat to the species at the time of listing was past and ongoing loss of its preferred habitat, old growth and mature forests dominated by conifers and mixed conifers-hardwoods, from timber harvest and other disturbance.

At the time of the northern spotted owl listing, the closely related barred owl was a relatively recent colonizer of the Pacific Northwest, having extended its pre-European range from eastern North America starting probably 100 years ago. They reached Washington around the 1960s, and continued to expanding southward into Oregon, and finally California. Barred owls continue to increase in population numbers and density, now occupying the entire range of the northern spotted owl and recently expanding south into the range of the California spotted owl (S.o. occidentalis).

Barred owls now occupy much of the old growth and mature forest habitat that is preferred by the northern spotted owl. They have shown themselves to be habitat and prey generalists compared to northern spotted owls, able to use a variety of mid-seral forest habitats and prey species, in addition to older forest. Increasing evidence indicates that barred owls may be excluding northern spotted owls from their habitat through aggressive encounters, nest site usurpation, or competition for prey resources. Some researchers believe barred owls are contributing to the ongoing decline of the northern spotted owl. For example, populations of northern spotted owls have declined most significantly in areas where barred owl populations are most numerous and have been established for the longest time period. While barred owls were considered a potential threat of unknown severity at the time we listed the spotted, we now consider the barred owl to be one of the primary threats to the conservation and recovery of the northern spotted owl.

To respond this significant threat, the recently completed 2008 Recovery Plan for the Northern Spotted Owl identifies the need to conduct a series of designed experiments to examine and document the effect of barred owls on northern spotted owl population dynamics (Recovery Action 29). If the results of these experiments show a significant negative effect, the Service may consider, through separate planning and review, long-term management of barred owls to ensure recovery of the northern spotted owl. For specific information about this and other recovery tasks involving barred owls, we refer you to the recovery plan. The full document may be downloaded from:

www.fws.gov/pacific/ecoservices/endangered/recovery/NSORecoveryPlanning.htm.

To implement Recovery Action 29, Region 1 of the Service has initiated an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) to evaluate the feasibility of these experiments and options for their implementation. These experiments likely will involve removing barred owls from a portion of existing spotted owl population study areas while monitoring the response of northern spotted owl and barred owl populations within paired treatment and non-treatment areas. We anticipate these experiments will occur over a period of three to 10 years, beginning 2011, and will occur on one or more demographic study areas where researchers have studied the northern spotted owl for much of the past 20 years.

A stakeholder group assisting us in the scoping process for this project has requested that the Service fully consider live capture and translocation of barred owls as a method for removal from the treatment areas, and not rely solely on lethal removal. Lethal methods would most likely include field crews calling in barred owls and dispatching them with shotguns; nonlethal methods would most likely include similar crews using various live-trapping techniques. For nonlethal removal to be feasible, we would need to permanently relocate the trapped individuals, either to their historic range, or to captive holding facilities (zoos or zoological parks) for scientific and educational purposes.

The Service is working closely with our stakeholder group to identify any and all capture, handling, transport and other methods that ensure the highest standards of ethical treatment of live-captured as well as lethally removed barred owls. For lethally removed individuals, we expect to fully implement standards for removal that minimize concerns over unnecessary killing. For relocated barred owls, the Service is pursuing appropriate information to address concerns over translocation outside the historic range of the northern barred owl (S.v. varia) subspecies from which our birds most likely descended, and addressing other concerns for genetic makeup of the relocated birds. In addition, we want to ensure that relocated individuals do not create unnecessary conflicts with resident barred owls or other native species through competition for resources or predation or affect the genetic makeup of local populations.

Request for Information

To fulfill the expectations of our stakeholder group and reasonably inform our EIS analysis, we are requesting information from state wildlife agencies within the historic range of the northern subspecies of the barred owl. We are asking for your help in completing the attached 12-question information request. We respectfully request your timely response so that we can evaluate the potential for live capture and translocation of some or all barred owls necessary for removal from our study areas during the period of study.

In addition to reducing the number of barred owls lethally removed, there may be significant conservation benefits for barred owls if states within the northern barred owl's historic range have currently unoccupied yet suitable habitat available. We would appreciate the opinion of your state wildlife or other appropriate state agency. Should your agency express interest in acquiring translocated barred owls, we will be in further communication regarding specifics and logistics. If we decide to conduct the experiments and capture barred owls, we will contact you with a request for more formal coordination. Completion of this questionnaire does not obligate the state to accept these birds in the future, but we need your honest evaluation as to any interest in accepting translocated barred owls so we may accurately evaluate the potential for such translocations.

The results of this information request will be summarized with the responses of other states and presented in the draft EIS. If you desire, we can provide a copy of the draft EIS for your review and comment when it becomes available this spring. Full results of the state responses to our information request will be emailed to all participants once the data are fully analyzed.

Please do not hesitate to contact Robin Bown U.S. Fish and Wildlife Service, 2600 SE 98th Ave, Suite 100, Portland, OR 97266, phone (503) 231-6179, Fax (503) 231-6195, robin_bown@fws.gov if you have any questions. To expedite our effort, please mail or email the completed information request to me by Friday, February 19, 2010.

Thank you in advance for your assistance on this important conservation issue.

Sincerely,
Paul Henson, PhD.
State Supervisor

Information Request Regarding Relocation of Barred Owls

As part of our information collection for an EIS on the potential experimental removal of barred owls to identify potential conservation benefit of threatened northern spotted owls in Washington, Oregon, and California, we are seeking information on the potential for relocation of captured barred owls. Response to this information request does not represent a final commitment by the responder. Information will be used to evaluate the potential feasibility of relocating captured barred owls. Please direct any questions to Robin Bown at (503) 231-6179 or ***Robin_Bown@fws.gov.***

Thank you in advance for your timely response to this request.

1. Please provide the following information for whomever in your agency would be the most appropriate contact point for correspondence or additional information requests regarding this subject:
   Name ____
   Agency ____
   Position ____
   Address ____
   Address ____
   Email ____

2. How would you describe the current *population* status of the barred owl in your state? Please check the cell corresponding with the status and rating of certainty you believe is most reasonable given your agency's current state of knowledge.

Status	Very Likely	Likely	Unlikely	Very Unlikely	Unknown
Increasing					
Stable					
Decreasing					

3. Indicate the current *management* status of the barred owl in your state. Check any that apply:

   □ Barred owl has no special status in this state.
   □ Listed as Threatened or Endangered under state law or regulation.
   □ Is a candidate for listing under state law or regulation.
   □ Other state-wide special status. If so, please describe: ____________
   ____
   □ Is a species of conservation concern (e.g., listed in state wildlife plan). If so, please describe: ____

____

4. If the species has special management status, does your state implement a management program that addresses the factors that limit the population? Please circle: No Yes

   If "yes" please briefly describe: ____

____
____

5. In your estimation, does your state have sufficient unoccupied yet suitable habitat to accommodate relocation of barred owls?

   □ No, all known suitable habitat is considered fully or potentially occupied.
   □ Yes, we have areas of suitable habitat to support translocated barred owls.
   □ We have insufficient information to indicate that habitat may be unoccupied.

6. Would your state potentially be interested in receiving translocated barred owls? Please check the most appropriate response:

   □ No, my state has no interest now or in the foreseeable future.
   □ Yes, my state has a definite, immediate interest.
   □ Possibly. My state would be willing to consider in the future, perhaps part of a longer term management approach.

7. If barred owls can be provided, can you estimate of the *maximum number of pairs* of barred owls your state might be willing to receive *over a three-year period*? Please circle your most reasonable estimate:

   Zero 1-10 11-20 21-50 51-100 101-200 01-400 > 400 No estimate

8. We understand that even if you are willing to receive barred owls, you may have some concerns. So whether or not you are interested in receiving barred owls from Washington, Oregon or California, please indicate concerns you may have with the proposed relocation? Please check all concerns that apply.

   □ Genetic concerns (e.g., genetics of relocated animals dissimilar to residents)
   □ Subspecies concerns (e.g., the northern barred owl does not occur here)
   □ Disease/parasite concerns (e.g., relocated animal carrying parasites)
   □ Conflicts with barred owls already resident in the relocation area
   □ Conflicts with other native species in the relocation area
   □ Cost concerns (e.g., monitoring costs, transportation costs, etc.)
   □ Regulatory concerns (e.g., translocation requires state regulatory review)
   □ Other concerns: ____

9. Would the methods below eliminate your concerns, or reduce them to an acceptable level? Please circle:

   Genetic research into source population prior to relocation. No Yes Not sure
   Disease/parasite screening prior to relocation. No Yes Not sure
   Behavior monitoring after relocation. No Yes Not sure
   Your agency would require financial support for relocation. No Yes Not sure
   Other methods (please describe): ______________________________________
   ____
   ____

10. If your state is willing to receive barred owls, would your state be willing to pay for certain analyses prior to translocation to address genetics or disease/parasite concerns? Please circle:

Genetics:	No	Yes	Partial	Not sure
Disease/parasites:	No	Yes	Partial (	Not sure

11. If your state is willing to receive barred owls, would your state be willing to pay for certain costs associated with treatment or transport of the owls? Please circle:

Veterinary inspection:	No	Yes	Partial	Not sure
General care:	No	Yes	Partial	Not sure
Transportation costs:	No	Yes	Partial	Not sure

Can you recommend any zoos, research institutions, or similar organizations who we may contact that may be interested in acquiring barred owls for educational and scientific purposes?

Describe other concerns or standards for how and where we would translocate, and what conditions we would consider as appropriate for translocation?

Any additional thoughts?

Please return this questionnaire to: Robin Bown, USFWS, 2600 SE 98th Avenue, Suite 100, Portland, OR 97266 or via email: robin_bown@fws.gov

Appendix D

Methodology for the Removal of Barred Owls.

D.0 Changes between Draft and Final EIS

- Reorganized the protocol to clarify intent.
- Clarified the removal of hybrids
- Clarified safety, training, skills, and presence of dogs.
- Added a requirement for training on humane field euthanasia techniques and possession of needed equipment.

D.1 Introduction

The U.S. Fish and Wildlife Service (Service) intends that any removal of barred owls for purposes of this Barred Owl Removal Experiment will be conducted in a professional manner using methods that are safe, humane, and effective while meeting the scientific need to collect the necessary experimental information. We adopt the following guidelines and precautions to ensure that barred owl removal meets this intent through appropriate consideration of methods, timing, and safety. Removal methods must ensure humane treatment of all affected barred owls. Every effort should be made to minimize the risk of unnecessary injury or trauma to barred owls or non-target species.

Changes to this methodology may occur during the experiment if information and experience justify changes that would make removal safer or more effective, while maintaining the intended high standards for humane and ethical treatment of affected animals. Any proposed changes would require approval by the Service prior to their adoption and implementation. These guidelines, as presented here, apply to this project alone, but may be used or adapted to other projects following any needed environmental review of those future projects.

D.2 Considerations Prior to Conducting Removal Activities

D.2.1 Limitation on Removal of Barred Owls with Dependent Young

The intent of this protocol is to avoid removal of barred owls with dependent young. Under all methods, removal of barred owls will be limited to adults or subadults not currently providing for dependent young, or to juvenile and immature birds independent of parental care. No removal of breeding barred owls with dependent young should occur, to avoid leaving orphaned young.

Removal of barred owls should generally be conducted during the fall and winter period after young are independent of their parents and prior to the egg hatching during the subsequent breeding period. Conducting removal between the post-fledging period and before the earliest date when eggs have hatched provides a high level of confidence that dependent young will not be orphaned. The specific dates will be developed for each study areas and approved by the Service prior to any removal, consistent with the intent of these guidelines. If a credible protocol or approach is developed that allows researchers responsible for barred owl removal to determine the non-nesting status of barred owls, or that an annual nesting attempt has failed, with a high level of confidence, removal of non-nesting adults or subadults may occur during the breeding season. Adoption of any changes to the protocol is subject to review and approval by the Service prior to its implementation.

D.2.2 Identification of Barred Owls Prior to Removal

Positive identification of barred owls prior to removal must be confirmed by either two observers or by a single individual identifying the bird by both visual and auditory cues. In the absence of auditory cues, we recommend that the bird be observed on at least two perches to ensure adequate opportunity to see species characteristics. Persons participating in removal activities must be able to accurately identify northern spotted owls (spotted owl) and barred owls using both visual and auditory means, and confidently distinguish between the two species. Those not fully familiar with such identification should receive training and testing in owl identification prior to removal activities.

D.2.3 Preparation for Accidental Injury of Barred Owls or Non-Target Species

While we have designed this protocol to avoid, injury to non-target species, such injury may still occur. Prior to conducting barred owl removal activities, whether lethal or nonlethal, parties responsible for removal should identify veterinary resources and wildlife rehabilitation facilities and specialists within reasonable transport distance of the removal sites. Those involved in removal should have contact information available during field work. Removal specialists should be aware of appropriate handling techniques for safe and humane transport of injured animals to rehab facilities and have any needed equipment (e.g., carriers).

To ensure that any barred owls wounded, but not killed, during removal do not continue to suffer, all people involved in removal should be trained in effective, humane methods of field euthanasia and have all the necessary material available at all times during removal.

D.2.4 Preparation for Carcass Collection

The experiment study plan will establish the methods to collect and conserve any barred owl carcasses to allow for their use in further scientific investigation or educational uses. These may vary depending on the intended use of the carcass, and this may change over the course of the experiment. Field staff should be made aware of the methods and any changes to those throughout the experiment. All necessary facilities and materials for effective carcass conservation should be acquired and available prior to any removal.

D.3 Guidelines and Precautions for Lethal Removal

The following are designed to minimize the risk of nonlethal injury or suffering of barred owls, or the injury or death of non-target species, during lethal barred owl removal, while ensuring the safety of field personnel and the public.

D.3.1 Lethal Removal Methods

D.3.1.1 Removal

When setting up the location for barred owl removal, all reasonable effort should be made to limit the shooting distance to no more than 30 yards to minimize the risk of nonlethal injury or prolonged death. We recommend avoiding shooting distances of less than 20 yards to provide a usable carcass for additional scientific and educational purposes. Shooters should seek a removal location that offers multiple unobstructed perch sites with clear shooting opportunities within the preferred distance of 20 to 30 yards prior to attempting to attract the barred owl into shooting range.

Before any removal, there should be positive identification of the barred owl, confirmed by either two observers or by a single individual identifying the bird by both visual and auditory cues. When spotted owls are detected in the immediate vicinity of barred owls, it may become difficult to “track” individual birds, especially during agonistic encounters between the two species. Lethal removal at that location should be postponed to a later date to minimize the risk of accidental injury or death of a spotted owl, either from removal or inter-species encounters.

To avoid disturbing nesting spotted owls, removal should not occur within 300 yards of a known active spotted owl nest during the critical breeding period for northern spotted owls (March 1 to July 31, or as established locally). To avoid drawing barred owls close to an active spotted owl nest, we recommend that any barred owl removal location be at least 0.25 miles from known active spotted owl nests, and in a direction tha that would not pull the barred owls towards the spotted owl nest.

All lethal removal should be done by shotgun of 20 gauge or larger bore, using non-toxic lead-substitute (e.g., Hevi-shot) shot. Lead shot should not be used. Rifles, pistols, or other firearms or methods are not authorized under this protocol. We recommend using a shot gun with a full choke. For shots at the 30 yard distance, we recommend 1 ounce #6 shot load, for shorter distances a smaller shot (#8) may be used. Shotguns should be equipped with an attached night scope or other gunsight designed specifically for night use for accurate and precise aiming in dark or low light conditions. These specifications may be changed with prior approval of the Service.

All shots must be directed at barred owls stationary on an unobstructed perch. On-the-wing shots are not authorized through this protocol. The fate of all shots taken during removal attempts should be recorded. For example, a single shot taken and bird killed, first shot missed, second shot successful, etc.

If barred owls are wounded, but not killed every reasonable effort should be made to locate any injured barred owls and euthanize it quickly and humanely. All personnel should be trained in field euthanasia and carry the needed equipment at all times during any removal attempt.

Any injury or death of a non-target species should be immediately reported to the designated Service contact. Any injured animals other than barred owls should be transported to a licensed rehabilitation facility. Circumstances surrounding such unintended injury or death should be described in an incident report sent to the designated Service contact within 3 business days of the incident; this information should also be included in the annual report. If the non-target species is a listed threatened or endangered species (e.g., spotted owl) the Service must be contacted immediately and no further removal activities may be conducted until the Service reviews the incident report and authorizes such activities to resume.

D.3.1.2 Carcass Recovery

Reasonable effort should be made to retrieve barred owl carcasses immediately after the shot while allowing for safety considerations, particularly at night in rough terrain. If the carcass cannot be located at the time of shooting, the shooter should return to the site as early as feasible the next day to resume the search. If the carcass cannot be located within a reasonable time, the shooter will describe the situation in an incident report, including any information regarding the likelihood that the shot may have missed, or that the bird was injured and escaped. Any such incident reports will be appended to the annual report for the project.

Whereas a well-trained retrieving dog may prove helpful in finding a downed bird, dogs not specifically trained to retrieve birds on command should not be in the vicinity of the removal. If dogs are needed for crew safety, these should be kept away from the immediate removal area. Dogs should never be allowed to harass or handle injured barred owls or carcasses, other than to retrieve them on command. Any dog on site should be present for a purpose and not just a pet.

The carcass should be immediately labeled with information, as will be specified in the detailed study plan. At a minimum, the information should include removal date and time, shooter's name, specific location (Universal Transverse Mercator (UTM) coordinates are recommended), other persons assisting or observing, and permit number under which the specimen was collected. Recording of other information, such as physical measurements, may be prescribed by the researcher responsible for removal. As soon as feasible, appropriate carcass conservation measures should be initiated.

D.3.2 Safety

Lethal removal involving firearms is inherently dangerous; more so under the evening or darkness conditions likely to be optimal for barred owl removal. The safety of the public and the persons involved in the activities is of utmost importance. Therefore, the following measures should be employed to ensure the safety of all involved.

All personnel involved in lethal removal will receive specific training and must demonstrate knowledge of proper firearm safety prior to conducting removal activities. They should also demonstrate skill and accuracy with the shotgun to be used. Accuracy is critical to avoid wounding barred owls. Training will cover shotgun use and protocol, along with the ethical, logistical, and safety considerations of conducting the removal.

Shooters are responsible for obtaining all applicable state and federal licenses and permits necessary for possession and use of firearms, and for their transport to and from the study area. Shooters are responsible for meeting all safety and operational requirements pertaining to those permits.

Shooters must observe all laws, regulations, ordinances, (including state and local) and site-specific requirements regarding use of firearms on public lands, near human habitation, within parks, etc. At a minimum, we require a no-shooting buffer zone of 0.25 mile around occupied dwellings, established open campgrounds, and other locations with regular human use. Individual land owners or managers may establish other requirements based on their knowledge of particular conditions or areas within the study area. Where conflicts with other human uses may occur, the shooters should attempt to draw the barred owls away from such situations to favorable removal locations through well-planned calling. A "silent" shotgun may be used in areas where people may be disturbed if allowed under state and local laws or with the appropriate permits.

Appropriate local and agency law enforcement should be contacted prior to field work to minimize public concerns over nighttime discharge of firearms, or their use in areas where they are generally prohibited (e.g., parks), thus avoiding unnecessary law enforcement response. Consider contacting local landowners to minimize public concern.

D.3.3 Lethal Removal of Hybrids

Hybrids between barred owls and spotted owls are rare and obvious hybrids are not commonly encountered. Hybrids are not a target of this removal experiment. However, first generation hybrids are also more difficult to distinguish from barred owls than spotted owls. Many first generation hybrids (one parent of each species) do exhibit physical or vocal characteristics (or both) intermediate to the parent stock, but even these characteristics may be difficult to identify under removal conditions. Second or third generation back-cross individuals (e.g., cross between a hybrid and a barred owl) are very difficult to detect even in hand and usually closely resemble the non-hybrid parent.

Since the prescribed method for lethal removal does not provide an opportunity to inspect the individual "in hand" prior to the commitment to remove, identification will rely on a reasonable consideration of observational evidence under field conditions. If in doubt, shooters should not remove the individual unless additional follow up can verify its appearance as a barred owl. If an owl is identified as a hybrid based on field characteristics, it should not be removed. However, we anticipate that most second-generation and later-generation hybrids that back-cross with barred owls will appear in the field as barred owls and will be removed.

Given the difficulty in identifying hybrids, inadvertent lethal removal of even a first generation hybrid may occur and the hybrid characteristics may not be evident until the specimen is in hand. If an owl carcass appears to be a hybrid once in hand, the specimen should be tagged for future analysis. All confirmed incidences of the removal of hybrids should be reported to the Service as part of required annual reports. These are not considered a take of spotted owls.

D.4 Guidelines and Precautions for Nonlethal Removal

The following guidelines and precautions apply specifically during nonlethal removal of barred owls. They are designed to minimize the risk of injury, excessive stress, or suffering of barred owls during capture, holding, relocation, and release, or the injury or death of non-target species.

In addition, this section describes the arrangements that should be made in advance of capture to ensure that live specimens of barred owls will be handled, transported, and placed in appropriate facilities, or translocated to pre-approved release sites, without undue risk of injury or unnecessary stress. Finally, we provide guidelines in the event of an inadvertent and incidental capture of non-target species or hybrids.

D.4.1 Arrangements Prior to Capture

Capture of live barred owls should not occur until and unless prior arrangements have been made with a facility appropriate for permanent retention of the specimen is arranged. Description of such facilities can be found in Arent (2007, entire). Facilities must have adequate facilities and commitment to provide a high quality of life for the captive barred owls, as well as any needed State and Federal permits. The Service (through the Oregon Fish and Wildlife Office) will assist in identifying appropriate facilities and opportunities to place live barred owls in captivity. No barred owls should be captured until and unless an approved facility it ready and able to take the individual owl.

Birds to be captured for translocation and release into the wild will be limited to adult barred owls or juvenile and immature barred owls independent of parental care. As described in Appendix D, Section D.2.1 of this Final EIS, capture of barred owls will generally be limited to the period between the post-fledging period and before the earliest date when eggs are likely to have hatched. If an approved protocol is developed to allow humane capture during other times of the year and approved by the Service, capture could occur at other times of the year.

A pre-arranged holding facility and veterinary services must be available within reasonable distance of the capture location. Arrangements should been made in advance ensuring that the captured animal(s) can be transported to the facility quickly, to avoid undue stress or risk of injury or mortality, generally a few hours or less.

D.4.2 Live Capture Methods

Capture should be accomplished using techniques that minimize the risk of injury or mortality to barred owls, yet prove effective in capture. Any technique should be designed to secure the barred owl quickly and with the minimum potential for injury. Any captured animal should be removed immediately from the capture device. Personnel responsible for barred owl capture should be trained and experienced with the capture technique. When deployed, capture devices must be attended at all times by a person trained in the employed capture method and handling and transport of live animals.

Immediately after capture, birds should be checked for injuries and secured in a safe carrying or transport device. Any barred owl injured during capture, or otherwise found to be physically impaired, may be euthanized immediately using effective and humane techniques, based on the judgment of the responsible biologist. Birds taken to rehab should not be released in the wild, but send on to an appropriate facility. Such incidences of injury and euthanasia should be described in an incident report, and provided to the Service through an annual report. Carcasses of any euthanized barred owls should be retained and conserved for future educational and scientific purposes, similar to provisions for retention of lethally removed barred owls.

As soon as possible (within a few hours at most), the captured bird should be transported to a holding facility with appropriate services and space for the captured individuals, or maintained in adequate holding devices. Birds should be checked for health and potential injuries, stabilized, and transferred to their final location in a timely manner.

Any non-target species inadvertently or incidentally captured during the attempted capture of a barred owl should be inspected for injury and, if uninjured, released immediately at the capture site.

Any injury or death of a non-target species should be reported to the designated Service contact within 3 business days unless the species is federally listed, in which case notification so be as soon as possible after the incident. Injured animals should be transported to a licensed rehabilitation facility immediately. Circumstances surrounding such unintended injury or death should be described in an incident report sent to the designated Service contact within 3 business days of the incident; this information should also be included in the annual report. If the non-target species is a listed threatened or endangered species (e.g., northern spotted owl) no further removal activities may be conducted by the permittee until the Service authorizes such activities to resume.

The presence of dogs, including dogs trained in bird retrieval, at the capture site is strongly discouraged. Should dogs accompany the trapper, they should be leashed and restrained away from the immediate capture location at all times, and never be allowed to harass or handle owls. Any dog on site should be present for a purpose and not just a pet.

D.4.3 Capture of Hybrids

Hybrids between barred owls and spotted owls are rare and obvious hybrids are not commonly encountered. Hybrids are not a target of this removal experiment. However, first generation hybrids are also more difficult to distinguish from barred owls than spotted owls. Many first generation hybrids (one parent of each species) do exhibit physical or vocal characteristics intermediate to the parent stock, but even these characteristics may be difficult to identify under removal conditions. Second or third generation back-cross individuals (e.g., cross between a hybrid and a barred owl) are very difficult to detect even in hand and usually closely resemble the non-hybrid parent.

In general, obvious hybrid owls should not be the target of capture efforts. Inadvertent capture of a hybrid may occur, particularly where characteristics of spotted owl lineage are not evident prior to capture. If an owl’s hybrid lineage is evident once captured, the bird should be released at the capture site unless retention of a hybrid individual is pre-approved by the Service to meet a specific request for hybrid retention. This guideline applies to any obvious hybrid, regardless of generation or proportional species composition.

Hybrids may be considered for permanent captivity for scientific or educational purposes if such a need is documented, and the necessary permits are approved by the Service prior to capture. As with all individual owls retained for captivity or for scientific and educational purposes, these specimens may not be released into the wild at a future date.

Should a hybrid owl be injured during live capture, the bird should be retained for rehabilitation by a licensed wildlife rehabilitation facility. The Service should be contacted under these circumstances; such rehabilitated hybrids should not be released into the wild without prior Service approval.

Appendix E

General Description of Demographic and Occupancy Study Approaches

E.0 Changes between Draft and Final EIS

- No substantial changes.

E.1 Demography Study Approach

Demographic studies are conducted on areas where all territorial northern spotted owls (spotted owl) are marked with individually identifiable bands and attempts are made to resight each individual on an annual basis (Johnson *et al.* 2008, p.3). The record of whether or not individual owls are resighted or not found each year provides the encounter history data used to conduct demographic analyses. The encounter history is a series of 1s and 0s, that indicate whether or not an individual owl was observed (1) or not observed (0) in each year.

Estimating demographic rates including annual survival, reproduction, and population growth rate is important for understanding how populations change over time, identifying factors that influence survival and reproduction, and identifying factors that influence population growth (Williams *et al*. 2001, p. 333). With the mark-resighting data described above, annual rates of population growth (lambda, λ) can be estimated for spotted owls using temporal symmetry models developed by Pradel (1996, entire). In addition to estimating population growth rate, these models break down population growth rate into two components: apparent annual survival and recruitment of new individuals into the population. Apparent survival is the probability of an owl alive on the study area in year (t) remains alive and on the study area at year (t+1), and recruitment rate is the ratio of new recruits to the total population at time *t*. Survival accounts for both mortality and emigration, and recruitment accounts for recruitment within the study area and immigration. These models also estimate detection probability (p), which is the probability that an observer will detect an owl given that it is present. Annual population growth rate is estimated from survival and recruitment. [(λ_t) = survival (t) + recruitment (t)]. Lambda (using the described approach) is the observed rate of growth in successive samples of a population. This method does not; however, predict future population trends. A primary goal of this approach will be to compare changes in population growth rates (lambda, λ) between treatment and control areas. This approach provides a population-level rate of change, and allows for comparison of changes in contributions of individual vital rates (e.g., survival, recruitment) to population growth rate over time.

There are several advantages to using this approach for a barred owl removal experiment. First, this approach will allow assessment of change in population growth rates, annual survival, and recruitment between treatment and control areas. In addition, it allows estimation of specific spotted owl vital rates (e.g., reproduction, survival) that may be influenced by barred owl competition (Johnson *et al.* 2008, p. 19). Second, because spotted owl demographic study areas have relatively large sample sizes (100 to 200 spotted owl sites) and have more than 15 years of data that provide annual estimates of survival, recruitment, and rate of population change (Forsman *et al.* 2011a, entire), this approach has substantial strength of inference for assessing effects of barred owl removal (Johnson *et al.* 2008, p. 19). Strength of inference is the likelihood that an observed difference between groups within a study represents a real difference rather than mere chance or the influence of confounding factors (Ott 1988, p.2-8). The demographic study approach also has reduced confounding factors (biotic or abiotic) over a site-specific approach to a barred owl removal experiment (see Johnson *et al.* 2008, p. 19).

There are some limitations to this approach as well. It requires capture, banding, and following of individual spotted owls over time; and requires intensive data collection. For areas that are not in spotted owl demographic study areas or where demographic data have not been collected recently (i.e., within the past 5 years), it will take several of years of data collection (e.g., more than 5) before we have sufficient data to estimate demographic rates and trends. For areas that are ongoing spotted owl demographic study areas, removing barred owls on a portion of these study areas will reduce the effective study area size for monitoring demographic rates over time for that study area. Such a reduction in size affects how results from ongoing spotted owl demographic study areas can be compared before, during, and after a removal experiment. For example, if barred owls were removed on half of the Oregon Coast Ranges Spotted Owl Demographic Study Area in 2012, demographic rates for this study area from the next meta-analysis (likely 2014) may not be directly comparable with those from 2011, 2006, 1999, and 1996, given the difference in study area size. However, the treatment-control effects can be incorporated into the modeling process for demographic analyses, allowing for evaluation of population trends (on original, treatment, and control areas) over time (Johnson *et al.* 2008, p. 19) (see Appendix I of this Final EIS for a complete discussion of this issue). This approach also requires conducting vocal surveys for barred owls across the entire spotted owl demographic study area (Johnson *et al.* 2008, p. 19) which could influence interactions between spotted owls and barred owls across the study area. There are also limited areas where a demographic study approach (where current demographic data are available) can be implemented for barred owl removal study (Johnson *et al.* 2008, p. 19); these areas include the 10 study areas described in Alternative 1.

E.2 Occupancy Study Approach

In contrast to a demographic study that estimates vital rates, an occupancy study compares changes in occupancy of spotted owl territories between treatment and control areas. Occupancy models use repeated sampling to estimate the probability that the areas surveyed are occupied by the species of interest (MacKenzie *et al.* 2006, entire). For our purposes, occupancy is defined as the proportion of sites occupied by spotted owls on each area. For this type of study, surveyors can record simple presence-absence of spotted owls or they may gather additional data on reproductive success at owl sites.

Occupancy models are similar to demographic studies in some ways. However, specific sites rather than individual owls are tracked over time. Surveyors visit owl sites (either known sites or sites where owls are likely to occur) and develop encounter histories based on whether or not owls were detected at each site. Similar to demographic studies, the encounter history is a series of 1s and 0s, that indicate whether or not an individual owl was observed (1) or not observed (0) in each year. Each encounter history is linked to a site rather than an individual owl. Encounter histories are used to estimate the probability that sites are occupied by owls, the probability that surveyors detect owls given that they are present (detection probability), and the probabilities that owls colonize or become locally extinct at individual sites between years. Local colonization (γ) and local extinction (ε) rates enable monitoring dynamic population processes over time (MacKenzie *et al.* 2006, pp. 40-41). Rate of population change (lambda) can be estimated using the difference in occupancy rates between successive years; however, we cannot identify the relative contributions of survival and recruitment to population change using this approach. In addition to recording whether owls are observed or not (occupancy), data on reproductive success could also be collected to obtain more information on population processes. These data can be analyzed using a multistate occupancy model (sites are unoccupied, occupied by a non-reproducing pair, or occupied by a reproducing pair) to assess changes in reproductive status.

As with demographic studies, there are advantages and disadvantages to this this approach. Compared to demographic studies, an occupancy study is a simpler methodology. Because surveyors need only to record whether owls are present or not at individual sites, there is no need to capture or band, or resight individual owls. Because this approach is less data intensive, there are also more options for study areas that could be used, including areas where some spotted owl survey data exists but not to the level of spotted owl demographic study areas (Johnson *et al.* 2008, p. 19). Because this approach is conducted at a landscape scale, territorial-level effects of barred owls can be better evaluated and there should be reduced confounding factors (biotic or abiotic) compared to a site-specific approach (Johnson *et al.* 2008, p. 19).

While an occupancy study design is simpler, there are more disadvantages compared to a demographic study. First, response variables are limited to occupancy, abundance, and possibly reproduction (Johnson *et al.* 2008, p. 19). Because an occupancy study monitors sites rather than individual owls, this approach does not allow identification of most vital rates that may be affected by barred owls competition including annual survival and recruitment (Johnson *et al.* 2008, p. 19). Second, this approach also does not record turnover of individual owls at as sites. If there is high turnover or mortality within a study area but sites remain occupied, a population may be a sink population yet this dynamic would not be detected using an occupancy approach. Third, similar to a demography study, an occupancy study requires conducting vocal surveys for barred owls in all study areas used (Johnson *et al.* 2008, p. 19), which could potentially influence interactions between spotted owls and barred owls across the study area. Fourth, estimating occupancy at a landscape scale will require care that spotted owls are not double-counted, as this would result in overestimates of abundance. Because owls are not individually marked in an occupancy study, minimizing the risk of double-counting will require that survey stations be spaced appropriately. Finally, sample sizes for some of the proposed occupancy areas may be small (less than 50 owl sites), and with small sample sizes, strength of inference will be low.

E.3 Summary Comparison Between Demographic and Occupancy Study Approaches

Detecting changes in site occupancy after barred owl removal is somewhat less informative than detecting changes in population growth rate in a demographic study; however, an occupancy study requires somewhat less effort to conduct (Table E-1). We would be less able to identify mechanisms through which population is changing in an occupancy study. For example, in an occupancy study framework if individual spotted owls had high mortality but were being replaced by new owls (floaters) each year, sites would continue to be recorded as "occupied" during the study. Using a demographic study approach, we would be able to note that individual owls were being lost from these sites and that the area was functioning as a "sink". Although survival and recruitment cannot be estimated in an occupancy study, we can detect changes in local colonization and extinction rates in an occupancy model framework. This would enable us to evaluate whether more spotted owl sites become colonized after barred owls are removed or whether local extinction rate decline after barred owls are removed. Overall strength of inference will be greater for demographic studies given the long history of demographic monitoring at spotted owl demographic study areas and the relatively large numbers of spotted owls on these areas.

Table E-1. Tradeoffs between demography and occupancy approaches to evaluating effects of barred owl removal on spotted owl populations.

Approach	Benefits	Limitations
1. Demographic	**A.** Identification of spotted owl vital rates that are influenced by competition. **B.** Substantial strength of inference. Long record of monitoring for individual study areas – increases power to detect effects of barred owl removal. **C.** Use of landscape scale increases likelihood that territory-level effects of barred owls can be evaluated. **D.** The influence of confounding biotic and abiotic factors is reduced over the site-scale approach.	**A.** Few existing study areas from which to choose. **B.** Requires conducting vocal surveys for barred owls within ongoing spotted owl demographic study areas. **C.** Reduces sample size for long-term research in ongoing spotted owl demographic study areas. **D.** Requires capture and banding of individual owls.

Approach	Benefits	Limitations
2. Occupancy	**A.** More potential study areas, because it is not limited to spotted owl demographic study areas. **B.** Use of landscape scale increases the likelihood that territory-level effects of barred owls can be evaluated. **C.** The influence of confounding biotic and abiotic factors is reduced over the site-scale approach. **D.** Calculation of lambda is possible. **E**. Does not require capture and banding of owls. **F**. Can use a multistate occupancy model to consider reproductive status.	**A.** Does not allow identification of most vital rates that are influenced by competition. **B.** Response variables are limited to occupancy, abundance, productivity, etc. (but not survival – or determining which vital rate is most influenced by barred owls). **C**. Increase in site occupancy may not necessarily indicate improved demographic performance.

Appendix F

Calculation of Barred Owl Population and Removal Numbers

F.0 Changes between Draft and Final

- Re-estimated the number of barred owls removed under each alternative to reflect additional information. Our revised estimates of number removed are somewhat lower than those reported in the Draft EIS, primarily as a result of new estimates regarding the rate of reoccupancy of sites by barred owls where the prior territorial adult barred owls(s) have been removed. Although the reported numbers have changed, the results are within the range of variability of our initial estimates.
- Updated our analysis to include new data from the Hoopa Study Area collected and analyzed since release of the Draft EIS.
- Clarified the assumptions used in our calculations of barred owls removed to better reflect how we considered the available information.
- Prepared an example calculation of the number of barred owls to be removed, based on a hypothetical removal area, to assist the reader in understanding our methodology and assumptions.
- Added text explaining how variability in removal rates of territorial barred owls and immigrant dispersers influence the number of barred owls removed annually.

F.1 Estimating Initial Barred Owl Site Density and Population within Each Study Area.

Most of the study areas considered in this proposed action have not been surveyed for barred owls using a protocol that supports a precise estimate of the number or density of barred owl sites over a large landscape. Except for small areas on the landscape where intensive barred owl surveys have been conducted, precise quantitative data are not available to directly estimate the initial barred owl population on each study area included in our proposal. Therefore, we have relied on available data extrapolated from the few available, intensive barred owl site surveys to estimate the number and density of barred owls on each of our proposed study areas. Details and results of those number and density estimates can be found in Section 3.2.1.2 of this Final EIS. We provide a summary of those calculations in this appendix, and use those results plus other information to estimate the number of barred owls to be removed from each study area, under each alternative considered in this proposed experiment.

Three potential study areas (Cowlitz Valley, Veneta, and Hoopa) have been surveyed extensively for barred owls, and density estimates of barred owl sites can be calculated from those data. Survey data from the Veneta and Hoopa areas cover most of each study area within a single year, so we have relied on those data as point-of-time estimates. Surveys have been completed for a substantial portion of Cowlitz Valley Study Area over multiple years. Hence, for Cowlitz Valley, we rely upon compiled data from more than 1 year of survey.

An important consideration in our calculation of the number of barred owl sites in each study area is the density of barred owls in relation to what might be considered a saturated population. The Cowlitz Valley Study Area, having been colonized by barred owls more than 30 years ago, shows a relatively high density of barred owls (1.79 barred owl sites per 1,000 acres of northern spotted owl (spotted owl) suitable habitat) (Table F-1). Surveys within a limited portion of the Cowlitz Valley Study Area (Woods Creek), where intensive surveys have been completed, resulted in nearly double that density (3.96 barred owl sites per 1,000 acres of spotted owl habitat), and may represent saturation density in those areas. The Veneta Study Area, occupied by barred owls for at least 20 years, shows a density of barred owls of approximately 2.96 sites per 1,000 acres of spotted owl suitable habitat (Table F-1). This study area, thought to include high-quality habitat where barred owls could achieve high density, may not yet have achieved carrying capacity, though it may be approaching saturation. The Hoopa Study Area has also been occupied by barred owls for approximately 20 years, but initially showed a very low rate of increase. Since 2004, however, the population has grown at an ever-increasing rate, achieving a 2012 density of 1.07 sites per 1,000 acres of spotted owl suitable habitat (Table F-1). The population trend continues on an increasing trajectory. However, since the habitats and prey base in the Hoopa area differ from those in coastal Oregon and the Cascades of Washington, we do not have an estimate of the saturation density that this area may achieve as the population grows and achieves a relatively stable carrying capacity.

Table F-1. The estimate of the density of barred owls on study areas with extensive barred owl surveys.

Study Area or Spotted Owl Demographic Study Area	Area Well Surveyed for Barred Owls (acres)	Suitable Spotted Owl Habitat on Surveyed Area (1,000s of acres)	Estimated Number of Barred Owls Sites in Study Area [1]	Number of Barred Owl Sites per 1,000 Acres Suitable Spotted Owl Habitat
Cowlitz well-surveyed area [2]	402.5	189.6	339	1.79
Veneta	193.6	39.2	116	2.96
Hoopa area	88.0	52.5	56	1.07

[1] This value is based on the assumption that each site has, or will have by the time of the experiment, a pair of barred owls. Based on the fact that removals will not occur for probably at least 2 years, it is highly likely that any sites we currently know of will be occupied by a pair at that time.
[2] This calculation is based on the portions of the larger Cowlitz Study Area that were well surveyed; it was developed in discussions with Bob Pearson, the researcher surveying this area.

We estimated the number of barred owl sites that occur within the remaining study areas for which survey-based density estimates are unavailable. We extrapolated known barred owl site density estimates from the Cowlitz Valley, Veneta, and Hoopa Study Areas to unsurveyed study areas based on their proximity and habitat similarity. Table F-2 provides the association between Cowlitz Valley, Veneta, and Hoopa Study Areas, the unsurveyed study areas, and the estimated number of barred owl sites on each study area.

In our estimate of the number of barred owls occupying each study area, we assumed that each site is occupied by a pair of barred owls. We assumed that individual barred owls will tend to occupy those locations with the best quality habitat, and most likely to attract or retain a mate. The net effect is that a high proportion of sites will be occupied by paired barred owls, as opposed to a simply random distribution of individuals. This assumption, if incorrect, may result in a slight overestimate of barred owls to be removed. However, this outcome is preferable than to underestimate the effects to barred owls of conducting this experiment. These results represent our best estimate of the initial number of occupied barred owl sites, and the number of territorial barred owls on each study area at the start of the experiment.

Table F-2. Study area data and barred owl density.

Study Area or Spotted Owl Demographic Study Area	Acres of Suitable Spotted Owl Habitat (1,000s)	Estimated Number of Barred Owls per 1,000 Acres Suitable Habitat [1]	Estimated Number of Barred Owls in Study Area [2]
Ross Lake	170	1.79	608
Wenatchee	267.6	1.79	957
Cle Elum	143.7	1.79	514
Olympic Peninsula	384.7	1.79	1,378
Olympic Revised portion of Olympic Revised (Olympic Peninsula)	127.3	1.79	455
Rainier	148.5	1.79	531
Cowlitz Valley [3]	221	1.79	790
Columbia Gorge	210.8	1.79	754
Oregon Coast Ranges[3]	307.2	2.96	1,818
Veneta portion of Veneta (Oregon Coast Ranges/Tyee)	39.2	2.96	232
Tyee	74.1	2.96	439
McKenzie	131.8	2.96	780
HJ Andrews	224.4	1.79	804
Union/Myrtle portion of	98.1	2.96	581

Study Area or Spotted Owl Demographic Study Area	Acres of Suitable Spotted Owl Habitat (1,000s)	Estimated Number of Barred Owls per 1,000 Acres Suitable Habitat [1]	Estimated Number of Barred Owls in Study Area [2]
Union/Myrtle (Klamath)			
Klamath	132.3	2.96	783
South Cascades	252.3	2.96	1,494
Rogue Cascades portion of Rogue Cascades (South Cascades)	79.3	2.96	469
Horse/Beaver	117.4	1.07	252
Goosenest	13.2	1.07	28
Hoopa [3] portion of Hoopa (Willow Creek)	52.5	1.07	112
Willow Creek portion of Hoopa (Willow Creek)	46.1	1.07	102
Corral	43.3	1.07	92

[1] Estimated number of barred owl sites per 1000 acres of spotted owl habitat from three study areas with barred owl survey data, Cowlitz well surveyed area, Veneta, and Hoopa.
[2] This value is based on the assumption that each site has, or will have by the time of the experiment, a pair of barred owls. Based on the fact that removals will not occur for probably at least 2 years, it is highly likely that any sites we currently know of will be occupied by a pair at that time.
[3] Three potential study areas (Cowlitz Valley, Oregon Coast Ranges, and Hoopa) served as example study areas for our estimation of potential sources of barred owl reoccupying the treatment areas. These three study areas represent a range of treatment area size, barred owl density sufficient to project estimates to the remaining study areas.

F.2 Factors Influencing the Number of Barred Owls Removed on Each Treatment Area under Each Action Alternative

Starting with the estimated initial population of barred owls in each treatment area, we then estimated the number of barred owls that would likely be removed during the barred owl removal experiment for each alternative, considering four factors:

- Rate at which territorial barred owls would be removed from each treatment area.
- Source and rate at which barred owls reoccupy sites in the treatment areas after the initial territorial barred owls have been removed.
- Rate at which barred owls recolonizing the treatment areas are themselves removed.
- Number of years over which barred owl removal would occur.

F.2.1 Annual Rate of Removal of Territorial Barred Owls.

Initial results of work done on lands of the Green Diamond Resource Company, under a separate research and collecting permit, provide evidence that removal of territorial barred owls in treatment areas with good access, and employing experienced, trained shooters, can achieve rates exceeding 90 percent per year. Removal rates can approach 100 percent in areas with excellent access if intensive surveys are done prior to initiating removal; however, removal rates are likely lower in areas with restricted access (e.g., wilderness areas or parks) or extended periods of snow cover. Although our goal for territorial barred owl removal is 100 percent, we anticipate an overall rate closer to 90 percent and use this for assessing the effects of removal of barred owls. The experiment will collect additional data on rates of removal to improve future estimates and monitor our current assumptions.

F.2.2 Source of Barred Owls That May Occupy the Treatment Area.

Similar to spotted owls, territorial barred owls tend to remain within their home ranges as long as they can defend a territory, and maintain a pair bond, or attract a mate. We anticipate that very few territorial barred owls will leave their territories and move into the treatment areas from adjacent suitable habitat unless they are displaced or are unsuccessful in establishing a pair bond in that territory. A few adult spotted owls have moved from their existing territories. Forsman *et al.* (2011a, p. 73) reported 6.6 percent of the resident spotted owls on a subset of the demography study areas moved each year. Most of these are found on adjacent territories or nearby (Forsman *et al.*, 2011a, p 73). We anticipate that displaced adults moving into the treatment areas would be removed at the same rate as any other territorial barred owl.

We evaluated three sources of barred owls that may repopulate sites once the territorial barred owls are removed: "floaters" and dispersers. Dispersers may come from outside the removal area or residual reproduction from within the removal area.

F.2.2.1 Floater Barred Owls

"Floater" barred owls are defined as adults or subadults that have not been able to achieve pair or territorial status. Floaters do not have established territories, but may persist within the landscape as potential replacements for territorial individuals. Floaters may not disperse great distances, yet typically are not restricted in their annual movements to a home range associated with a single territory. We anticipate that floaters will occur within suitable habitat in or near treatment areas, especially where barred owls are currently at or near carrying capacity within a landscape. Such individuals, as differentiated from dispersing barred owls, tend to move shorter distances and remain within a more localized landscape. We are unaware of data or numeric information that would allow us to precisely quantify the extent of this population, or that would allow us to estimate the distances such individuals may travel in search of a potentially vacant territory or available mate.

We anticipate that the number of floaters would be highest in populations where territorial pairs approach saturation densities (i.e., near carrying capacity), and low in populations where territorial densities are not fully saturated and unpaired mates or empty territories may be available in suitable habitat. Removal of territorial barred owls in treatment areas creates vacant territories or unpaired potential mates where floaters may attempt to establish a territory or pair up with unmated barred owls. Removal of territorial individuals will likely result in the floaters rapidly establishing territories, and themselves being subject to a high rate of removal. We anticipate the number of floaters would decline during the early years of the experiment, with few floaters remaining on the treatment area in later years. A few floaters may move into the treatment area from areas near the boundary and be removed themselves, either later in the initial removal period or in subsequent removal periods.

We anticipate that most "floaters" will become territorial individuals after the removal of the initial territorial barred owls. The number of floaters that reoccupy vacated sites is limited by (a) the number of available floaters in or immediately adjacent to the removal area and (b) the number of territorial individuals removed during the prior year. The number of floaters that become territorial would not exceed the number of available territories in the removal area. We also assume that the total number of available sites within the removal area does not change over the duration of the experiment.

Between the start of the first and second removal periods, we anticipate that a relatively high proportion of the territorial barred owls that have been removed will be replaced by adult and subadult floaters already present in the removal area or immediately adjacent untreated area. The reoccupancy rate for this period is anticipated to be higher (60 percent) than for subsequent years (40 percent) due to the presence of a pool of floaters in the removal area during the first removal period. The number of barred owls in floater pool depends on two factors: (a) the current density of territorial barred owls compared to the overall carrying capacity of the area; and (b) the number of years that the area may have been at or near carrying capacity, producing young who survive as non-territorial floaters on the landscape. In areas substantially below carrying capacity, floaters have many opportunities to establish a territory thus few individuals have to remain floaters (non-territorial and moving around the landscape). In these cases, the number of floaters on the landscape would be low. Conversely, we anticipate that landscapes already at carrying capacity will have a high number of available floaters that would reoccupy vacated territories soon after removal of territorial barred owls.

F2.2.2 Dispersing Barred Owls

We define dispersing barred owls as individuals emigrating from their natal area. These individuals may travel over large areas, potentially up to 50 miles or more, in search of suitable habitat and available mates before attempting to become territorial. Based on our knowledge of spotted owl dispersal, we anticipate barred owl dispersal begins in early fall, and a large proportion of the total distance moved during the animal's lifetime occurs during the first 6 months to 1 year following fledging, though some may continue to disperse for 2 or more years. The rate of natural mortality during the initial dispersal period is usually quite high; as many as 50 to 90 percent of dispersing juveniles spotted owls may die during their first year of life as a result of starvation, avian predation, and other natural causes. We anticipate similar rates for juvenile barred owls. We anticipate that some dispersing individuals from within the removal area and the surrounding, untreated landscape will move into suitable habitat within the treatment area from which barred owls have been removed.

After the first year of removal, we anticipate very low barred owl reproduction within the treatment areas themselves, as there will be few pairs to nest. If we achieve our anticipated 90 percent removal of territorial barred owls within the treatment areas, very few barred owl sites would be occupied by a stable pair during the experiment; therefore, reproduction within the treatment area would be extremely low. We expect some pairs would be successfully re-established during the non-removal period, but since removal may occur during the months immediately prior to the breeding season, we anticipate few of these pairs would establish fully functional pair bonds and successfully nest. In addition, since most dispersers entering the treatment area are young-of-the-year juveniles or immature subadults, their ability to form pair bonds prior to the breeding season may be substantially less than territorial adults.

A very low proportion of barred owl sites within the treatment area will be occupied by territorial adult or subadult pairs during the experiment once removal has been implemented. Since our goal is to minimize the effect that barred owls may have on spotted owls, we anticipate reducing the number of breeding barred owls to as close to zero as we can reasonably get. A high rate of removal of territorial adult barred owls and the follow-up removal of barred owls reoccupying those sites annually should ensure very few fledglings are produced within the removal area. Our model reflects this assumption.

F2.2.3 Conclusion:

After the first removal period, we anticipate a low population of floaters in the treatment area, limited to the number of dispersing juveniles and subadults that immigrate into the removal area. Most of these individuals will soon become territorial, and be removed at high rates for as long as the experiment continues.

F.2.3 Rate of Removal of New Territorial Individuals and Pairs.

Following the removal of territorial pairs or individuals, and the consequent availability of unoccupied suitable habitat and unpaired mates, we anticipate that barred owls will reoccupy some of these vacated sites. Early in the experiment, we anticipate that the majority of the barred owls filling the vacated territories would be from the floater population within or immediately adjacent to the treatment area, especially in treatment areas that are near barred owl carrying capacity. Since these individuals would display territorial behavior, and be readily detected during subsequent removal efforts, we anticipate annual removal rates for these barred owls to be comparable to removal rates for the initial, territorial individuals, 90 percent.

We anticipate that resident floaters may establish and defend territories as empty territories become available within the removal periods themselves. We also anticipate that such individuals are likely to be less responsive to survey calls initially, as they have only recently established their territories and may not have mates. Therefore only a portion of this population may be detected before the end of the removal period. Our ability to remove even those we detect within the removal period will be limited by the duration of the removal period. Hence, the removal rate for these newly territorial individuals during the removal periods is lower than for well-established territorial barred owls. Following the initial removal period, we anticipate that most barred owls that reoccupy the vacated sites will be dispersing individuals. Most of these individuals will come from around the area, though a few may be produced within the study area. As with the newly territorial floaters, these individuals are anticipated to be less responsive to survey calls than well-established territorial barred owls and would be removed at lower level.

For the analysis we assumed a constant rate of dispersal into the area, and a constant rate or removal of these individuals after the first year. We acknowledge that this approach simplifies the annual variation in removal that may occur in any treatment area. The actual rate of dispersal would likely vary from year to year, in response to highly variable annual breeding success, that itself is subject to climatic and other stochastic influences. Our example attempts to estimate removal numbers based on averaged conditions over several years and we believe it represents a reasonable scenario of removal conditions and numbers.

F.2.4 Number of Years Barred Owl Removal Would Occur.

The proposed barred owl removal experiment would require removing barred owls for a period of from 3 to 10 years, depending on the alternative. The duration of the removal effort would vary by study area and by alternative to meet specific objectives of the experiment. This provides a means to consider the consequences of barred owl removal under a range of action alternatives. The number of years of removal may also vary within a study area under different alternatives, since each alternative has slightly different objectives, dictating a different experiment length and, hence, number of barred owls to be removed. In the calculations that follow, we have accounted for the specific time period for removal for each study area within each alternative.

F.3 Estimate of the Annual Number of Barred Owls Removed in Each Study Area under Each Action Alternative

We report our estimates of the number of barred owls removed under each alternative, for the duration of the experiment, in Section 3.2.2.2 of this Final EIS. We consider the impacts to the barred owl from this level of removal in Section 3.2 of this Final EIS. To develop these estimates, and evaluate their effects, we evaluated the initial population estimates for each of the study areas and the number of barred owls removed under each alternative and option. In the following sections, we describe how we estimated the number of barred owls removed under each alternative and option. Our estimation methodology is described for each year of the proposed multiyear studies.

F.3.1 First Year of Removal

At the start of the first year of removal, the initial barred owl population includes many territorial individuals who typically respond well when surveyed, allowing us to locate a high proportion of the occupied barred owl sites. Nearly all territorial individuals are assumed to be members of territorial pairs. We anticipate being able to remove approximately 90 percent of those individuals during the first year of removal.

In addition to the territorial individuals, we anticipate that the barred owl population in the treatment area will include floaters or dispersing juvenile and subadult barred owls that are not yet territorial, as described above. We anticipate that some of these floaters will quickly attempt to reoccupy sites when territorial barred owls are removed. Some of these individuals may become territorial, and thus be located and removed during the first removal period. We anticipate a reoccupancy rate of 60 percent of the initial number of territorial barred owls between the start of the first and second removal periods. Of these recently territorial barred owls, we anticipate some may be removed during the initial removal period. Since these recently territorial birds may be less responsive than well-established territorial birds, we anticipate a lower detection rate. In addition, a substantial portion of the reoccupancy of sites will occur outside of the removal period (i.e., during the breeding season), and those barred owls will not be immediately removed. After considering these factors, we assume a relative low rate of 25 percent removal of the recently territorial barred owls removed in the first year of removal.

Based on these above assumptions, we estimate the number of barred owls removed from any selected study area during the first full season of removal to be approximately 1.05 times the number of initial barred owls in the treatment area. Table F-4, at the end of this appendix, displays the estimated number of barred owls removed from the treatment area for each year of the experiment under each alternative.

F.3.2 Second Year of Removal

At the start of the second removal period on each selected study area, approximately 10 percent of the territorial barred owls individuals remain from, and approximately 75 percent of the re-colonizers would remain as our starting territorial population (holdover population). We anticipate that the removal of approximately 90 percent of these territorial barred owls during the removal period.

During the second year of removal (second removal period and following breeding season), we anticipate a reoccupancy rate of approximately 40 percent of initial barred owl population. This is less than the 60 percent reoccupancy rate used in the first year of removal because we anticipate fewer floaters remain to reoccupy cleared sites and fewer dispersing barred owls exist due to the reduced within-treatment-area reproduction. We anticipate that we will be able to remove approximately 25 percent of the newly territorial barred owls, as described for the first removal period above.

We anticipate the barred owls available to reoccupy empty sites will gradually decline over time from an initial high level in the pretreatment population to a stable, lower level in subsequent years. The number of such birds will tend to stabilize at some non-zero value, since the source of these individuals is through immigration from outside the removal area. This concept is also true for subsequent years of removal as well.

In study areas where the population density is substantially below carrying capacity, this removal rate may be an overestimate. In such circumstances, relatively few floaters will be available to immediately reoccupy vacant sites, and be removed. However, in the interest of full disclosure of the anticipated effects of this proposed action, we seek to avoid underestimating the effects of our removal effort on the species.

F.3.3 Third year of Removal

At the start of the third removal period on each selected study area, approximately 10 percent of the territorial population from the second removal period and approximately 75 percent of the barred owls that recently reoccupied the sites would remain as our starting territorial population (holdover population). We anticipate removing 90 percent of these holdover individuals.

During the third year of removal, we anticipate a reoccupancy rate of approximately 40 percent of initial barred owl population. We anticipate being able to remove approximately 25 percent of these individuals during the third year of removal. Table F-4, at the end of this appendix, provides the removal estimates for each study area.

F.3.4 Fourth and Subsequent Years of Removal

At the start of the fourth and subsequent years of removal on each selected study area, approximately 10 percent of the holdover individuals and approximately 75 percent of the previous-year's reoccupying barred owls would also remain as starting territorial population (holdover population.) We anticipate removing 90 percent of these holdover individuals.

As with the previous years, we anticipate a reoccupancy rate of approximately 40 percent of initial barred owl population during the removal period and following breeding season each year. We anticipate being able to remove approximately 25 percent of these individuals during each removal year. By the fourth year of removal, and in subsequent years, we anticipate that virtually none of the territorial adults and non-territorial floaters would remain from the initial population. The barred owls on the treatment area would consist solely of those dispersers from prior years who survived to become territorial individuals.

By the fourth year of removal, and in subsequent years, the number of barred owls removed from any treatment area stabilizes at a low rate, relative to the rate calculated for the first year. This steady rate results from a constant rate of immigration into the treatment area from adjacent untreated areas, and the lack of remaining floater individuals in the treatment area from the initial pre-experiment population. In the estimates we created in this analysis, based on a long-term 40 percent immigration rate, the annual long term removal would stabilize at 40 percent of the initial population. This low rate would continue for any experiment lasting more than 4 years, as can be seen in Table F-4 at the end of this appendix, for alternatives that include barred owl removal for 5 or more years.

F.3.5 Example Calculation of Barred Owl Removal

In this section, we provide an example calculation for a hypothetical study area, using the methods described above to assist the reader in understanding our methods, and assumptions. All values are hypothetical and do not correspond directly to any of the proposed study areas, though they generally mimic removal rates in the Preferred Alternative and are based on the average conditions on the study areas in the alternative.

For this example, we assume a removal area occupied by an initial population of 360 territorial barred owls and experiment duration of 4 years, as well as an unknown number of floaters (Table F-3). The removal area is surrounded by habitat that also supports barred owls which are not subject to removal and provide a source of dispersing individuals, some of will enter the removal area during each year of the experiment.

During the first year of removal we anticipate successful removal of 324 (i.e., 90 percent) of the initial 360 territorial barred owls. Between the start of the first and second removal periods, we anticipate that 216 floaters or dispersing barred owls will reoccupy some of the newly emptied sites (60 percent of the initial territorial population level) and we will be able to remove removing 54 (i.e., 25 percent) of these individuals during the first removal period. Therefore, during the first year of removal we estimate a total of 378 barred owls being removed from the total removal area.

At the start of the second year of removal, there would be 198 territorial barred owls on the removal area. We anticipate removing 178 (i.e., 90 percent) of those individuals during the second removal period Between the start of the second and third removal periods we anticipate 144 barred owls (40 percent of the initial population level) would reoccupy the empty sites or other areas. Most of these will likely be dispersers from the surrounding untreated area as most floaters probably acquire territories after the first removal period. We anticipate removing 36 of these animals (25 percent) during the second removal period. Therefore, during the second removal period we estimate a total of 214 barred owls being removed from the total removal area.

At the start of the third year of removal, there would be 128 territorial barred owls on the removal area. We anticipate removing 115 (i.e., 90 percent) of these individuals during the third removal period. Between the start of the second and third removal periods we anticipate 144 barred owls (40 percent of the initial population level) would reoccupy the empty sites or other areas. We anticipate removing 36 of these animals (25 percent) during the third removal period. Therefore, during the third removal period we estimate a total of 151 barred owls being removed from the total removal area.

At the start of the fourth year of removal (and any subsequent years, if the studies were to last longer), this pattern of 90 percent removal of territorial barred owls, and 25 percent removal of reoccupying barred owls continues. By the fourth year of removal, the number of barred owls being removed each year stabilizes to approximately 145 birds each year.

Table F-3. Example of the methodology used to estimate the number of barred owls removed from study areas under each alternative. This is based on a hypothetical study area occupied by an initial population of 360 territorial barred owls and experiment duration of 4 years.

Barred Owls at Each Step of Removal Calculations	Number of Barred Owls Removed				
	Year 1	Year 2	Year 3	Year 4	Total for Experiment
Territorial barred owls at start of removal period	360	198	128	121	
Territorial barred owls removed in period	324	178	115	109	726
Initial territorial barred owls remaining at end of removal period	36	20	13	12	
Barred owls that reoccupy sites before start of next removal period	216	144	144	144	
Reoccupying barred owls removed in period	54	36	36	36	162
Reoccupying barred owls left at end of period	162	108	108	108	
Total barred owls removed in removal period	378	214	151	144	888
Total territorial barred owls remaining at the start of the next period	198	128	121	120	

F.4 Sensitivity Analysis of Our Estimated Rates of Immigration and Removal.

As indicated earlier, we assume that a 90 percent annual removal rate of territorial barred owls is achievable in study areas with good to excellent access. However, we also acknowledge some uncertainty in that assumption, based primarily on differences in access of each study area, but also attributable to varying degrees of pre-removal data on locations of barred owls within the treatment area, and the skill of those tasked with doing the removal. Therefore, we chose to conduct a sensitivity analysis of the annual removal rate by analyzing the difference in total barred owls removed with an 80 and 100 percent annual removal rate. The results of those analyses indicate that the overall total number of barred owls removed varies relatively little across the range of 80, 90, or 100 percent removal, when considered in light of the estimates of occupied territories within a study area. This result comes about as a result of annual removal efforts that, in essence, remove a very high (i.e., 80, 90, or 100 percent) proportion of any holdover barred.

For example, on a hypothetical study area of 360 barred owl sites (180 sites in the removal area), we estimate a total of 888 barred owls would be removed during a 4-year experiment, assuming a 90 percent removal rate of territorial individuals. If removal achieves a 100 percent rate, an estimated total of 918 barred owls would be removed (approximately 3.4 percent more). If removal only achieves an 80 percent removal rate, an estimated 855 barred owls would be removed or 3.7 percent less. For a comparable, but longer duration 10-year experiment, the number of barred owls removed would total 1,719, 1,752, and 1,782 for 80 percent, 90 percent, and 100 percent removal, respectively. Thus, reducing the removal rate to 80 percent results in a 1.9 percent decline in the number of barred owls removed, and increasing the removal rate to 100 percent would result in a 1.7 percent increase in the number of barred owls removed. Our estimated number of barred owls removed is would not change significantly with up to a 10 percent change in removal rate.

We believe our assumption of 90 percent annual removal rate of territorial barred owls is achievable. However, the sensitivity analysis shows that if the actual annual removal rate drops as low as 80 percent, the total number of percent owl removed remains high and the experiment should still yield results within a reasonable time frame.

The number of barred owls potentially removed from any treatment area is influenced by the number of juveniles and subadults that may immigrate into the treatment area during dispersal from their natal area. This is the primary source of barred owls to reoccupy sites after we remove the territorial individuals, particularly after the second removal period when most floaters have been removed from the population. In our analysis, we assumed that 40 percent of the initial barred owl population would be replaced each year. This estimate represents a high rate, and has a strong influence on the total number of barred owls to be removed over the duration of the experiment. Using our earlier hypothetical example of a removal area initially populated by 360 barred owls, a 20 percent rate of immigration into the treatment area by juveniles and subadults reduces the total number of barred owls removed over a 4-year experiment from 888 to 732, a reduction of 17.6 percent compared to a 40 percent immigration rate. The implications for a longer-term experiment are even more profound. A similar reduction in the rate of immigration over a 10-year experiment would result in a 33.6 percent decline in the number of barred owls removed. As we indicated earlier in this appendix, we have adopted the higher rate of immigration in our analysis to avoid underestimating the effects of our action on the barred owl. As part of this experimental effort, we will monitor this immigration rate as it influences our removal numbers.

We also adopted a fairly low estimate of the rate of removal newly territorial barred owls that establish during the initial year in the treatment area. We adopted a value of 25 percent. The number of barred owls removed over the course of a 4- to 10-year experiment varies little despite substantial changes to this rate. The reason for this limited change is that any barred owl that survives their initial year of immigration into the treatment population will be removed at a high rate during the next year as a territorial individual.

For example, on a study area of 360 barred owl sites, we estimate a total of 888 barred owls would be removed during a 4-year experiment, assuming a 25 percent removal rate of newly territorial individuals, and 90 percent removal of territorial individuals. If removal of newly territorial barred owls achieves a substantially higher (50 percent) rate, an estimated total of 928 barred owls would be removed, or approximately 4.5 percent more. If removal only achieves a 12.5 percent removal rate (i.e., half of the assumed 25 percent rate), an estimated 868 barred owls would be removed, or 2.3 percent less. For a comparable but longer duration 10-year experiment, the number of barred owls removed would total 1,732, 1,752, and 1,792 for 12.5 percent, 25 percent, and 50 percent removal of non-territorial barred owls, respectively. Thus, reducing the removal rate of newly territorial barred owls to 12.5 percent results in a 1.1 percent decline in the number of barred owls removed, and increasing the removal rate of newly territorial barred owls to 50 percent would result in a 2.3 percent increase in the number of barred owls removed. Thus, our estimated number of barred owls removed would not change significantly, even at removal rates for newly territorial barred owls double, or half, of our anticipated rate. We believe our assumption of 25 percent removal rate of territorial barred owls is adequate and the sensitivity analysis shows that if the actual rate increased or decreases by 50 percent, the total number of percent owl removed remains high and the experiment should still yield results within a reasonable time frame.

Of greater consequence to the number of barred owls removed during the experiment is the number of "holdover" individuals remaining in the territorial barred owl population at the start of the next removal year. Our low estimated rate of removal of immigrants results in a fairly high number of holdover individuals at the start of each subsequent removal year. A higher rate of removal of newly territorial immigrants would substantially reduce the number of holdovers at the beginning of each year, and would likely improve our ability to document the influence of barred owls on spotted owls. However, we do not anticipate being able to achieve removal rates of newly territorial barred owls substantially above our assumed 25 percent due to the limited period when most removal will occur. We do not believe this is an impediment to conducting the experiment. However, we will monitor actual removal rates during the experiment to test our assumption.

Table F-4. Estimate of barred owl removal numbers by alternative and year.

Treatment Areas (Barred Owl Removal) Within Each Action Alternative [1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Number of Years of the Experiment	Estimated Number of Barred Owl Sites [2]	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Number of Barred Owls Removed
							Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Preferred Alternative: Demographic Experiment on Four Study Areas; Lethal and Nonlethal Removal																	
Cle Elum	0	4	4	257	129	257	270	153	108	103	-	-	-	-	-	-	634
Oregon Coast Ranges/Veneta (half)	0	4	4	512	256	512	538	305	215	205	-	-	-	-	-	-	1,263
Union/Myrtle (Klamath)	0	4	4	682	290	580	608	345	243	234	-	-	-	-	-	-	1,430
Hoopa (Willow Creek)[3]	0	4	4	107	56	112	118	66	47	45	-	-	-	-	-	-	276
Totals				**1,955**	**731**	**1,461**	**1,534**	**869**	**613**	**587**	**-**	**-**	**-**	**-**	**-**	**-**	**3,603**
Alternative 1: Select a Single Ongoing Spotted Owl Demographic Study Area; Lethal Removal Only																	
Cle Elum	0	7	7	257	129	257	270	153	108	103	103	103	103	-	-	-	942
Rainier	0	6	6	266	133	266	279	158	112	107	106	106	-	-	-	-	869
Olympic Peninsula	0	5	5	689	345	689	723	410	289	277	276	-	-	-	-	-	1,975
Oregon Coast Ranges	0	4	4	909	454	909	954	541	381	365	-	-	-	-	-	-	2,242
Tyee	0	4	4	219	110	219	230	130	92	88	-	-	-	-	-	-	540
HJ Andrews	0	4	4	402	201	402	422	239	169	162	-	-	-	-	-	-	992
Klamath	0	4	4	392	196	392	412	233	164	158	-	-	-	-	-	-	967
South Cascades	0	4	4	747	374	747	784	444	313	300	-	-	-	-	-	-	1,842
Hoopa (Willow Creek)	0	5	5	107	56	112	118	67	47	45	45	-	-	-	-	-	321
Alternative 2: Select a Combination of Three Ongoing Spotted Owl Demographic Study Areas; Lethal and Nonlethal Removal																	

Treatment Areas (Barred Owl Removal) Within Each Action Alternative [1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Number of Years of the Experiment	Estimated Number of Barred Owl Sites [2]	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Number of Barred Owls Removed
							Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Large [4]	0	4	4	2,345	1,225	2,450	2,462	1,395	984	943	-	-	-	-	-	-	5,784
Barred Owl Work Group [5]	0	4	4	1,558	779	1,558	1,636	927	654	626	-	-	-	-	-	-	3,843
Small [6]	0	4	4	583	294	588	617	350	247	236	-	-	-	-	-	-	1,450
Alternative 3: Select a Combination of Two Ongoing Spotted Owl Demographic Study Areas with Lethal and Nonlethal Removal																	
Veneta (Oregon Coast Ranges/Tyee)	0	4	4	232	116	232	244	138	97	93	-	-	-	-	-	-	572
Union/Myrtle (Klamath)	0	4	4	682	290	580	609	345	243	233	-	-	-	-	-	-	1,431
Totals				**914**	**406**	**812**	**853**	**483**	**341**	**326**	**-**	**-**	**-**	**-**	**-**	**-**	**2,003**
Sub-Alternative 4a: Initiate a 5-Year Demography Experiment on Two Areas; AFTER Gathering Initial Data for 5 Years; Lethal and Nonlethal Removal																	
Columbia Gorge	5	5	10	378	189	378	0	0	0	0	0	397	225	159	152	142	1,074
McKenzie	5	5	10	390	195	390	0	0	0	0	0	410	232	164	157	147	1,109
Totals				**768**	**384**	**768**	**0**	**0**	**0**	**0**	**0**	**806**	**457**	**322**	**309**	**289**	**2,183**
Sub-Alternative 4b: Initiate a 6- to 8-Year Demography Experiment on Two Areas; CONCURRENTLY Gather Initial Data; Lethal and Nonlethal Removal																	
Columbia Gorge	2	6	8	378	189	378	0	0	397	225	159	152	151	151	-	-	1,235
McKenzie	2	6	8	390	195	390	0	0	410	232	164	157	156	156	-	-	1,274
Totals				**768**	**384**	**768**	**0**	**0**	**806**	**457**	**322**	**309**	**307**	**307**	**-**	**-**	**2,509**

Treatment Areas (Barred Owl Removal) Within Each Action Alternative [1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Number of Years of the Experiment	Estimated Number of Barred Owl Sites [2]	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Number of Barred Owls Removed
							Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Alternative 5: Conduct a 3- to 5-Year Occupancy Experiment on Three Study Areas with Existing Occupancy Data; Lethal Removal Only																	
Cowlitz Valley [7]	0	3	3	396	198	396	416	236	166	-	-	-	-	-	-	-	818
Veneta (Oregon Coast Ranges/Tyee)	0	3	3	232	116	232	244	138	97	-	-	-	-	-	-	-	479
Union/Myrtle (Klamath)	0	3	3	682	290	580	609	345	243	-	-	-	-	-	-	-	1,197
Totals				**1,310**	**604**	**1,208**	**1,268**	**719**	**507**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2,494**
or ...																	
Cowlitz Valley	0	5	5	396	198	396	416	236	166	159	158	-	-	-	-	-	1,135
Veneta (Oregon Coast Ranges/Tyee)	0	5	5	232	116	232	244	138	97	93	93	-	-	-	-	-	665
Union/Myrtle (Klamath)	0	5	5	682	290	580	609	345	243	233	232	-	-	-	-	-	1,663
Totals				**1,310**	**604**	**1,208**	**1,268**	**719**	**507**	**486**	**483**	**-**	**-**	**-**	**-**	**-**	**3,463**

Treatment Areas (Barred Owl Removal) Within Each Action Alternative[1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Number of Years of the Experiment	Estimated Number of Barred Owl Sites[2]	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Number of Barred Owls Removed
							Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Sub-Alternative 6a: Initiate Occupancy Experiment on Three Study Areas; AFTER Gathering Occupancy Data; Lethal and Nonlethal Removal																	
Olympic Revised (Olympic Pen.)	3	3-5	6-8	917	228	456	0	0	0	479	271	191	183[2]	182[2]	-	-	941 to 1,307[2]
McKenzie	3	3-5	6-8	390	195	390	0	0	0	410	232	164	157	156	-	-	805 to 1,118
Horse/Beaver	3	3-5	6-8	126	63	126	0	0	0	132	75	53	51	50	-	-	260 to 361
Totals (simple occupancy)				**1,433**	**473**	**945**	**0**	**0**	**0**	**1,021**	**578**	**408**	**-**	**-**	**-**	**-**	**2,007**
Totals (occupancy and reproduction)				**1,433**	**473**	**945**	**0**	**0**	**0**	**1,021**	**578**	**408**	**391**	**389**	**-**	**-**	**2,786**
Sub-Alternative 6b: Initiate Occupancy Experiment on Three Study Areas; CONCURRENTLY Gathering Occupancy Data; Lethal and Nonlethal Removal																	
Olympic Revised (Olympic Pen.)	0	4-6	4-6	917	228	456	479	271	191	183	182	182	-	-	-	-	1,125 to 1490
McKenzie	0	4-6	4-6	390	195	390	410	232	164	157	156	156	-	-	-	-	962 to 1,274
Horse/Beaver	0	4-6	4-6	126	63	126	132	75	53	51	50	50	-	-	-	-	311 to 412
Totals (simple occupancy)				**1,433**	**486**	**972**	**1,021**	**578**	**408**	**391**	**-**	**-**	**-**	**-**	**-**	**-**	**2,397**
Totals (occupancy and reproduction)				**1,433**	**486**	**972**	**1,021**	**578**	**408**	**391**	**389**	**389**	**-**	**-**	**-**	**-**	**3,175**

Treatment Areas (Barred Owl Removal) Within Each Action Alternative [1]	Number of Years of Barred Owl Pre-removal	Number of Years of Barred Owl Removal	Number of Years of the Experiment	Estimated Number of Barred Owl Sites [2]	Estimated Number of Barred Owl Sites in Treatment Area	Estimated Initial Number of Barred Owls in Treatment Area	Estimated Number of Barred Owls Removed Each Year of the Experiment										Estimated Number of Barred Owls Removed
							Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	
Alternative 7: Conduct Combined Demography and Occupancy Studies on 11 Areas; Duration Varies by Area; Lethal and Nonlethal Removal																	
Ross Lake	0	10	10	304	152	304	319	181	128	122	122	122	122	122	122	122	1,479
Olympic Revised (Olympic Pen.)	0	4	4	917	228	456	479	271	191	183	-	-	-	-	-	-	1,125
Rainier	0	6	6	266	133	266	279	158	112	107	106	106	-	-	-	-	869
Wenatchee	0	3	3	479	240	480	504	286	201	-	-	-	-	-	-	-	991
Veneta (Oregon Coast Ranges/Tyee)	0	10	10	232	116	232	244	138	97	93	93	93	93	93	93	93	1,129
HJ Andrews	0	4	4	402	201	402	422	239	169	162	-	-	-	-	-	-	992
Rogue Cascades (South Cascades)	0	4	4	1,087	235	470	494	280	197	189	-	-	-	-	-	-	1,159
Hoopa (Willow Creek)	0	10	10	107	56	112	118	67	47	45	45	45	45	45	45	45	545
Horse/Beaver	0	4	4	126	63	126	132	75	53	51	-	-	-	-	-	-	311
Goosenest	0	10	10	14	7	14	15	6	6	6	6	6	6	6	6	6	68
Corral	0	10	10	46	23	46	48	27	19	18	18	18	18	18	18	18	224
Totals [8]				**3,980**	**1,454**	**2,908**	**3,053**	**1,730**	**1,220**	**976**	**390**	**390**	**283**	**283**	**283**	**283**	**8,892**

[1] Study areas arranged north to south within each alternative.
[2] For study areas that are removal only and use a neighboring area as control, this number includes both areas
[3] Parenthetical notation indicates that the study area includes both a treatment (in this case, Hoopa) and associated experimental control area (in this case, Willow Creek).
[4] The "large" three study area combination includes the Olympic Peninsula, Oregon Coast Ranges, and South Cascades Demographic Study Areas.
[5] The " Barred Owl Work Group recommendation includes three study area combination includes the Cle Elum, Oregon Coast Ranges, and Klamath Demographic Study Areas.
[6] The "small" three study area combination includes the Cle Elum, Tyee, and Hoopa (Willow Creek) Demographic Study Areas.
[7] Not all sites surveyed every year, last number surveyed 88, total sites historically = 155
[8] Note that numeric rounding within columns may result in minor discrepancies in numbers reported in each alternative.
[9] Alternatives 6a and 6b each includes two options for experiment duration. Values for number of barred owls removed include estimates for each experiment’s duration, as reflected in later years of removal, and totals for the full number of years of removal.

Appendix G

Procedure for Determining the Number of Possible Spotted Owl Sites on Individual Study Areas

G.0 Changes between Draft and Final EIS

- No substantial changes from draft

G.1 Analysis Process

To estimate the total potential number of northern spotted owl (spotted owl) territories on each study area, we used data from ongoing spotted owl surveys in combination with an owl estimation methodology (USDI and USDA 2008, entire) to estimate numbers of spotted owls in areas where surveys were not conducted. Some areas have been surveyed extensively over many years while others have not. However, all study areas had at least some historical data that identified spotted owl locations on the landscape. For the purpose of this Draft EIS, we used the sum of known and historical spotted owl sites plus the number of estimated owl sites on lands that fell outside the territories of the known sites to estimate the number of potential spotted owl sites.

The owl estimation methodology estimates the number of spotted owl sites likely to occur within an area, based on the amount and distribution of owl habitat and best available information on known owl sites and their spacing patterns for that area. In particular, the methodology relies upon known spotted owl locations derived from surveys as the foundation for developing a "spotted owl site occupancy" map. The methodology was reviewed by agency biologists responsible for application of the methodology, along with leading spotted owl researchers.

The owl estimation methodology evaluates habitat conditions around known spotted owl sites at three spatial scales (nest patch, core area, home range), and uses habitat minimums from known sites to assess habitat conditions across the area of interest. Based on the amount of habitat, home range size, and nearest neighbor distances around known owl sites for a given area, numbers of potential owl sites are estimated for the remaining areas where survey data are not available. Specific details for conducting these analyses in a GIS framework using digital habitat maps are presented in USDI and USDA (2008, entire). Spotted owl home range and core area sizes vary geographically, generally decreasing from north to south. Amount of habitat within nest patches, core areas, and home ranges around known owl sites is used to establish criteria for estimating numbers of additional spotted owl sites in unsurveyed areas. Table G-1 lists the size of areas used to delineate nest patches, core areas, and home ranges by study area.

Table G-1. Size (radius in feet) for nest patch, core area, and home range used to measure available habitat for estimating additional spotted owl sites in unsurveyed areas.

Study Area	Nest Patch Radius [1]	Core Area Radius	Home Range Radius
Ross lake	656	3,695	9,498
Olympic	656	7,387	14,246
Olympic (revised)	656	7,387	14,246
Cle Elum	656	3,695	9,498
Rainier	656	3,695	9,498
Colwitz	656	3,695	9,498
Wenatchee	656	3,695	9,498
Columbia Gorge	656	3,695	9,498
HJ Andrews	656	2,623	6,334
McKenzie	656	2,623	6,334
Oregon Coast Ranges	656	2,623	7,915
Tyee	656	2,623	7,915
Veneta	656	2,623	7,915
Union/Myrtle	656	2,623	6,859
South Cascades	656	2,623	6,334
Klamath	656	2,623	6,859
Rogue	656	2,623	6,859
Goosenest	656	2,623	6,859
Willow Creek	656	2,623	6,859
Corral	656	2,623	6,859
Horse Beaver	656	2,623	6,859
Hoopa	656	2,623	6,859
Green Diamond	656	2,623	6,859

[1] 2008 owl estimation methodology differed between versions in the use of either a 656 foot- or 984 foot-radius for nest patch delineation. Because we wanted to determine the maximum possible number of spotted owl sites, we used a nest patch radius of 656 feet.

Appendix H

Power Analyses for Barred Owl Removal Experiment Options

H.0 Changes between Draft and Final EIS

- Added summary of results for Preferred Alternative.

H.1 Introduction

An important factor to consider when evaluating alternatives is how well each study design will be able to detect changes in northern spotted owl (spotted owl) populations when barred owls are removed.

To assess the ability of the eight action alternatives to detect change in spotted owl population trends, we need to consider the difference in the statistical power of each. The power of a statistical test is the probability that it will correctly lead to the rejection of a false null hypothesis (Ott 1988, p. 143), or in other words, the ability of a test to detect an effect, given that the effect actually exists (High 2000, pp. 1-2). Studies with larger sample sizes will have higher power to detect effects of barred owl removal; thus, study areas with more owl territories or owls will have higher power to detect changes in occupancy or demographic rates than areas with fewer owls. In addition, power to detect changes is also greater for areas where there is a larger (actual) change in spotted owl performance between treatment and control areas.

Study areas with more years of pretreatment data will also have greater power to detect effects of barred owl removal, as these data allow for more precise estimates of annual survival, reproduction, and rate of population change. Pretreatment data provide valid estimates of the parameters of interest for a study area prior to barred owl removal. With no pretreatment data, we have less information to evaluate the differences between treatment and control areas at the start of the experiment. Without these data, we are just making a comparison between treatment and control areas without knowing how similar or different the two areas were prior to removing barred owls.

Demography studies focus on annual rate of population change (lambda; λ). A lambda value of 1 indicates a stable population, lambda greater than 1 indicates an increasing population, and lambda less than 1 indicates a declining population. Lambda values have the same interpretation regardless of study area and relative changes in lambda are comparable across areas. Occupancy analyses, by comparison, assess changes in the proportion of sites occupied by spotted owls. Changes in occupancy over time reflect changes in number of sites occupied by spotted owls;

however, changes in occupancy rates are less comparable across different study areas than rates of population change because initial occupancy rates will vary across study areas and no one occupancy value indicates stable population trends. Rates of population change can be assessed in an occupancy study; however, this approach does not provide the same level of detail as a demography study. With the exception of the Preferred Alternative and Alternatives 1 and 2, which occur on ongoing spotted owl demographic study areas, we cannot directly compare the power of each alternative to detect an effect, given that: (1) the measures of population performance aren't comparable (e.g., occupancy vs. population growth rate), and (2) we do not know what current or past population growth or occupancy rates are for areas that are not long-term study areas.

All the action alternatives contain demographic, occupancy, or combined demographic-occupancy study designs. Alternatives 1 through 4 and the Preferred Alternative are demography area studies, and Alternative 7 also includes some demography studies. Alternatives 1 and 2 include ongoing spotted owl demographic study areas with 15 or more years of pretreatment demographic data (Forsman *et al.* 2011a, entire); Alternative 3 uses areas with some demographic data as treatment (removal) areas and ongoing spotted owl demographic study areas (Tyee, Oregon Coast Ranges, Klamath) as control areas. For Alternative 4, the Columbia Gorge and McKenzie Study Areas have minimal monitoring data and would be new demography areas with no preexisting data. Alternatives 5 and 6 are occupancy analyses. While we can conduct power analyses for occupancy studies, the analyses for occupancy studies are not directly comparable to those for demography studies because they are looking at different measures of population dynamics. Alternative 7 is a combination of demographic and occupancy analyses. This alternative includes study areas across as many physiographic provinces as possible and continues removal of at least four of the study areas for a full 10 years to evaluate longer term effects. Because of the complexity of this alternative and the wide differences in availability of data among the individual study areas, we did not attempt a power analysis for this alternative.

In order to assess the likely ability of each of the eight action alternatives to detect changes in spotted owl rate of population change after barred owl removal, we needed to establish what effect size. This is the amount of change in the spotted owl rate of population growth or occupancy that we consider reasonable to anticipate under the experiment for each study area or alternative. For ongoing spotted owl demographic study areas in the Draft EIS, we evaluated the power to detect an increase from current lambda to 1.0, 1.05, and 1.10. These three scenarios represent the effect of barred owl removal resulting in (1) a stable spotted owl population, (2) a spotted owl population increasing at 5 percent per year, and (3) a spotted owl population increasing at 10 percent per year. For the Preferred Alternative in the Final EIS, we evaluated the power to detect a 0.03 and 0.05 increase in lambda compared to current lambda. These represent slightly smaller changes in lambda than what we originally evaluated for Alternatives 1 and 2. For the Preferred Alternative, we chose to test for an increase of 0.03 as this represents the 1999 to 2008 estimate of the rangewide population decline (Forsman *et al.* 2011a, p. 3) and a 0.03 increase in lambda across the four treatment areas would represent a stable population assuming results were applicable across the range of the owl. We chose 0.05 as a reasonable level at which all but two of the study areas included in the spotted owl demography meta-analysis would achieve stable or increasing populations. We did not perform a revised power analysis on Alternative 1 and 2 for 0.03 and 0.05 increases in lambda because we have sufficient information to compare the power of these with the Preferred Alternative without the extensive effort and time required to conduct the analysis. The Preferred Alternative includes four study areas and more total spotted owl sites than even the largest combination of study areas in Alternative 2, thus we can conclude it will have greater power to detect an effect.

For areas that do not have current demographic data, but are being considered for a demographic removal experiment, we used ongoing spotted owl demographic study areas of similar size (number of owl sites) to evaluate power. Formal occupancy studies have not been conducted on any of the areas under consideration for an occupancy experimental design. Because we do not know what current occupancy rates are for most of these areas, we conducted three general power analyses looking at the power to detect changes where occupancy rates go from: (1) low (0.30) to high (0.85); (2) moderately low (0.4) to moderately high (0.68); and (3) moderate (0.5) to slightly higher (0.65).

In general, the power to detect an effect greater than 0.80 is considered high. This means the test would detect a real difference 80 percent of the time. However, these levels are often not achieved in wildlife studies given the relatively small sample sizes and high levels of variation in natural systems. We did not establish a target power to achieve, but rather used the power analysis to compare the power of the alternatives or study areas within alternatives. We conducted separate power analyses for demography and occupancy studies as follows:

H.2 Power Analyses for Demographic Studies

Power analyses for Alternatives 1, 2, and 3 were based on data from Forsman *et al.* (2011a, entire). These alternatives use encounter histories (whether or not an owl was observed in each year) to estimate annual rate of population change (lambda) using reverse-time capture-mark-recapture models for open populations in Program MARK (Pradel 1996, entire). Reverse-time capture-mark-recapture models provide year-specific estimates of survival, recruitment, and rate of population change. Encounter histories are used to estimate annual survival and recruitment. Annual rate of population change (lambda, λ) at a particular time (time t) is calculated as follows:

$$\lambda(t) = survival(t) + recruitment(t).$$

where survival (t) is apparent annual survival, or the probability that an animal alive and available to be observed in the previous year (t-1) is alive and available to be observed in the current year time (t), and recruitment (t) is the number of new animals in the population the next year (t+1) relative to the number of animals in the population this year (t).

Lambda measures the rate of change in populations between successive years. A minimum of 3 years of data collection are needed before lambda can be estimated from mark-resighting data, because the first and last estimates of lambda will be confounded (Pradel 1996, p. 704).

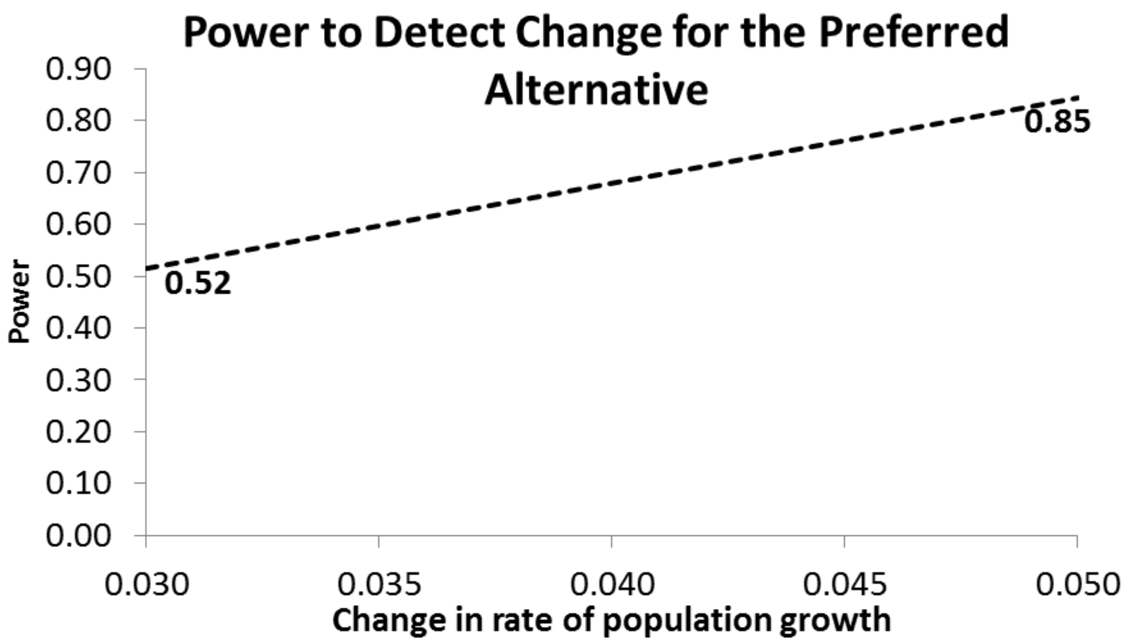
For the purposes of the power analysis, we assumed that 10 years of pretreatment data were available for each area. We generated data using a reverse-time capture-recapture model (see Forsman *et al.* 2011a, p. 18) that assumed constant survival, recapture, and recruitment values across time, except that recruitment changed between pre- and post-removal on the treatment area. Recruitment rate was assumed to be the same during pretreatment for both areas but varied through time. There was a constant difference in recruitment between treatment and control areas following removal. We conducted 200 simulations to estimate each of the power analyses. Sample sizes used in the power analyses were based on data from the past decade. If spotted owl numbers continue to decline (further reducing sample sizes), overall power to detect changes will be lower than what is reported here.

H.2.1 Power Analysis for Preferred Alternative

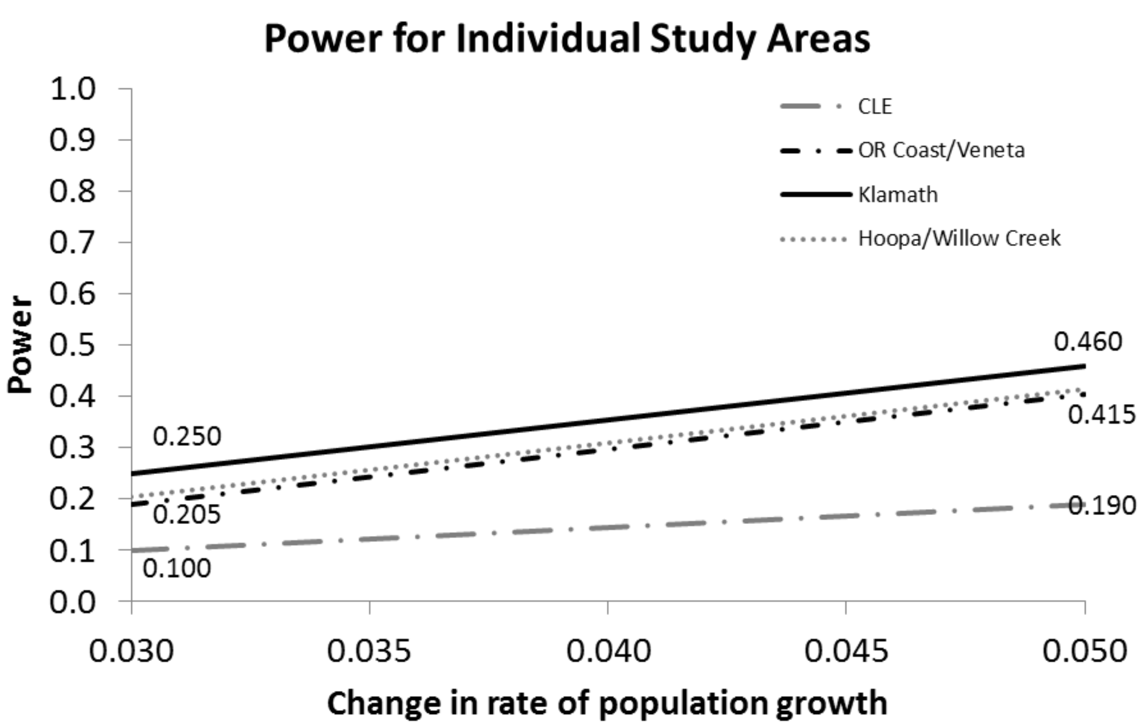
The power analyses for the Preferred Alternative followed the methods described above. We evaluated the power to detect a 0.03 and 0.05 increase in lambda compared to current lambda rates (Figure H-1). A change in lambda of 0.03 represents a small change, and the power to detect such a change is not great. The power to detect a 0.05 change in lambda was strong for this alternative (0.85), indicating that this alternative is likely to have sufficient power to detect even relatively small increases in spotted owl vital rates on these areas.

Figure H-1. Estimated power to detect a 0.03 and 0.05 change in the rate of population growth (λ) from current levels for the complete experiment (A) and for detecting changes at the individual treatment-control study areas (B) over a 4-year experiment duration of barred owl removal.

A.



B.



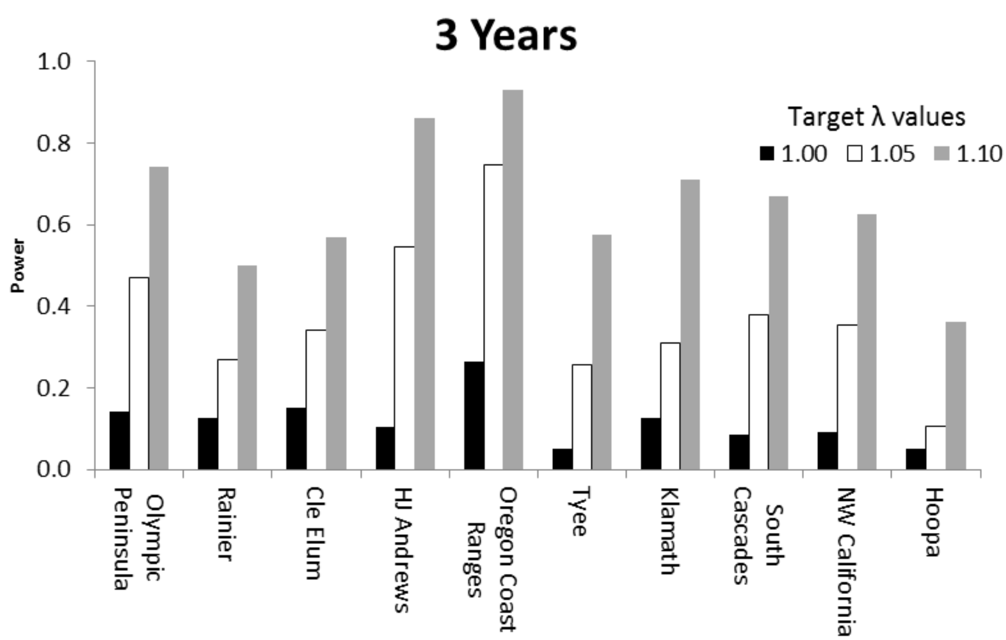
H.2.2 Alternative 1

We evaluated the three levels of change in lambda described above (1.0, 1.05, 1.10), based on hypothesized effects of barred owl removal on spotted owl populations on these study areas. As individual study areas started at different lambda, the change required to reach these values varied by study area. Sample sizes for individual study areas are presented in Table H-1 at the end of this appendix.

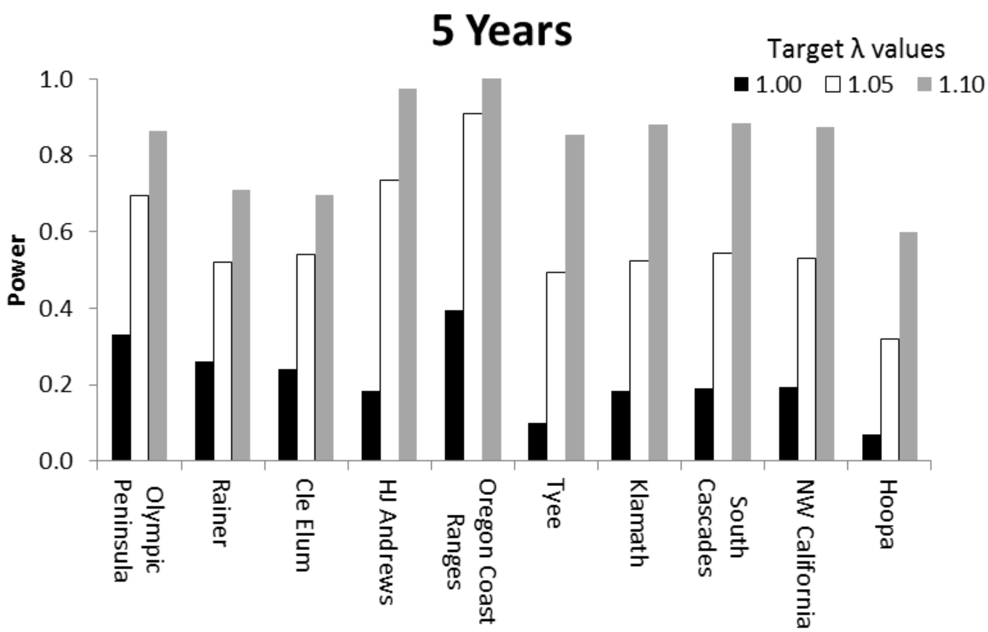
For Alternative 1 (individual areas), the power analysis results shown in Figure H-1 indicate that larger study areas (more spotted owl sites) have greater power to detect changes in population growth rate resulting from barred owl removal. The power analyses considered the ability to detect increases in lambda to 1.0, 1.05, and 1.10. All study areas used in the power analysis have lambda values less than 1.0, with actual values ranging from 0.93 to 0.99 (Forsman *et al.* 2011a, p. 44) (Table H-1). For Alternative 1 (single study area), the Oregon Coast Ranges Study Area has the greatest power, while Rainier has the lowest (Figure H-2).

Figure H-2. Estimated power to detect change in rate of population growth (lambda) for barred owl removal experiment on a single ongoing spotted owl demographic study area with 10 years of pretreatment data and 3 (A) or 5 (B) years of barred owl removal on half the study area (Alternative 1). Two-hundred simulations were conducted to estimate each of the power values. Data used in these analyses were those presented in Forsman *et al.* (2011a, entire) and study area boundaries may not align precisely with those presented in this Draft EIS.

A.



B.

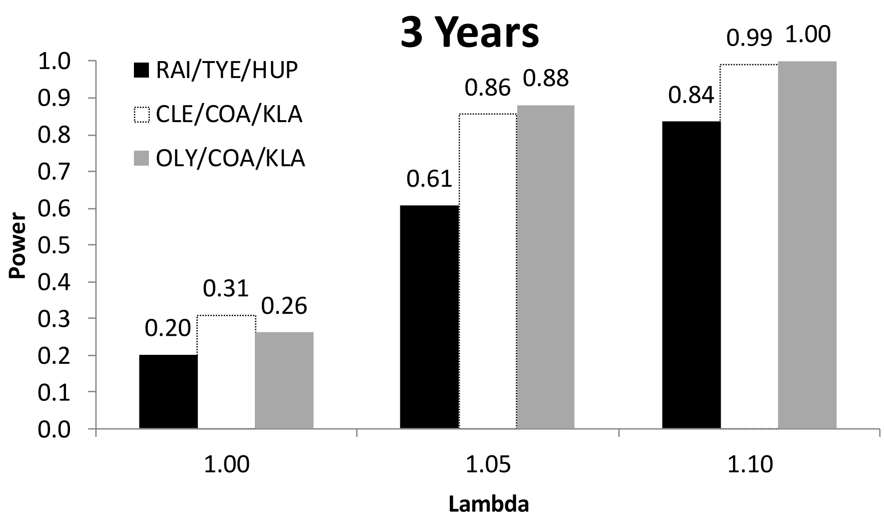


H.2.3 Alternative 2

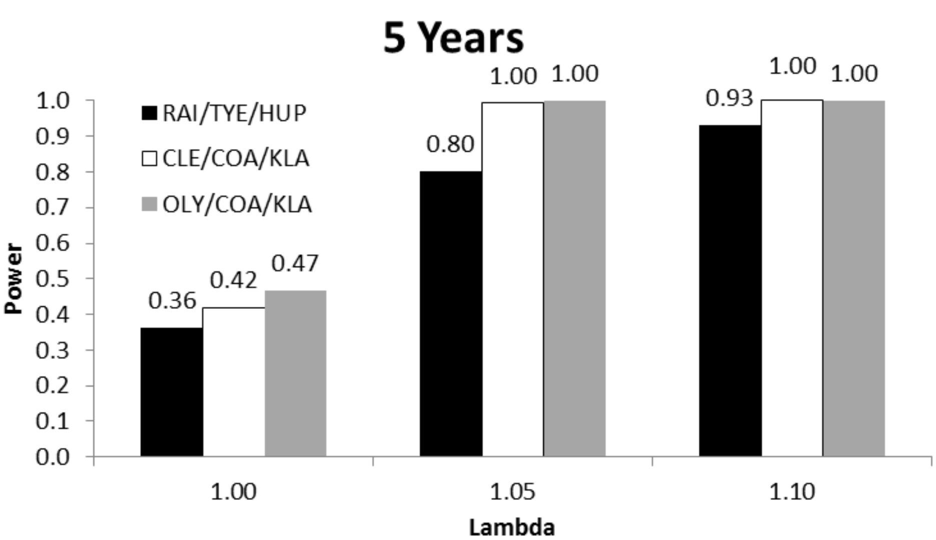
Alternative 2 considers combinations of three ongoing spotted owl demographic study areas (See Figure H-2 for power graphs for three-area combinations). Power analyses were conducted using methods described for Alternative 1; however, power was considered for three-area combinations rather than single areas. Combined (three areas) study areas have considerably greater power than any single study area and this design is more representative of the entire range of the northern spotted owl. We evaluated the three combinations (Olympic Peninsula/Oregon Coast Ranges/Klamath (largest), Rainier/Tyee/Hoopa (smallest), Cle Elum/Oregon Coast Ranges/Klamath (grouping developed by the Barred Owl Work Group)). The combination of largest areas had the highest power; however, power for the alternative developed by the Barred Owl Work Group was not much lower (Figure H-3).

Figure H-3. Estimated power to detect a change in rate of population growth (lambda) from current levels to 1.0, 1.05, and 1.10 for barred owl removal experiment on combinations of three ongoing spotted owl demographic study areas with 10 years of pretreatement data and 3(A) or 5(B) years of percent owl removal on half of each study area (Alternative 2). Combinations are based on including one study area in Washington, one in northern Oregon, and one in southern Oregon or northern California. Two-hundred simulations were conducted to estimate each of the power values. The combinations shown three largest areas (Olympic Peninsula/OregonCoast Ranges/Klamath (OLY/COA/KLA)), Barred Owl Work Group recommendation (Cle Elum/Coast Ranges/Klamath (CLE/COA/KLA)), and three smallest areas with one each from Washington, Oregon, and California (Rainier/Tyee/Hoopa (RAI/TYE/HUP)).

A.



B.

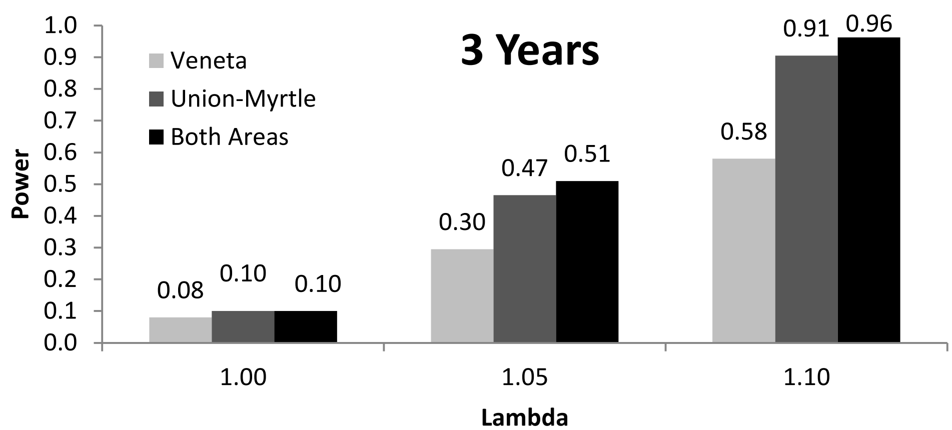


H.2.4 Alternative 3

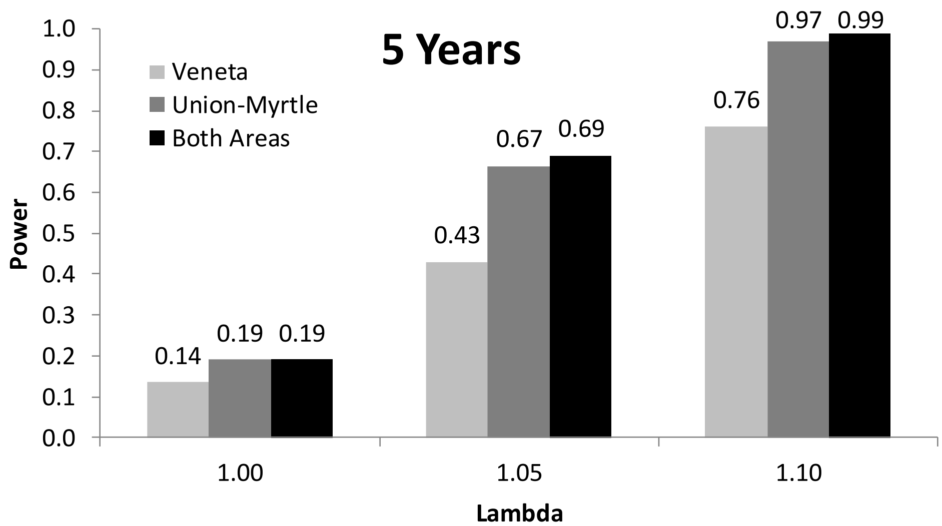
Alternative 3 considers demographic studies with removal on areas that are not ongoing spotted owl demographic study areas, but have long-term monitoring data and using neighboring ongoing spotted owl demographic study areas as controls. See Figure H-4 for power analyses for Veneta and Union/Myrtle. Power is relatively high for both individual areas and highest for both areas in combination. Sample sizes are reasonably large given that adjacent, ongoing spotted owl demographic study areas are used as controls.

Figure H-4. Estimated power to detect a change in rate of population growth (lambda) from current levels to 1.0, 1.05, and 1.10 for barred owl removal experiment on study areas that are not ongoing spotted owl demographic study areas (but have long-term spotted owl data) with 10 years of pretreatment data. Figure A for 3 years and B for 5 years of barred owl removal on half the study area (Alternative 3). For conducting the power analyses, demographic rates at Veneta were assumed to be similar to Tyee, and demographic rates at Union/Myrtle were assumed to be similar to Klamath. Two-hundred simulations were conducted to estimate each of the power values.

A.



B.



H.2.5 Alternative 4

Alternative 4 considered new demographic studies on areas that do not have current demographic data. Sub-Alternative 4a collects pretreatment data while sub-Alternative 4b does not. Power to detect changes in lambda is therefore higher for 4a than for 4b. However, power for these areas will be considerably less than areas of similar size (similar numbers of spotted owl sites) with pretreatment data. For this alternative, we had no data on current demographic rates. The McKenzie Study Area is likely most similar demographically to HJ Andrews Study Area; however, sample size is most similar to the Olympic Peninsula Study Area. The Columbia Gorge Study Area is likely most similar in habitat conditions and sample size to Cle Elum Study Area.

Given the lack of data, we were unable to conduct a formal power analysis for this alternative, but we can provide some general observations. Power for the McKenzie area with pretreatment data will be somewhat lower than for the Olympic Peninsula given that there will be fewer years of pretreatment data in Alterative 4a than currently exist for demographic studies at the Olympic Peninsula. Lack of pretreatment data in sub-Alternative 4b will further lower the power to detect changes in demographic rates. Similarly, power for Columbia Gorge will be lower than for Cle Elum given fewer years of pretreatment data in sub-Alternative 4a than for demographic studies at Cle Elum. Again, the lack of pretreatment data in 4b results in lower power than for sub-Alternative 4a.

H.2.6 Summary of Power Analyses for Alternatives Using a Demographic Study Approach

- The largest ongoing spotted owl demographic study areas have greatest power to detect changes in population growth rate (lambda) or other demographic parameters in Alternative 1. Combinations of three areas in Alternative 2 have considerably more power than single areas and are more representative of the species' range.
- The Preferred Alternative has greater power than any of the options in Alternatives 1 or 2 because it includes four study areas with pretreatment demographic data.
- The Veneta (Oregon Coast Ranges/Tyee) and Union/Myrtle (Klamath) Study Areas in Alternative 3, while not current and ongoing spotted owl demographic study areas, have reasonable power to detect change in the rate of spotted owl population growth due to existence of demographic quality pretreatment data or estimates. In addition, the control areas for this alternative use data from ongoing spotted owl demographic study areas.
- Starting new demography areas (sub-Alternatives 4a and 4b), would have lowest power of all demography options.
  - Lack of pretreatment data results in less precise estimates of demographic rates.
  - It often takes several years (e.g., 3 years minimum) of mark-recapture observations before the rate of population growth can be effectively estimated.

H.3 Power Analysis for Occupancy Studies

Because we do not have established databases for site occupancy for the areas included in the occupancy alternatives and existing data have not been analyzed in an occupancy model framework, we conducted a "hypothetical power analysis" for the alternatives applying an occupancy experimental design to examine power to detect changes in site occupancy under scenarios we believed were likely or reasonable for Alternatives 5 and 6.

H.3.1 Hypothetical Power Analysis

Alternative 5 uses Cowlitz Valley, Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle (Klamath). The proposed treatment areas (a portion of Cowlitz Valley, Veneta portion of the Veneta (Oregon Coast Ranges/Tyee), and Union/Myrtle portion of the Union/Myrtle (Klamath) Study Areas) do have existing occupancy data and the control areas are either ongoing spotted owl demographic study areas (Tyee, Oregon Coast Ranges, Klamath) with data that can be used in an occupancy framework or areas where occupancy data are available (Cowlitz Valley).

For the treatment areas in Alternative 5, the total number of estimated spotted owl sites on all three areas is approximately 210. There are currently about 44 spotted owl sites on the Veneta portion of the Veneta (Oregon Coast Ranges/Tyee) Study Area, approximately 87 sites on the Union/Myrtle portion of the Union/Myrtle (Klamath) with a 2010 occupancy rate of around 50 percent, and approximately 159 sites at Cowlitz Valley with a 2010 occupancy rate of around 40 percent. Half of the 159 sites at Cowlitz Valley will be used for the treatment area. Comparable number of sites will be used on each of the three control areas.

Alternative 6 includes the Olympic Revised area (53 estimated spotted owl sites), the McKenzie area (111 sites), and the Horse/Beaver area (120 sites) for a total of 284 estimated spotted owl sites on treatment areas. For sub-Alternative 6a, pretreatment data are collected, while no pretreatment data are collected for sub-Alternative 6b. As with other alternatives, the option with pretreatment data will have higher power than the option without.

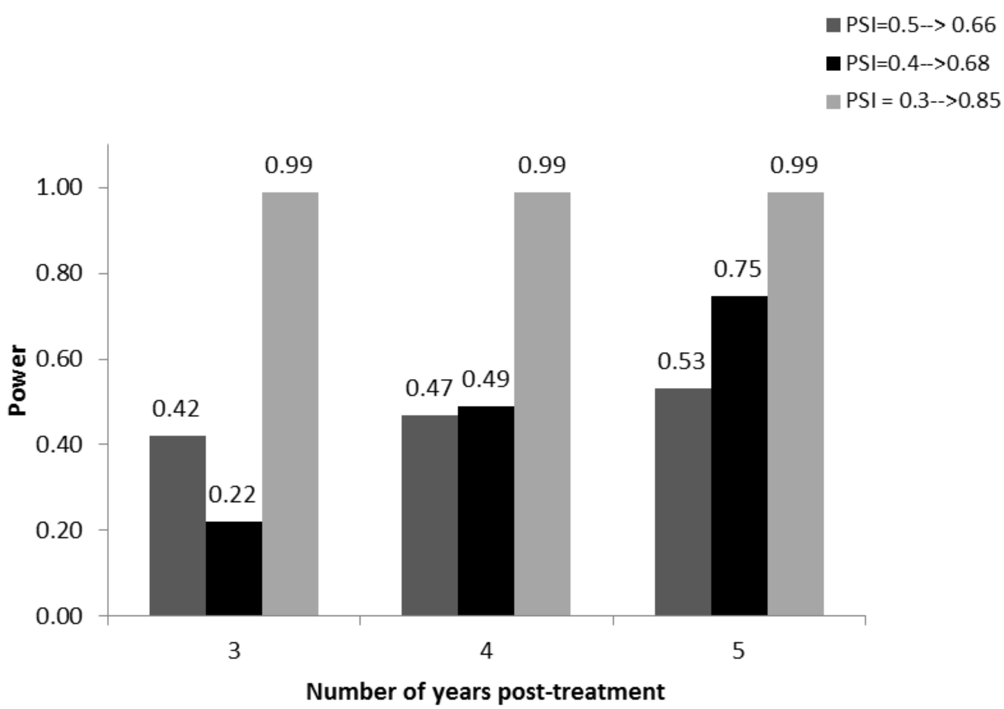
To conduct a power analysis, we used a multiseason occupancy model where we estimated rates of initial occupancy of sites, relocating owls on the site the following year, resighting, colonization of sites, and extinction rates (MacKenzie *et al*. 2006, p. 185). For this analysis, we assumed a hypothetical study area of 50 treatment and 50 control sites. This is similar to the expected numbers of sites in individual treatment areas for Alternatives 5 and 6. When three areas are considered together, power will be higher than for single areas. We assumed a constant relocation rate of 0.50 in all analyses, based on information provided by biologists at several of these areas. Relocation rate is the probability that a spotted owl will be observed (seen or heard) on the same site, given that it is present, at the next time step (MacKenzie *et al*. 2006, p. 9). We assumed local extinction rate, or the probability that a site that was occupied at initial time (t) becomes unoccupied the next year (t+1), was the same for treatment and control areas. Occupancy rates were held at the pretreatment level on control areas. Changes in site occupancy on the treatment area were modeled by increasing colonization rate in the treatment area after barred owl removal such that occupancy rate increased from:

- Low (0.30) to high (0.85) in the treatment area.
- Moderately low (0.4) to moderately high (0.68) in the treatment area.
- Moderate (0.5) to slightly higher (0.65) in the treatment area

We used 3 years of pretreatment data, and 3 or 5 years post treatment data for each power analysis, and conducted 200 simulations to estimate power for each analyses.

Figure H-5 shows results of the power analyses for the occupancy alternatives. Power to detect changes in site occupancy after 3 years is low, except where there is a substantial increase in occupancy rates (e.g., occupancy rate increases from 0.3 to 0.85). After 5 years, the power to detect changes in site occupancy is greater for all three cases. These power analyses represent effects on individual study areas (e.g., around 50 spotted owl sites on treatment and 50 on control).

Figure H-5. Estimated power to detect changes in occupancy rates (psi) for barred owl removal experiment on occupancy study areas with 3 years of pretreatment data and 2 to 5 years of barred owl removal on half the study area (Alternative 5, 6). As we have limited data for the proposed occupancy study areas, this is a generic example. We estimated power for a hypothetical study area with 100 spotted owl sites (50 treatment, 50 control) and several different effects sizes.



For Alternative 5 and 6, power for all areas included will be higher than what is shown on the graphs because numbers of owl sites on these study areas is somewhat higher than those used in simulations. Power will also be higher when pretreatment data are collected relative to when they are not.

Alternative 5 will have essentially the same power as Alternative 6 given the almost identical sample sizes of potential spotted owl sites. For Alternative 5, power will be higher for the alternative with pretreatment data (Option 1) than without (Option 2).

H.3.2 Summary of Occupancy Power Analyses

This analysis was a simpler and more generalized analysis that was done for the demographic studies. Results show that areas with larger sample sizes and more years of pretreatment data will have higher power to detect differences in occupancy rates between treatment and control areas.

H.4 Power Analyses for Alternative 7

This Alternative uses study areas that span the range of the northern spotted owl. Some will be conducted as demographic studies, some will be occupancy studies, and data availability varies widely by area. Given the complexity of this arrangement and the lack of data for a number of areas, no formal power analysis was conducted for this alternative. Given the long time frame (10 years) and large number of study areas many of which have long-term monitoring data, power to detect effects of barred owl removal should be relatively high.

Table H-1. Number of spotted owl sites (territories), current or recent rates of population change (starting lambda), and amount of increase in rate of population change (lambda) needed to achieve stable or increasing population growth rates.

Study Area	Number of Spotted Owl Sites from Forman et al. (2011) [1]	Starting Lambda[2]	Change in Lambda Required to Reach 1.00, 1.05. or 1.10		
			1.0	1.05	1.10
Cle Elum	55	0.937	0.06	0.11	0.16
Olympic Peninsula	105	0.957	0.04	0.09	0.14
Rainer	65	0.929	0.07	0.12	0.17
Oregon Coast Ranges	217	0.966	0.03	0.08	0.13
Veneta	28	0.996	0.00	0.05	0.10
Tyee	98	0.996	0.00	0.05	0.10
HJ Andrews	155	0.977	0.02	0.07	0.12
Union/Myrtle	85	0.990	0.01	0.06	0.11
Klamath	126	0.990	0.01	0.06	0.11
South Cascades	105	0.982	0.02	0.07	0.12
Northwest California	98	0.983	0.02	0.07	0.12
Hoopa	46	0.989	0.01	0.06	0.11
Green Diamond	141	0.972	0.03	0.08	0.13

[1] For a number of reasons, these numbers may not match the total number of spotted owl sites reported elsewhere in this document. For example, Final EIS study area boundaries may differ from those used in Forsman *et al*. (2011a, pp. 5-8).
[2] Starting lambdas for individual study areas are from Forsman *et al.* (2011a, p. 64, Table 22). Veneta and Union/Myrtle were not part of this experiment. We used estimates of lambda from the closest demographic study area for these areas: we used rates from Tyee for Veneta and rates from Klamath for Union/Myrtle.

Appendix I

Effects of Barred Owl Removal Studies on Ongoing Spotted Owl Demographic Study Areas

I.0 Changes between Draft and Final EIS

- No substantial changes from draft

I.1 Effects Analysis

Given their importance for monitoring northern spotted owl (spotted owl) populations over time on a region-wide basis, concerns about the use of ongoing spotted owl demographic study areas for barred owl removal experiments have been expressed by some members of the scientific community. These ongoing spotted owl demographic study areas have been used since the late 1980s or early 1990s to monitor northern spotted owl population trends and demographic rates (Forsman *et al.* 1996a, entire; Franklin *et al.* 1999, entire; Anthony *et al.* 2006, entire; Forsman *et al.* 2011a, entire). While the locations of these long-term study areas were not randomly selected, they do span the geographic range of the subspecies and encompass the majority of forest types used by spotted owls and have therefore been used to assess status of northern spotted owls across the range of the subspecies. They are unique in that a large number of individual spotted owls have been marked (banded) and monitored over time, providing one of the most comprehensive demographic datasets for birds of prey in the world. Some agency managers and scientists have expressed concern that using these areas for a barred owl removal experiment may compromise their utility for long-term monitoring of northern spotted owls under the Northwest Forest Plan Effectiveness Monitoring Program for the Northern Spotted Owl (Lint *et al.* 1999, entire). While such an experiment would have effects on these study areas, we show (in this appendix) that the utility of these areas for long-term monitoring of spotted owl populations can be retained while conducting a barred owl removal experiment.

The goal of this appendix is to identify what the specific effects would be and the magnitude of these effects as they pertain to region-wide demographic monitoring of spotted owls under the Effectiveness Monitoring Program. The ongoing spotted owl demographic study areas span most of the range and habitat types used by northern spotted owls. These study areas have been used to assess population trends across the range of the subspecies since the early 1990s, and eight study areas that are primarily Federal lands have been part of the Effectiveness Monitoring Program for the Northwest Forest Plan (Lint *et al.* 1999, entire). In addition to the eight Federal monitoring areas, a number of other study areas with long term monitoring data have been included in analyses. Individual study areas have been added and dropped from the region-wide analyses over time. Boundaries of study areas have also changed slightly over time (See Anthony *et al.* 2006, pp. 6-8, and Forsman *et al.* 2011a, pp. 5-8 for details). In 1999, there were 16 areas (Franklin *et al.* 1999, p. 4), and in 2006 there were 14 (Anthony *et al.* 2006, p. 6). As of 2008, there were 11 areas, although the eight Federal monitoring areas have remained unchanged since 1996 (Forsman *et al.* 2011a, pp. 5-8). These eight study areas include the Olympic Peninsula, Cle Elum, HJ Andrews, Oregon Coast Ranges, Tyee, South Cascades, Klamath, and Northwest California (of which the Willow Creek area is being considered for use in removal experiments). In addition, several spotted owl demographic study areas that are no longer active are being considered in this Final EIS), including Wenatchee and a portion of the original Olympic Peninsula study area.

Concerns have been raised regarding the use of the eight ongoing spotted owl demographic study areas that are part of the Effectiveness Monitoring Program for the Northwest Forest Plan for experimental removal of barred owls. Because the primary goal of effectiveness monitoring is to track spotted owl populations over time, there is uncertainty about what conducting removal experiment would do to the agency's ability to monitor spotted owl populations. If conditions on half of a study area are fundamentally changed by removing barred owls, population trends from this portion will differ from those on the control area (untreated). These differences will need to be appropriately addressed in order to continue monitoring population trends in northern spotted owls. Conducting removal experiments on these areas is not unprecedented. Barred owl removals have been occurring on one long-term study area (Green Diamond) included in Forsman *et al.* (2011a, entire).

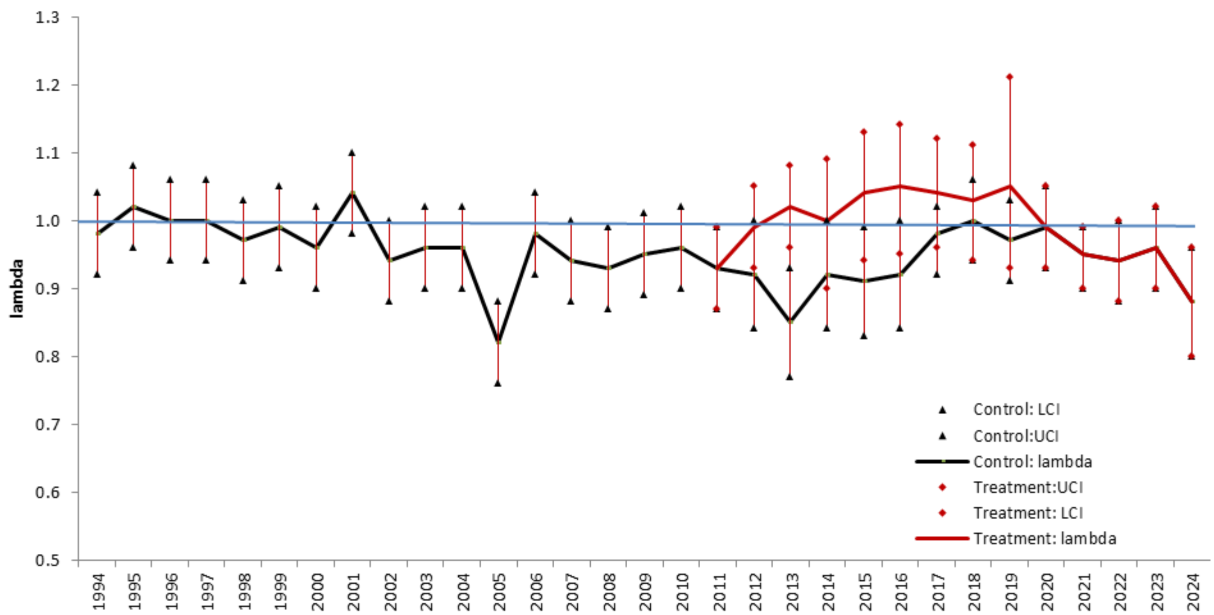
While conducting a removal experiment on one-half of an ongoing spotted owl demographic study area will influence how results from this area can be interpreted, data can continue to be analyzed under the same modeling framework used in the past (Franklin *et al.* 1996, entire; 1999, pp. 7-24; Anthony *et al.* 2006, pp. 8-14; Forsman *et al.* 2011a, pp. 9-19). For the duration of the removal experiment and for (several) years following the experiment, estimates of demographic rates from the removal areas will not reflect general conditions for that particular region (as the control area does). Half (or a portion) of a study area will be used for a removal experiment for a limited amount of time. Spotted owl data from both the treatment and control areas (e.g., one ongoing spotted owl demographic study area) can still be analyzed as in the past (although interpretation of results will be affected during the treatment period and for some years after). We can address the removal effects within the existing modeling framework by using a covariate to assess the treatment effect. If barred owl removal is included as a covariate (treatment effect), one set of estimates will be generated for the control area and a second for the treatment area. For the pretreatment years, rates are the same in both treatment and control areas (treatment covariate = 0). Once barred owl removal is initiated, the treatment area gets a "treatment effect" after removal starts while the control area does not. The effect of removing barred owls will likely remain for (some) years after removal is stopped; however, we anticipate that differences in demographic rates for the treatment and control areas will diminish to pretreatment levels within several years (Figure I-1).

Including a "treatment effect" covariate in the models adds one parameter for each model component where it is used. For example, the model used for assessing rate of population change includes three components: annual survival, recruitment, and detection probability. Including a treatment effect on all three components would add three parameters to the model. Models containing these additional parameters will be better supported if: 1) there truly is an effect of barred owl removal on the model component; and 2) the experimental design has high power to detect differences between treatment and control areas. Larger study areas and experimental designs that contain multiple study areas will have greater power to detect treatment effects (see Appendix H of this Final EIS for details of power analysis). However, given the relatively large sample sizes and large number of years of data available for most areas, we do not anticipate that adding one to three parameters to models will create problems for estimating demographic rates (White 2010, pers. comm.).

If a barred owl removal experiment is conducted on an ongoing spotted owl demographic study area, it is likely that demographic rates from only the control portion of the study area would be used for monitoring spotted owl population trends in meta-analyses. However, this does not imply that an area half the size of any ongoing spotted owl demographic study area is necessarily sufficient for monitoring spotted owl populations under the Effectiveness Monitoring Strategy of the Northwest Forest Plan. While estimates of demographic rates for the treatment area will (likely) differ from the control area, the strength of this design is that both the treatment and control areas can be included in the same model, taking advantage of the full set of spotted owl sites on a given study area. We anticipated that once barred owl removal ceases, differences in demographic rates between treatment and control areas would diminish over time and the full study area will eventually be usable as in the past. Figure I-1 provides an example of anticipated results from this type of analysis. Once barred owl removal is initiated, the control area population growth rate should follow the previous trajectory or pattern while the treatment areas should show a change in population growth rate (lambda) if barred owl removal affects spotted owl populations. Standard errors for both treatment and control estimates will be somewhat larger than pre- or post-experiment years.

One consequence of estimating unique demographic rates for treatment and control areas is that variation associated with demographic parameter estimates (e.g., standard errors) for the control and treatment areas will be larger than current estimates for the full study areas. This is a result of the smaller sample sizes used to estimate demographic rates for the separate treatment and control areas. If half of a particular ongoing spotted owl demographic study area is used for a removal experiment (and this half was not included in the subsequent meta-analysis), parameter estimates (survival, fecundity, recruitment, lambda) would have larger confidence intervals than for the time periods where the full area was analyzed. The change in standard error (SE) on a single study area would be (SE/sqrt (proportion of total area included)) = SE/sqrt(0.50) = (SE/0.71) (White 2010, pers. comm.). For example, for the KLA Study Area, mean population growth rate for 1990-2008 was 0.99 with a standard error of 0.01. If only half the number of owls had been available but the mean population growth rate was the same, standard error for the estimate of population growth rate would increase to 0.02. The 95 percent confident interval (estimate +/- 1.96*SE) around the estimate of population growth rate (0.99) for the full study area is 0.96-1.03, while the 95 percent confidence interval for half the study area is 0.95-1.03, indicating a very slight increase in variation. Additional examples of how variation in standard error for estimates of population growth rate would increase are shown for several other study areas in Table I-1 and for a region-wide meta-analysis in Table I-2.

Figure I-1. Hypothetical example of estimates of rate of population growth (lambda) for a barred owl removal experiment on an ongoing spotted owl demographic study area. The period from 1994-2010 represents conditions similar to ongoing spotted owl demographic study areas (no barred owl removal). In this example, barred owls are removed from the treatment area during 2011-2016. Removal is discontinued in 2017, but population growth rate remains higher on the treatment area for several years. By 2020, population growth rate at the treatment area have returned to similar levels as the control area. Error bars represent 95 percent confidence intervals.



Based on the alternatives presented in Section 2.2 of this Final EIS, removal activities may occur on a portion of one, two, or three study areas. Using three ongoing spotted owl demographic areas could have a greater impact on region-wide demographic monitoring for spotted owls. An experimental design using three demographic study areas would have considerably greater power and strength of inference for assessing effects of barred owl removal than a single study area design (Johnson *et al.* 2008, pp. 5-9). However, the ability to monitor region-wide spotted owl population trends could be compromised to some degree because the sample size of each of the three study areas would be reduced during the removal period (and likely for several years after). Reduced sample sizes will lead to less precise estimates of demographic parameters, leading to less certainty in changes or trends in demographic rates across years.

Table I-1. Examples of how estimated standard errors for realized rate of population growth (lambda) for ongoing spotted owl demographic study areas in Washington and Oregon would change if the number of spotted owl territories was reduced by 50 percent.

Study Area	Number of Spotted Owls Banded During Study (1990-2008)	Mean Population Growth Rate (λ)	Standard Error (λ)	Standard Error for Same Period if Sample size Were Reduced 50 Percent
Cle Elum	211	0.937	0.014	0.020
Olympic	388	0.957	0.020	0.028
Oregon Coast Ranges	649	0.966	0.011	0.015
Klamath	650	0.990	0.014	0.020
H.J. Andrews	576	0.977	0.010	0.014

Table I-2. Example of how estimated standard errors for realized rate of population growth (lambda) on ongoing demographic study areas that are part of the Northwest Forest Plan Effectiveness Monitoring Program would change if 1) the largest single study area (Oregon Coast Ranges) was reduced by 50 percent, 2) Cle Elum was reduced by 50 percent and Oregon Coast Ranges/Veneta was reduced by 33 percent (Preferred Alternative), or 3) the three largest study areas (Olympic Peninsula, Oregon Coast Ranges, Klamath) were reduced by 50 percent.

Study Area	Population Growth Rate Estimate (λ)	Estimated SE (λ)	Estimated SE (λ) with Experiment[1]
One of eight areas reduced by 50 percent	0.972	0.006	0.006
Preferred Alternative (one area reduced by 50 percent and one reduced by 30 percent of eight)	0.972	0.006	0.006
Three largest of eight areas reduced by 50 percent	0.972	0.006	0.007

[1] Estimated changed SE. Calculated by SE = SE/sqrt(proportion of original area included).

The overall effect on the influence of a removal experiment on the ability to monitor region-wide spotted owl populations depends where the study areas selected are located. If a province or region has only one area (e.g., Cle Elum in Washington Cascades), there will be a greater effect of using half of that single long-term study area as treatment area than using a long term study area from a region that has multiple study areas (Oregon Cascades, which has HJ Andrews, Klamath, South Cascades).

In summary, conducting barred owl removal on up to half of an ongoing spotted owl demographic study area for barred owl removal will result in decreased precision of demographic estimates for the treatment and control areas relative to demographic estimates calculated for the original study areas. While this may be an area of concern, demographic data from both treatment and control areas can continue to be analyzed under a unified model framework by including a “treatment effect” covariate in models. We anticipate that barred owl population levels will become similar at both treatment and control areas within a few years of the cessation of barred owl removal. If barred owl removal experiments are conducted on two of the eight Northwest Forest Plan Effectiveness Monitoring study areas (Cle Elum and Oregon Coast Ranges) as described in the Preferred Alternative, standard error estimates for the individual control areas will be expected to increase by the amounts shown in Table I-1. When data are combined for the range-wide meta-analysis of rate of population change, effects of using up to one-half of Cle Elum and up to one-third of the Oregon Coast Ranges study areas as removal sites will be minimal (Table I-2) given that six of the eight study areas in the Effectiveness Monitoring Program will not be affected by barred owl removal.

Appendix J

Listed Species and Species of Concern in the Action Areas

J.0 Changes between Draft and Final EIS

- Updated information on species by study area, including changes in species status and range.

J.1 Introduction

To determine the potential effects we developed a list of species considered at risk or sensitive, including those with small or declining populations that are likely to interact with barred owls. These include species listed as threatened or endangered under State or Federal law, and those identified as State or Federal species of concern, special status species, or sensitive species. We have limited this list to species that are likely to occur within at least one of the study areas and live within or pass through forest habitat (because species that do not use forests are unlikely to interact with barred owls as either prey or competitors). We limited the list to species that barred owls are likely to prey on or compete directly with, eliminating large mammals such as grizzly bears, and plants.

Table J-1 displays the Federal and State endangered, threatened, candidate, and proposed species found in the forest environment, providing the status and the study areas where each species is anticipated to occur.

Table J-2 displays Federal and State species of concern found in the forest environment. Federal species of concern is an informal term, not defined in the Federal Endangered Species Act, and commonly refers to species that are declining or appear to be in need of conservation. The U.S. Fish and Wildlife Service in California does not maintain a species of concern list. Therefore, in California we used the State of California lists of Species of Special Concern. These lists provide essential information for land management planning and conservation efforts. The table provides the status and the study areas where each species is likely to occur

Table J-1. Federal- and State-listed species that live in the same environment as barred owls (forested environment) and may interact with them. This does not include large mammals that are not likely to be prey of, or compete with barred owls. Scientific names for all species are found in the Scientific Names Section).

Common Name [2]	State-Listed Species Status[3] WA	State-Listed Species Status[3] OR	State-Listed Species Status[3] CA	Federal-Listed Species Status [4]	Listed Species within Areas [1] Washington: Ross Lake	Olympic Peninsula	Olympic Revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Oregon: Oregon Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	California: Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral
Mammals																									
Fisher, West Coast DPS	E			C		x	x								x			x	x	x	x	x		x	x
Mazama (Western) pocket gopher	T	-	-	C		x	x			x	x														
Western gray squirrel	T		-	SOC	s			s	s			s													
Red tree vole, North Oregon Coast DPS (North of Siuslaw River)	-	-	-	C									x	x											
Keen's myotis bat	C	-	-	--	s	s	s																		

					Listed Species within Areas [1]																				
					Washington								Oregon									California			
	State-Listed Species Status[3]			Federal-Listed Species Status [4]																					
Common Name [2]	WA	OR	CA		Ross Lake	Olympic Peninsula	Olympic Revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Oregon Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral
Birds																									
Marbled murrelet [5]	T	T	E	T	x	x	x	x	x	x	x		x	x	x			x	x			x		x	x
Western yellow-billed cuckoo	C		E	C			x	x	x	x	x	x													
Flammulated owl	C	s	-	--				s	s																
Great gray owl	s	s	E	--													s			s	s	s	s		
Northern spotted owl	E	T	-	T	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Reptiles and Amphibians																									
Western pond turtle	E	s	s	SOC						s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
Western toad	C	s	-	SOC	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s		s	s	s	s
Scott Bar salamander	-	-	T	--																		s			
Siskiyou Mountains salamander	-	-	T	--																					
Cascade torrent salamander	C	s	-	--							s	s				s									
Oregon spotted frog	E	s	s	C	x					x	x	x	x	x		x	x				x	x	x		
Fish																									

	State-Listed Species Status[3]				Listed Species within Areas [1] Washington								Oregon									California			
Common Name [2]	WA	OR	CA	Federal-Listed Species Status [4]	Ross Lake	Olympic Peninsula	Olympic Revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Oregon Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral
Chum salmon DPSs	C	s	s	T		x				x	x	x	s	s	s	s	s	s	s	s					
Coho salmon DPSs	-	s	T	T									x	x	x	x	x	x	x	s	x	x		x	x
Steelhead DPSs	C	-	s	T/ SOC				x	x	x	x	x	x	s	s	x	x								
Chinook salmon DPSs	C	s	T E	T/E	x			x		x	x	x	x	x	s	x	x	s	s	s					
Oregon chub	-	-	-	T									x	x		x	x								
Bull trout DPSs	C	-	E	T	x	x	x	x	x	x	x	x	x	x		x	x				x				
Eulachon DPS	C	-	-	T																		x		x	

					Listed Species within Areas [1]																				
					Washington								Oregon									California			
	State-Listed Species Status[3]																								
Common Name [2]	WA	OR	CA	Federal-Listed Species Status [4]	Ross Lake	Olympic Peninsula	Olympic Revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Oregon Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver	Goosenest	Hoopa (Willow Creek)	Corral
Invertebrates																									
Trinity bristle snail	-	-	T	--																				s	s
Shasta crayfish	-	-	E	E																					

[1] Locations of federally listed species are indicated by an "x"; locations for state-listed only species are indicated by "s".
[2] DPS= Distinct population segment.
[3] State Listed status: E = endangered, T = threatened, C = candidate, s = species of concern (actual title differs by state)
[4] Federal Listed Species: E = endangered, T = threatened, P = proposed, C = candidate, SOC = species of concern, and -- = none
[5] While within the potential inland range of the marbled murrelet, extensive surveys of the Hoopa portion of the Hoopa (Willow Creek) Study Area have not verified any marbled murrelet use.

Table J-2. Species of Concern that live in the same environment as barred owls and may interact with them. This table does not include species that do not live in forested environments or large mammals that are not likely to be prey of compete with barred owls. It does not include species that are Federal or State listed (Table J-1).

					Species of Concern[1]																				
					Washington								Oregon									California[2]			
	State Species of Concern [3]																								
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Mammals																									
White-footed vole			C2	X									x	x	x	x	x	x	x		x			s	
Red tree vole[5]		SS		X									x	x	x	x	x	x	x	x	x				
Pygmy rabbit				X																	x				
Western gray squirrel		SS		X (WA)	x							x	x	x	x	x	x	x	x	x	x				
Townsend's ground squirrel				X					x																
Pacific water shrew	SM				s	s	s	s	s	s	s	s													
Destruction Island shrew				X		x	x																		

					Species of Concern[1]																					
	State Species of Concern [3]				Washington								Oregon									California[2]			
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Camas pocket gopher				X									x	x		x	x								
Pallid bat	SM	SS	C2	X				x	x				x	x	x	x	x	x	x	x	x		s	s	s
Townsend's big-eared bat		SS	C2	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xs	s	s	s
Silver-haired bat		SS		X									x	x	x	x	x	x	x	x	x				
Hoary bat		SS											s	s	s	s	s	s	s	s	s				
Small-footed myotis bat				X									x	x	x			x	x		x				
Long-eared myotis bat	SM			X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Fringed myotis bat	SM	SS	C2	X									x	x	x	x	x	x	x	x	x	x	s	s	s
Long-legged myotis bat	SM	SS	C2	X	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	s	s	s
Yuma myotis bat				X									x	x	x	x	x	x	x	x	x				

					Species of Concern[1]																					
					Washington								Oregon										California[2]			
	State Species of Concern [3]																									
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Spotted bat			C2																				s		
Birds																									
Olive-sided flycatcher		SS	C2	X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	xs	s	s	s
Lewis' woodpecker				X									x	x	x	x	x	x	x	x	x				
Northern goshawk			C2	X	x			x	x			x										s	s	s	s
Band-tailed pigeon[6]				X									x	x	x	x	x	x	x	x	x				
White-headed woodpecker				X									x	x	x			x	x	x	x				
Purple martin			C2	X									x	x	x	x	x	x	x		x	s	s	s	s
Black-backed woodpecker			C2																			s	s	s	s
Vaux's swift			C2																			s	s	s	s

					Species of Concern[1]																				
	State Species of Concern [3]				Washington								Oregon									California[2]			
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Reptiles and Amphibians																									
Coastal tailed frog	SM	SS	C2	X	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	s	s	s
Northern red-legged frog		SS	C2	X									x	x	x	x	x	x	x	x	x			s	
Foothill yellow-legged frog		SS	C2	X									x	x	x	x	x	x	x	x	x	x		s	s
Cascades frog	SM	SS	C1	X	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x			
Clouded salamander		SS											s	s	s	s	s	s	s	s	s				
Black salamander		SS																				s			
Oregon slender salamander		SS		X									x	x	x	x	x	x	x		x				
Cope's giant salamander	SM	SS				s	s					s													

					Species of Concern[1]																				
					Washington								Oregon									California[2]			
	State Species of Concern [3]																								
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Del Norte salamander		SS	C2	X									x	x	x			x	x	x	x	x		s	s
Larch Mountain salamander	SS	SS		X				x	x	x	x	x													
Van Dyke's salamander				X		x	x			x	x	x													
Columbia torrent salamander	SM	SS				s	s			s	s														
Olympic torrent salamander	SM			X		x	x																		
Southern torrent (seep) salamander		SS	C2	X									x	x	x	x	x	x	x		x	x		s	s
Sharptail snake				X	x			x	x			x													
Common kingsnake				X											x			x	x	x	x				

					Species of Concern[1]																				
					Washington								Oregon									California[2]			
	State Species of Concern [3]																								
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
California mountain kingsnake				X											x			x	x	x					
Fish																									
Jenny Creek sucker				X															x	x	x				
Klamath largescale sucker				X																	x				
Malheur mottled sculpin				X									x	x		x	x								
Slender sculpin				X																	x				
River lamprey				X	x	x	x	x		x	x	x	x	x	x			x	x		x	x		x	x
Western brook lamprey		SS		X	x			x				x	x	x	x			x	x	x		x			
Pacific lamprey	SM	SS		X	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x

	State Species of Concern [3]				Species of Concern [1]																				
					Washington								Oregon									California [2]			
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver [4]	Goosenest	Hoopa (Willow Creek)	Corral
Coastal cutthroat trout		SS	C2	X		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x				
Westslope cutthroat trout		SS		X	x			x				x													
Steelhead (includes Redband trout)		SS		X	x			x	x			x	x	x	x							x		x	x
Umpqua chub				X									x	x	x			x	x		x				
Millicoma dace				X									x	x	x			x	x		x				

					Species of Concern[1]																					
					Washington								Oregon										California[2]			
	State Species of Concern[3]																									
Common Name	WA	OR	CA	Federal Species of Concern	Ross Lake	Olympic Peninsula	Olympic revised	Wenatchee	Cle Elum	Rainier	Cowlitz Valley	Columbia Gorge	Coast Ranges	Veneta	Tyee	McKenzie	HJ Andrews	Union/Myrtle	Klamath	Rogue Cascades	South Cascades	Horse/Beaver[4]	Goosenest	Hoopa (Willow Creek)	Corral
Invertebrates																										
Roth's blind ground beetle				X									x												
Siskiyou carabid beetle				X															x	x	x				
Oregon giant earthworm				X									x												
Giant Columbia spire snail				X	x			x																	

[1] Locations of Federal species of concern indicated by an "x"; locations for state only species are indicated by "s".
[2] The USFWS does not maintain Federal Species of Concern (SOC) lists in California; therefore we have used CA State Recommended Species of Special Concern for this category. National Marine Fisheries Service maintains a SOC list for its listed species.
[3] State Species of Concern. WA: SS = State sensitive list; SS = State monitor list; OR: SS = sensitive species list; CA species of special concern: C1 = Class 1 – qualify as endangered or threatened; C2 = Class 2 – special concern.
[4] Horse/Beaver Study Area is located both in OR and CA and therefore contains species categorized as both Federal Species of Concern and CA State Recommended Species of Special Concern – denoted by xs.
[5] Red Tree Vole (North Oregon Coast DPS) is now a Federal candidate species in the Oregon Coast Range north of the Siuslaw River. It remains a species of concern in Oregon in the Oregon Coast Range.
[6] USFWS "Bird of Management Concern."

Appendix K

Summary of Comments on the Draft EIS and Responses

K.0 Changes between Draft and Final EIS

- This appendix is new to the EIS

K.1 Introduction

The Draft EIS was released for public review and comment on March 9, 2012. Comments were due on June 6, 2012. We conducted one public meeting in Seattle on May 3, 2012. We also conducted five informational webinars for the public and a webinar for the Barred Owl Stakeholder Group in May. We provided an informational booth at the Spotted Owl Critical Habitat public meetings, one of which occurred before the close of the comment period.

In addition, we conducted several meetings with Federal land managing agencies, Federal agencies involved in the Northwest Forest Plan, State wildlife agencies, the Hoopa Valley Tribe, and involved researchers to coordinate on issues related to the alternatives.

We received 66 comments by the end of the comment period and 9 additional comments in the following weeks. Fifty-two of the comments were from individuals, including three scientists. The remainder of the comments was received from organizations including environmental, conservation, animal welfare, and industry groups; tribes; professional societies; and Federal, State, and County governments or their agencies. A summary of the issues from the public comments and our responses follow. Throughout these comments, use of the word, "Service" means the U.S. Fish and Wildlife Service. Use of the word "spotted owl" refers to the northern spotted owl subspecies.

K.2 Comments and Responses

K.2.1 Comments on Purpose, Need, and Effectiveness

Comment: Two commenters stated that the Service should have a specific direction or strategy for future management of barred owls or a specific plan for utilizing the results of this experiment before conducting this experiment.

Response: The Service considered developing a barred owl management strategy to support recovery of the northern spotted owl, but determined that additional information is necessary to effectively develop a reasoned strategy. Developing a barred owl management strategy with the limited information we currently have would likely result in a general non-specific approach that would need to be substantially revised in the near future. This is not an effective use of time or resources.

In particular, we identified barred owl removal as one of the promising potential management tools, but noted that we lack sufficient information on the feasibility, effectiveness, and cost of barred owl removal to apply this tool at this time. We identified the need to gather this information and deemed a removal experiment as the most efficient way to do so. So while we have not identified a specific direction or detailed strategy for managing barred owls, we have identified specific information we need for its development. We have identified that we will use the information from this experiment in developing a barred owl management strategy. However, because the final decision on a barred owl management strategy includes many issues other than removal feasibility, it would be inappropriate to develop specific triggers based on the results of this experiment.

Comment: One commenter stated that the proposed experiment was a waste of resources because they did not believe that the Service would have the political, public, or financial support to apply the approach at a broad scale even if it worked. The experiment should occur only if the Service could demonstrate it was reasonably certain that we could proceed with broader management.

Response: A primary reason to conduct the proposed research experiment includes acquiring the information the commenter suggested is necessary to determine if broader management actions are feasible and, to provide information for the design of a broad scale barred owl management program. Without the experimental data regarding costs, feasibility, and effectiveness, the Service could not responsibly assess whether removal is a potential tool for future management of the barred owl to promote the conservation of the spotted owl. We disagree with the commenter's opinion that the Service will not have the necessary political, public, and financial support to conduct long-term management of barred owls. While we agree that significant obstacles exist in implementing a long-term conservation strategy, including costs and public perceptions, the Service has a history of commitment to species recovery in the face of seemingly insurmountable obstacles, with substantial success. The whooping crane, black-footed ferret, and California condor are examples of situations where the Service dedicated substantial resources and time to rare and declining populations to achieve significant progress toward recovery of the species, and with strong public support.

Comment: One commenter stated the EIS should address whether barred owl removal must be the primary recovery tool.

Response: The 2011 Revised Recovery Plan for the Northern Spotted Owl identifies 33 recovery actions, 12 of which are related to the barred owl threat. Barred owl removal only appears in 2 of the 33 recovery actions, demonstrating that barred owl removal is only one of many recovery tools. We have identified barred owl removal as one potential management tool, but have not in any way indicated that this is the only tool we would consider in developing a barred owl management strategy or in the broader strategy of spotted owl recovery. The experiment will provide information on the effectiveness and efficiency of removal as a potential tool, but makes no determination whether it must or should be used as part of a larger barred owl management strategy.

Comment: One commenter stated that the success of the Green Diamond pilot experiment indicates that barred owl removal is a desirable conservation tool for recovery of the northern spotted owl.

Response: The preliminary results of the Green Diamond experiment provide additional information supporting the contention that barred owls adversely affect spotted owls. However, these results are preliminary, based on an initial study with limited scale and duration. The Service believes that the appropriate next step is to conduct more extensive experiments, potentially on multiple study areas and other habitat types, to fully document not only whether an effect occurs, but to better understand the mechanism of the effect, prior to pursuing more extensive, long-term, barred owl management.

Comment: One commenter stated that the costs and logistics of barred owl removal can be reasonably estimated without the experiment, but cannot be estimated accurately without knowing future management options. As such, this experiment is a waste of public funds.

Response: We received several comments on the accuracy of our cost estimates (both supportive and corrective), indicating the difficulty of estimating such costs without actual data from doing similar work. The Service believes it prudent to collect such data, and estimate long-term costs, rather than relying upon estimates based on long-distance extrapolation or numerous assumptions in making its long-term decision. The purpose and need describes the information we have determined is necessary to develop a reasoned and feasible barred owl management strategy. This information will allow us to more accurately estimate the likely success and costs of removal as a management tool.

K.2.2 Comments on Number and Distribution of Study Areas

Comment: Several commenters made recommendations on the number of study areas needed to conduct a scientifically credible experiment. All suggested the need for more than one study area. Specific recommendations ranged from 3 to 11 study areas.

Response: We concur with the commenters. We also conclude that multiple study areas are important to a scientifically credible, timely experiment that can be used to consider barred owl management options across the range of the northern spotted owl. In selecting the Preferred Alternative, we determined that 4 study areas, distributed north to south in the range of the northern spotted owl, provide the most efficient and effective experiment.

Comment: One commenter suggested that several smaller study sites would be preferable to a single large study area.

Response: We agree that several study areas provide stronger data that are more applicable across the range of the northern spotted owls. However, there is also a need for study areas that are large enough to reach a significant result in a reasonable time, which is driven largely by the internal study area sample size. Small study areas have a large edge effect and therefore it may be more difficult to keep barred owl populations at a low level due to immigration from the area around the experiment. In the Preferred Alternative, we attempted to address both issues.

Comment: One commenter suggested that the Service include one or more alternatives with five to seven study areas, rather than jump from three or fewer under Alternative 1 through Alternative 6, to eleven study areas under Alternative 7.

Response: The Service considered from one to three study areas under most of the action alternatives, and considered Alternative 7 as the broadest, and potentially most impacting, action alternative. The Draft EIS did not include an action alternative with five to seven study areas, nor did we add such an alternative in the Final EIS. Because Alternative 7 includes up to 11 study areas we were not limited to considering only 1, 2, 3, or 11 study areas. In developing the Preferred Alternative, we considered options with more than three study area, as long as they were within the scope of the DEIS in that they meet the following criteria: 1) the alternative does not exceed 11 study areas; 2) the impacts do not exceed the impact to any resource (such as on total number of barred owls removed across all study areas) estimated in the Draft EIS; 3) the alternative does not include activities in any area not analyzed in the Draft EIS; 4) the alternative does not result in new impacts to any resource, or impacts to a degree not considered in the Draft EIS; and 5) barred owl removal under the alternative does not exceed 10 years in duration. We have carefully considered these criteria, as well as the suggestion for more study areas, in the development of our Preferred Alternative. While this Preferred Alternative includes four study area (as opposed to the suggested five to seven study areas), the Service believes this Preferred Alternative addresses the potential barred owl-spotted owl conflict across the range of the northern spotted owl. We refer the reader to Section 2.2.3.1 of this Final EIS for a complete description of the Preferred Alternative.

Comment: One commenter recommended we not use study areas in Washington because spotted owl populations in Washington have been greatly reduced and the small size of the population could be a confounding factor, that is, if there are too few spotted owls to quickly reoccupy empty territories within the time frame of the experiment.

Response: The Service anticipates that the response by northern spotted owls to removal of barred owls will manifest in two basic forms. Once relieved of competitive pressure from barred owls, northern spotted owls that have been unable to obtain or maintain nesting territories (e.g., have become “floaters”) will re-establish nest sites and, if effective in finding a mate, will successfully breed. We also anticipate that spotted owls that have been able to maintain territories, yet have suffered reduced reproductive success due to competition from barred owls, will exhibit improved reproductive rates. In those portions of the subspecies’ range where barred owls invaded earliest (e.g., Washington), and have achieved near maximum density, spotted owls have been subject to strong competitive pressures for years. We agree with the commenter that some study areas where spotted owl populations are severely reduced may show low reoccupancy rates once barred owls are removed because the source population is low.

However, in these areas, we anticipate that spotted owls that reoccupy these newly available habitats, and spotted owl pairs who maintained territories, albeit with reduced reproductive rates, will show significantly higher reproductive rates compared to associated experimental control areas where barred owl competition persists. We acknowledge that the statistical power achieved by using such study areas may be lower, relative to the power achieved using study areas with relatively high populations of spotted owl; that consideration was factored into the decision to include a Washington study area in the Preferred Alternative. The response by spotted owls under these circumstances remains a key question for the Service to answer prior to making future decisions regarding the feasibility of long-term management of barred owls to promote the conservation and recovery of the northern spotted owl throughout it range.

Comment: One commenter recommended inclusions of Hoopa (Willow Creek) to represent the southern Klamath region.

Response: The Hoopa (Willow Creek) Study Area is included in three of the alternatives (1, 2, and 7) and the Preferred Alternative in the Final EIS. We agree that the Hoopa (Willow Creek) Study Area would represent the southern Klamath region, but note that Corral and Horse Beaver Study Areas also fall within this area. Each study area has advantages and disadvantages.

Comment: One commenter supported the experiment but only outside of National Parks.

Response: We considered all study areas in developing the Preferred Alternative. In the end, our Preferred Alternative did not include any National Parks. These areas were not excluded because they were National Parks, but because other areas provided a better basis for this particular experiment.

Comment: The EPA supported the use of multiple study areas, but suggested that if the controversy was too strong, the Service could consider initiating a single experiment, and initiate studies on additional study areas if the initial experiment yields positive results.

Response: We concur that use of multiple study areas is important to high quality, scientifically rigorous results. This experiment is controversial with some people regardless of the size of the area or areas. We have attempted to deal with the controversy with extensive outreach and working closely with stakeholders (See Appendix B of this Final EIS). A phased approach would significantly extend the time required to reach results equivalent to a multiple-area approach, which would not meet our Purpose and Need for a timely result. Because barred owl populations would continue to increase, the phased approach could actually result in more barred owls being removed, an issue several of our stakeholders noted. We have attempted to develop a Preferred Alternative that meets our needs for quality results in a timely manner while addressing as many stakeholder concerns as possible.

K.2.3 Comments on Type of Study

Comment: Five commenters recommended using a demography approach for the experiment due to the strength of the information compared to an occupancy approach.

Response: We agree that removal studies conducted under a demographic study framework provide a more rigorous design for assessing the impacts of removing barred owls on spotted owl population performance. However, both demography and occupancy study designs were evaluated because we believe both can provide valid approaches to addressing the questions of interest depending on the areas selected for conducting an experiment.

Comment: One commenter notes that the occupancy study approach has limitations including the inability to detect whether responses from multiple locations are from the same individual.

Response: We generally agree. Because spotted owls are not banded in an occupancy study, it can be more challenging to determine whether multiple responses represent one or more than one owl. This is one of the considerations in establishing the survey locations in an occupancy study.

Comment: One commenter disagreed with our discussion of the disadvantage of occupancy studies as compared to demographic studies. Their specific concern was our conclusion that occupancy rates are not necessarily comparable across sites because the rates depend on the number of sites surveyed.

Response: We revised this discussion within the Final EIS to clarify our analysis of occupancy rates.

Comment: One commenter stated that the occupancy study approach is flawed because the presence of barred owls suppresses spotted owl response to survey calls, biasing the data.

Response: Both demography and occupancy studies use calling to locate spotted and barred owls. Conducting multiple surveys within a season allows researchers to estimate site occupancy (or other demographic rates) even though detection probability is less than 100 percent and spotted owl detection rates have declined in the presence of barred owls. Declines in detection can be addressed in the analysis of the results, and as such do not bias the data.

Comment: The EPA suggested that we should seriously consider the opportunity for cost saving by using study areas already used in the Effectiveness Monitoring Program of the Northwest Forest Plan, promoting economic efficiency.

Response: Cost was one of the many considerations in developing the Preferred Alternative. However cost is only one consideration and effects on these unique and valuable long-term studies were also considered. In our Preferred Alternative we were able to take advantage of some areas with comparable data and cost savings while reducing our effect on the monitoring study areas.

Comment: Seven commenters recommended using ongoing demography study areas for the removal experiment. They pointed out this would provide the most rigorous data. One commenter noted that demography areas on Federal lands are designed to evaluate the Northwest Forest Plan, and are thus appropriate for studying the effect of barred owl removal so evaluation of habitat protections on recovery can resume. As to effects on the ongoing demography studies, one commenter noted that the data were still useful and differences in vital rates can be accounted for with covariates. Another noted that any confounding effects would be temporary and likely could be accounted for during the analysis.

Response: We concur that the use of ongoing demography study areas with many years of data would result in the strongest power to detect a change in spotted owl population trends resulting from the removal of barred owls. We also evaluated the effect of removal studies on the ongoing demography study areas and provided a discussion of the potential effects in Appendix I of this Final EIS.

Comment: Two commenters stated that conducting the barred owl removal experiment on ongoing demography study areas could potentially have adverse effects on long-term data analysis. One recommended the Service use abandoned demography study areas that have the necessary historical data.

Response: The Service included several abandoned demography study areas in the action alternatives of the Draft and Final EIS. We have determined that each of these study areas had significant drawbacks, including the time period since extensive demographic data were collected. In some cases, approximately 10 years have elapsed. On these areas, numbers of remaining banded spotted owls will be low and no estimates of demographic rates from recent years are available. Under such circumstances, we would have to treat the study area as "starting from scratch" which would cost more, take longer, and greatly reduce our ability to detect changes resulting from barred owl removal.

We have fully evaluated the potential impacts of conducting barred owl removal experiments in ongoing demographic study areas in Appendix I of this Final EIS. In summary, we concluded that conducting barred owl removal on up to half of an ongoing spotted owl demographic study area for barred owl removal may result in decreased precision of demographic estimates for the treatment and control areas relative to demographic estimates calculated for the original study areas. The control (non-removal) area(s) on the demographic study areas will continue to provide unaffected estimates of demographic rates in the absence of barred owl removal while use of data from the removal area for analyzing demographic rates may be more difficult. The potential decreased precision will result from the smaller size of the control area relative to the full demography study area; however, this decrease in precision should be relatively small. While this may be of concern to some, demographic data from both treatment and control areas can continue to be analyzed under a unified model framework by including a "treatment effect" covariate in models. After conclusion of the removal experiment, we anticipate that barred owl levels will become similar at both treatment and control areas in less than a decade.

Comment: One commenter noted that several of the existing demographic study areas currently function in the Effectiveness Monitoring Program of the Northwest Forest Plan and wondered if the emphasis of the Effectiveness Monitoring Program would change to elucidate the role barred owls may have in declines of spotted owls. Another commenter, Forest Service Region 6, noted that they were satisfied with the additional analysis provided in Appendix I of the Draft EIS showing the potential impacts of the experiment on long-term spotted owl population monitoring if an experimental removal does occur within a demographic study area. Because the results indicate some impact on the results of the monitoring efforts, they recommended minimizing impacts on Northwest Forest Plan Effectiveness Monitoring study areas.

Response: In our Preferred Alternative we made every effort to reduce potential impacts on the ongoing Northwest Forest Plan Effectiveness Monitoring spotted owl demography studies while still meeting our Purpose and Need. We were able to find removal areas that are not part of the Northwest Forest Plan Effectiveness Monitoring Program in California (Hoopa) and southern Oregon (Union/Myrtle) while still meeting the recommendation for areas with pre-treatment data. We also reduced the portion of the Oregon Coast Ranges Study Area where removal would occur. We fully analyzed the effects of our alternatives on the ongoing demography effort and shared this information in discussions with the affected Federal agencies that fund the monitoring program.

Comment: The EPA noted that utilizing a demography area with existing pretreatment data would address the need for urgency described in the Draft EIS by allowing experimental removal to proceed without delay. Further, this approach would produce results more rapidly than the other proposed approaches.

Response: We concur.

Comment: One commenter disagreed with our statement that data from the removal portion of an ongoing demography study area could not be used to assess spotted owl demographic performance.

Response: We have revised Section 3.4.1 of this Final EIS to clarify our analysis of the effect of removal on ongoing demography study areas and future demographic analyses. We agree that the data from the removal portions of the study areas may still be usable for demographic analyses. However, in evaluating the effects of the experiment, we chose to make the “worst case” assumption that the information would not be usable for demographic analysis for the duration of the barred owl removal effects. We would rather overestimate than underestimate effects.

Comment: One commenter noted that demography studies have the greatest ability to address the important research questions and the underlying ecological mechanisms, and in effect maximizing the obtained information while not unnecessarily killing barred owls.

Response: We concur. Our Preferred Alternative employs demography studies.

Comment: One commenter suggested an experimental design including both occupancy and demography aspects would allow comparison of results from the methods.

Response: Within a demography study approach we can get information on site occupancy and compare the results. A primary purpose of this experiment is to acquire information on the effectiveness of removal of barred owls in improving spotted owl population trends. We chose demography studies in our Preferred Alternative because they provide the strongest power to detect this change. Comparing study approaches, while interesting, is not part of the Purpose and Need for this experiment.

K.2.4 Comments on Removal Method

Comment: One commenter suggested we place less emphasis on nonlethal removal methods because they are impracticable at any significant scale. However another commenter supported using both lethal and nonlethal methods because it made at least partial use of nonlethal removal. A third noted that nonlethal removal will only represent a very small percent of all removal, recommending that alternatives should all merely state that nonlethal removal of barred owls will be an option only when live individuals can be permanently relocated.

Response: Rather than emphasize nonlethal removal methods, we noted that using only nonlethal removal methods was not feasible for this experiment. As we note in the Final EIS, we are likely to find relatively few locations with adequate facilities to provide a good quality of life, and which are willing and able to take barred owls that would be removed in this experiment. Therefore, a combined removal approach would only use nonlethal methods to the extent we have ready facilities to accept barred owls. As such, this would be a minor component of the removal. We do believe that nonlethal removal can be an important component, albeit a minor one, of a removal program. This reduces the number of birds that would have to be killed and provides for public educational opportunities.

Comment: One commenter noted that relocation causes stress, and possibly death, of captured owls.

Response: Several of the action alternatives propose to remove barred owls from treatment areas using a combination of lethal and nonlethal removal methods as opportunities are found to capture and retain barred owls in permanent captivity in approved facilities for scientific and educational purposes. Under all alternatives, barred owls would not be relocated anywhere into the wild. We acknowledge that removing and relocating wild animals from their home ranges to permanent captivity may stress the individuals, and that stress-related death of some individual barred owls is possible. However, the Service will employ all reasonable means to minimize stress during capture and retention of permanently captive individuals. We have revised the protocol for capture of live barred owls to address these concerns; we refer the reader to Appendix D of this Final EIS for details.

Comment: One commenter noted that relocation of barred owls into their historic range from proposed study areas risks transmitting new diseases not found in their native range, with potential disastrous consequences.

Response: We explored the option of translocation to the historic range of the barred owl as part of our due diligence. Several of the states indicated that concerns over disease and pathogen transmission were part of their reason for not wanting to translocate barred owls from the west. We concurred with their conclusion and do not propose to translocate barred owls into the wild.

Comment: One commenter asked that the Service be more specific as to why shooting with a shotgun is a "humane" method of removal.

Response: The Service considered several possible lethal removal methods, in light of the effectiveness of the method as well as to ensure a minimum of suffering and risk of nonlethal injury. In discussing removal methods with species experts, as well as with individuals familiar with lethal removal methods, we concluded that the most appropriate, effective, and humane approach to lethal removal would be the use of shotguns as we describe in Appendix D of this Final EIS. Our methods call for use of a shotgun of specific gauge and shot size, under very specific conditions of location, distance, circumstances, safety, and experience of the shooter. We specifically rejected use of other firearms (e.g., rifle, pistol), or circumstances (e.g., shooting "on the wing") with a higher risk of nonlethal injury. Available information from a pilot experiment (Diller *et al*., in review) indicates that barred owls can be consistently and instantly killed with a single shot by an experienced shooter under our proposed protocol. Other methods, such as capture and euthanizing, have a far greater likelihood of injury or trauma to a target individual that would, at a minimum, suffer significant stress prior to euthanizing. We are unaware of any other feasible method that addresses the need for removal of a substantial number of barred owls from treatment areas, with less risk of inhumane treatment of target individuals.

Comment: One commenter felt that the hybridization of barred and spotted owls would make identification of individuals to be removed even more difficult.

Response: The commenters concern would apply if we were specifically attempting to remove hybrids or avoid removing hybrids. As described in Appendix D of this Final EIS, we will remove owls only if they resemble barred owls. This may result in the removal of most second-generation hybrids resulting from the mating of a hybrid and a barred owl. Removal of owls resembling barred owls that may be hybrids will be covered in the removal permit. Owls resembling spotted owls would not be removed, even if they are hybrids. Thus, the risk of accidentally removing a spotted owl remains very low under our Appendix D protocol.

Comment: Several commenters were concerned that spotted owls might be mistaken for barred owls and removed accidentally.

Response: While the two species are generally similar in size, coloration, and general pattern, they can be readily differentiated by trained individuals based on call notes, color patterns of body feathers, and behavior. We have several requirements in the removal protocol (see Appendix D of this Final EIS) to reduce the potential for any misidentification. First, each employee approved to conduct lethal removal must demonstrate knowledge of these differences prior to field work. Second, the removal protocol requires confirmation of at least two characteristics of barred owl identification, or that at least two observers confirm the identification. Third, we have prescribed situations when spotted owls may be detected in the vicinity, during which lethal removal of barred owls would be postponed to avoid accidental mortality of a spotted owl. Finally, we prescribed conditions during removal to further minimize the risk of false identification of a target individual, including limiting lethal removal to no more than 30 yards distance, and removal of only perched birds (no "on the wing" shots), among others. While we cannot prevent all accidents, we have provided protocols that should result in an extremely low risk of accidental removal of a spotted owl.

Comment: The National Park Service noted that if lands they manage are included in the experiment, removal must be done by professionals.

Response: In the Final EIS, we revised Appendix D to better describe specific criteria to be used by shooters tasked with removal of barred owls. Those criteria include demonstrated familiarity with firearms. Selection of shooters to conduct lethal removal will be done by the principle investigator responsible for project completion and will adhere to criteria described in Appendix D. The land management agency on whose lands the experiment will be conducted may identify further qualifications necessary for compliance prior to issuance of any special use permit by that agency. Under the Preferred Alternative, there will be no barred owl removal on lands managed by the National Park Service under this EIS.

Comment: Multiple commenters raised concerns about the effects of noise from shotgun discharges on the visitor experience in National Parks. The National Park Service further suggested that if removal occurs on National Park lands, we explore the option of silencing firearms to reduce impacts on the public, wildlife, and soundscape.

Response: No removal is proposed on National Park Service-managed lands under our Preferred Alternative. We have discussed the potential effects of shotgun noise disturbance to recreation and visitor use in Section 3.7 of this Final EIS. In that section, we acknowledge that slight impacts to some visitor use are anticipated with lethal removal within National Parks or similar areas where firearm use is either non-existent or rarely encountered. We will consider the use of "silenced" or other modifications to standard shotguns in areas of high human use and potential conflicts, though these may require special permits or licenses. We will discuss this with the researcher responsible for lethal removal of barred owls. However, the Service is not requiring the use of silencers or other methods or equipment to reduce firearm noise.

Regarding impacts to wildlife from noise associated with lethal removal, we have augmented the analysis of effects to include a more detailed discussion (Section 3.5.1.2 of this Final EIS). Briefly, we consider noise impacting terrestrial wildlife when essential behaviors, such as nest attendance, feeding of young, or use of communal roosts, are modified. We anticipate that noise disturbance to wildlife species from lethal removal activities will be insignificant because removal activities will be conducted outside the breeding season of most potentially affected species, and will be of such short duration and frequency as to preclude any long-term effects on nesting or communal roosting activities.

Comment: One commenter noted that because spotted owls presumably start prospecting for territories in late summer, earlier removal of barred owls would make reoccupation by spotted owls more likely. They suggested changing the guidelines so as not to orphan dependent young, leaving open the option to remove the entire group, including adults and young.

Response: The Service is committed to avoiding the risk of orphaning dependent barred owl young-of-the-year that may result from removal (either lethal or nonlethal) of adult barred owls. The criteria we have proposed include focusing removal in the time between young independence and hatching of eggs the following year to ensure that orphaning will not occur. Any future modification to these criteria will reaffirm our commitment to avoiding orphaning of dependent young. Removal in the fall and winter provides the spotted owls with sufficient time to reoccupy the empty territories. There is no information to indicate that spotted owls prospect for territories more in the late summer than in the fall and winter, just prior to the breeding season.

We agree that removal of territorial barred owls as early as possible in the post-fledging period would improve the likelihood of spotted owls successfully re-establishing breeding territories within their historic home ranges, or new territories being established by "floater" spotted owls. We anticipate substantial difficulty in removing entire barred owl family groups, as we see no cost- or time-effective way of ensuring that all potential dependent young are accounted for prior to removal of full family groups. Barred owls are substantially more difficult to monitor than are spotted owls, because they do not consistently "mouse", resulting in a much higher risk of failing to detect dependent young. Therefore, we believe that removing parents and their dependent young as a group could potentially violate this commitment.

Comment: One commenter suggested we include a discussion of crew safety issues, particularly when working off roads.

Response: Safety of crews conducting barred owl removal, particularly in unroaded areas, is important to us as well. We discuss general safety in Appendix D of this Final EIS. Ultimately the principal investigator is responsible for ensuring basic safety and responding to specific concerns from land management agencies about particular areas or conditions where removal would take place.

K.2.5 Comments on Experiment Duration

Comment: One commenter questioned why we assume it takes 3 years to obtain pre-treatment data for occupancy studies, noting that this seems too short for a population trend and longer than needed to establish basic occupancy status.

Response: We have revised the assumption of the time needed to establish pre-treatment occupancy levels for sub-Alternative 6a to 2 years as described in Section 2.2.2.3 of this Final EIS. An occupancy experiment measures the proportion of sites that are occupied by spotted owls on the study area, and changes in site occupancy between years can be measured. Because detection rates are not 100 percent and because there may be a learning curve for field crews working on a study area, it is generally believed that 1 to 3 years of surveys are needed for sound estimates of site occupancy. If occupancy studies are conducted across the entire study area, population trends can be assessed. Three years is the minimum amount of time needed to estimate a baseline population growth rate (Anthony *et al*. 2006, pp. 8-14). With the pre-treatment data, we are not looking to measure a long-term trend over time, but rather are establishing a baseline rate to compare with the treatment area.

Comment: One commenter suggested that occupancy and demography studies take the same time, though demography studies take more effort to gather the information.

Response: Once in full swing, occupancy and demography studies would generally require similar durations. However, if we are starting from scratch, a demography study requires more time as we would need to capture and band a significant portion of the spotted owl population before we can begin to track demography. This generally takes at least 2 years, whereas initial occupancy levels could be established within 1 year. Neither of these represents pre-treatment trend data, but rather the time required to initiate the study.

Comment: One commenter noted that while spotted owl apparent survival may increase quickly after removal of barred owls, effects on reproduction may take longer due to confounding effects of weather or prey base. They suggested that the 4 year estimate for removal duration may be too short, especially in Washington and Oregon where spotted owl populations are at low levels.

Response: If we require data on reproductive success to estimate the trend for spotted owl populations, then it might take longer than 4 years of barred owl removal to gather sufficient information. However, reproductive success data are not required to develop an estimate of demographic trend. While spotted owl reproduction is variable across years, a 4-year of barred owl removal experiment should be sufficient to document whether barred owl removal has a clear effect on spotted owl demographic performance. It is likely that improvements in population performance will be first documented as improvements in annual survival (including immigration and recolonization), but improvements in reproductive performance should also be detectable. Individual spotted owls in some areas and at some times tend to reproduce on an alternate-year cycle, so a 4-years of barred owl removal experiment should provide the opportunity to detect improvements in reproduction.

K.2.6 Comments on Alternatives Described in the Draft EIS

Comment: Commenters recommend selecting an option or combination of options that both minimize lethal control of barred owls and are robust enough to assure the public that adequate data will be collected to provide scientifically defensible answers to the questions that the Service seeks to answer. One recommended that any selected alternative should obtain the most significant and highest quality results as measured by a power analysis.

Response: The Service agrees with these recommendations. Experts on statistical aspects of experimental design conducted analyses to estimate the degree of confidence that the experiments would provide statistically powerful answers to the questions we pose. This "power analysis" is provided in Appendix H of this Final EIS. We incorporated the results of the power analysis into our final design of the Preferred Alternative, to meet our commitment to achieve statistically powerful results yet avoid unnecessary removal of barred owls. We considered multiple study areas under several of the action alternatives, to increase applicability of results to recovery of the northern spotted owl throughout its range, rather than just locally near the experimental landscape. Our Preferred Alternative includes four study areas with a relatively high power to detect the effect of barred owl removal on spotted owl populations (see Section 3.3.2.3 of this Final EIS).

Comment: One commenter stated that the action alternatives will not add to the current preponderance of evidence that removal of either of two closely related species with similar habitat requirements, as with barred owls and spotted owls, will benefit the remaining species.

Response: We are unsure on what "preponderance of evidence" that removal of barred owls will benefit the spotted owl the commenter refers to. The commenter provided no citations or examples. Two ongoing actions may shed some specific light on the effect of barred owl removal on spotted owl population dynamics: 1) a study in the redwood zone of California; and 2) a management removal as part of a reintroduction effort for spotted owls in Canada. While the information from these efforts will be valuable in future discussions on removal as a management tool, these two situations do not represent the conditions across most of the range of the northern spotted owl. The fact that removal may work for other species in other situations does not provide the specific information we need for future management decisions as described in our Purpose and Need.

Comment: One commenter recommended selecting Alternative 2 because it includes multiple study areas across the range of the northern spotted owl. Also, the availability of pre-treatment data on trends and vital rates would increase the rigor of the experiment.

Response: We concur that using multiple study areas with pre-treatment data is the strongest experimental approach. Our Preferred Alternative includes four study areas spread across the range of the northern spotted owl, all with pre-treatment data.

Comment: One commenter supported Alternative 3 because it did not include lands within the National Parks, used study areas with pre-treatment data, and included both lethal and nonlethal removal.

Response: There are several options under Alternative 1 (one of the nine ongoing demography study areas) and Alternative 2 (three of the nine ongoing demography study areas) that do not include National Parks and include areas with pre-treatment data. Only the Olympic and Rainier Study Areas include National Parks. In addition, combined removal is part of Alternative 2. Therefore, other alternatives also provide the conditions described by the commenter. Our Preferred Alternative does not include National Parks, uses both removal methods, and uses study areas with pre-treatment data.

Comment: The Society for Conservation Biology, The Wildlife Society, and the Ornithological Council recommended selection of Alternative 7 because of its high level of replication, longer duration, and use of a combination of study types and removal methods. They suggest that this provides the best information for future management decisions.

Response: We concur that Alternative 7 does represent the highest level of replication among the alternatives, and some studies would be conducted for a full 10 years. While Alternative 7 does include both occupancy and demography studies, this experimental combination can occur within a single demography experiment; that is, we can test both occupancy and demography experimental approaches in a demography study site. Because we anticipate we will have few opportunities to use live capture due to the limited availability of interested organizations with adequate facilities, we do not feel that a combined removal method will provide much information on management use of nonlethal removal.

Comment: The National Park Service recommended against Alternative 7 because it maximizes the area where barred owls are removed; as such, they believe this alternative would function as a management action. They also had concerns that this population-level of experimental removal is expensive and can complicate analysis of results.

Response: Alternative 7 includes the maximum area of the alternatives presented in the Final EIS. However, this still represents removal from only 6.5 percent of the spotted owl habitat and is an experiment, not a management application. We do not believe this alternative functions as a management action. This is the most expensive of the alternatives. We consider this approach only slightly more complicated than other alternatives to analyze due to the combination of demography and occupancy approaches. However, each study area will provide stand-alone results, and the replication on 11 study areas over the range of the spotted owl will provide the strongest ability to extrapolate results.

Comment: One comment stated that the Draft EIS identifies six criteria as important components of the alternatives, including: 1) large treatment effect; 2) pre-treatment data; 3) replication; 4) large numbers of barred owls and spotted owls; 5) logistic feasibility; and 6) demographic response variables. However, only the Cle Elum and Oregon Coast Ranges Study Areas appear to fully meet these criteria.

Response: We did consider the items described by the commenter in the selection of study areas and development of the alternatives. However, these were not intended nor presented as absolute criteria, but rather as considerations used to weigh options. All four of the areas selected for our Preferred Alternative meet these components to some degree. The total experiment includes a large area of treatment and number of spotted and barred owls. All study areas have pre-treatment demography data. Finally, all study areas are logistically feasible for this experiment.

K.2.7 Comments on Additional Alternatives to Consider

Comment: One commenter suggested that, instead of removing barred owls, we study them to see what allows them to adapt to changing environments.

Response: The Service agrees that additional research on barred owls, and their ability to adapt to a wide range of habitats, might help us to understand their potential role in the decline of the spotted owl. It is an established fact that barred owls are more generalist predators using a wider array of prey items, have greater reproductive output, and use a wider variety of habitats than spotted owls. However, understanding why they can do this, the focus of the commenter's suggestion, is extremely difficult, at best. The differences are likely based on genetic and behavioral factors, and we are not able to tie these to cause and effect. This information would not likely translate into better methods of managing barred owls to allow for the conservation of the spotted owl, our target for this experiment.

Our proposed experiment addresses a different and more urgent issue: the likely ongoing effect of barred owls on spotted owls in the current environment. The immediate need is an understanding of direct and indirect effects of barred owls on spotted owls, and the persistence of spotted owls on the landscape during the several decades necessary for habitat recovery. Whereas barred owl habitat research could be done at any time in the future, the loss of northern spotted owls across all or much of their range is an issue of immediate focus, with few options for future consideration if not addressed in the short term. Further, nothing we propose in our experimental removal would preclude conducting barred owl habitat research concurrently or in the future.

Comment: One commenter suggested we release spotted owls into suitable habitat, and if current locations do not have enough habitat, find others that do.

Response: Translocating spotted owls would only succeed if there were large areas of spotted owl habitat currently unoccupied by either spotted or barred owls. We are not aware of any such areas.

Comment: Three commenters recommended alternatives that we considered in the Draft EIS but did not fully analyze. These include supplemental feeding, removal of only a portion of the barred owls in selected study areas, and removal of different proportions of the barred owl population on different study areas.

Response: The Service carefully considered each of these potential alternative approaches (among others) to the proposed action. In evaluating action alternatives other than the ones proposed and fully analyzed in the Final EIS, we considered feasibility, operability, the ability of any alternative to meet the stated Purpose and Need, and other factors in making our decision. Each of the alternatives described by the commenters was included in our internal deliberations, but was not brought forward for detailed analysis based on our consideration of these and other relevant factors. The reasons why these and other potential alternatives were dismissed from detailed analysis are described in Section 2.3 of this Final EIS.

Comment: One commenter recommended that we consider an alternative wherein we develop a complementary strategy of habitat conservation and barred owl control over a large study area for a long period to more closely match a management approach.

Response: A complimentary spotted owl habitat conservation program and barred owl control effort would be a very appropriate approach under a long-term adaptive management strategy. However, it is not required to meet the Purpose and Need of this EIS. We have identified specific information that we need to obtain in a timely manner to determine if removal is a reasonable management tool.

Comment: One commenter suggested a nest box program using boxes that spotted owls could use but not barred owls.

Response: Providing nest boxes would only work if the limiting factor for spotted owl populations was the availability of nests, the owls defended only the nest itself, and there was sufficient difference in size to allow us to design a box that would accommodate spotted but not barred owls. Unfortunately, barred and spotted owls defend a larger core area, and there is generally more than one available nesting site in each core. This would prevent spotted owls from using the nest boxes within a core area defended by a barred owl. Competition between spotted and barred owls is more for space and habitat rather than nest sites. In addition, spotted and barred owls are only slightly different in size, and overlaps between individuals of both species exist. Therefore it is unlikely that a nest box usable by spotted owls could not also be used by barred owls.

K.2.8 Comments on Study Areas

Comment: One commenter recommended avoiding study areas with access or logistical issues.

Response: We considered access and logistical issues as one component in the selection of the Preferred Alternative study areas.

Comment: One commenter suggested adding Washington study area(s) as a second tier of the experiment in addition to three primary study sites in Oregon and California. This would ensure enough replication of the primary areas. Washington sites have very limited remaining spotted owl populations that may be much slower to respond to the removal of barred owls than study areas in Oregon and California. Including Washington study areas in this experiment may complicate the analysis of the results, or falsely reduce the strength of results detected on the more southern study areas.

Response: We believe it is important to test the efficacy and efficiency of barred owl in all areas of the northern spotted owl range, including Washington. Differences in responses on the study areas will be detected and can be accounted for in the analysis. That said, the Preferred Alternative does include three study areas south of Washington, as well as the Cle Elum Study Area in Washington.

Comment: Several commenters sent us updated or corrected information on study areas.

Response: The Service will update or edit data and analyses used in the Final EIS to ensure the use of the most recent data available.

Comment: One commenter recommended we avoid study areas in southern Oregon or northern California because the lower concentration of barred owls and limited declines in spotted owls may reduce the ability to detect the effect of removal.

Response: We agree that available information indicates that barred owl population numbers and density are generally lower in southern Oregon and northern California, compared to northern Oregon and Washington. These numeric differences are likely a result of the north to south invasion of barred owls into the range of the northern spotted owl, and the longer period of site occupancy and population increase in areas invaded earlier. However, data being reported to us indicate that the range extension, numbers, and density of barred owls is increasing rapidly throughout southern Oregon and northern California, and will continue to increase during the anticipated 3 to10 years of barred owl removal under the duration of the experiment. At this time, we believe that the density of barred owls in each of the proposed study areas, including the most southerly, is sufficient to investigate barred owl influences on spotted owl site occupancy, survival, and reproduction.

Comment: One commenter recommended that we not remove barred owls from National Parks or Wilderness Areas, as these are areas where "ecosystem processes and species are allowed to proceed naturally". Another commenter stated that removal of owls from wilderness areas would be a violation of the Wilderness Act, but did not provide any support for this statement.

Response: We share the interest in ensuring that natural ecosystem processes continue. Our perspective is that removing invasive species, while not always popular, is often an appropriate measure to allow natural ecological processes to continue. Barred owls are likely to reinvade the area soon after cessation of removal; so long term alteration of the changing ecosystem will not occur on the studies. Our Preferred Alternative will not result in removal of barred owls from National Parks. A small portion of the Alpine Lakes Wilderness Area lies within the Cle Elum Study Area (less than 1 percent of the area) and the Rock Creek, Cummins Creek, and Drift Creek Wilderness Areas are within the outer boundaries of the Oregon Coast Ranges Study Area (4 percent of the study area).

We have evaluated the effect of our proposed, short-term barred owl removal experiment on wilderness, and may do additional compatibility analyses if we chose to remove barred owls from wilderness areas. Removal of species for conservation or hunting is not necessarily a violation of the letter or intent of the Wilderness Act. In the absence of more detail on why the commenter considers this a violation, we cannot respond to the specific concerns. Only two of the study areas in the Preferred Alternative include wilderness areas, and these are very small portions of the experiment. Given the logistics of working in Wilderness Areas, these areas may not be included in the final removal experiment detailed study plan.

Comment: The National Park Service provided information on the operability of National Parks and Recreation Areas for a removal experiment. They consider Olympic National Park operable, thought there are more issues with Mount Rainier National Park. In addition, seasonal access to North Cascades National Park Complex is particularly difficult.

Response: Accessibility is one of the elements that we considered in developing our Preferred Alternative. National Parks are not included in our Preferred Alternative.

Comment: The National Park Service noted that funding for continuation of the Rainier Study Area is currently at risk.

Response: We have added language to the Rainier Study Area description reflecting the uncertainty of continued funding for the ongoing spotted owl demographic study. We have considered this information in developing our Preferred Alternative.

Comment: One commenter asked for more information on why we chose the specific boundaries of the Ross Lake Study Area, given its focus on recreation and the patchwork of community and National Park holdings in some portions.

Response: The study area was included because it represents a habitat condition different from other areas and adjacent to efforts to re-establish spotted owl populations in Canada. We have analyzed the potential effect on recreation and considered this in developing the Preferred Alternative in the Final EIS. Given the relatively large area needed to conduct this experiment, almost all of the study areas include some patchwork of Federal and non-federal holdings. Removal would only occur only on Federal lands unless we have express permission from non-federal landowners. Safety protocols would be in place near occupied areas. Removal would only occur on a portion of the study area, so this portion may not be included. The Ross Lake Study Area was not included as a study area in the Preferred Alternative.

Comment: One commenter described their concerns about more dramatic adverse impacts on spotted owls in Marin County, California as the barred owl population grows. In order for the results of the experiment to be applicable range-wide, the commenter suggests that the Preferred Alternative include a study area in southern Oregon or northern California with a more recent invasion history of barred owls.

Response: The Service acknowledges that multiple study areas, reflecting the full range of habitat conditions and barred owl population densities that occur across the range of the northern spotted owl, would best document effects that barred owls may have on the spotted owl. One or more study areas from the southern Oregon or northern California pool of potential study areas may represent conditions spotted owls encounter in the southernmost extent of their range in coastal California. The Service, in its Preferred Alternative, has addressed this need by including four study areas from across the species' range. While none of the selected study areas include redwoods, as occur in the Marin County area, other data gathered under a pilot experiment currently being conducted by Green Diamond Resource Company, in Humboldt County, California, will be available to evaluate barred owl effects on spotted owls in the redwood region.

Comment: One commenter suggested that including five study areas, one in the eastern and western Cascades of Washington and Oregon, and one in northern California would provide high inferential strength while considering the constraints of limited funding.

Response: We agree that five study areas spread as described would provide a strong opportunity for extrapolation to the various habitat types. In selecting the study areas and the number of areas included in the Preferred Alternative, we are considering habitat alongside issues like the density of barred owls and the length of time barred owls have been a significant part of the ecosystem. However, there are limited opportunities for studies in eastern Oregon where spotted owl habitat is naturally very limited and we did not find a likely location for a study area. In addition, adding study areas comes at a cost and is part of our analysis for our final decision.

K.2.9 Comments on Effects to Barred Owls

Comment: One commenter noted that barred owls have been present in the range of the northern spotted owl for 40 years and complained about our use of spotted owl habitat as a surrogate for barred owls habitat rather than having the research to identify actual barred owl habitat.

Response: Some research has been completed that attempts to quantify habitat parameters describing suitable habitat used by barred owls in specific areas. Although the research is not nearly as extensive as that done to describe suitable habitat for the spotted owl, the available information suggests that, with limited exceptions, barred owls use forest habitats similar to those used by spotted owls for nesting, roosting and foraging. Information also exists suggesting that barred owls use habitats in earlier seral stages than typically used by spotted owls.

We know that barred owls use some habitats not used by spotted owls, and therefore not entirely captured using spotted owl habitat as a surrogate. We also know that barred owls consistently occupy habitat suitable for spotted owls and, in forested areas, appear to focus on the same habitat as spotted owls in general. Comparable data specific to barred owl habitat use is not available across the range of the northern spotted owl to provide a consistent basis for comparison. Therefore, we are limited to the data we have, the spotted owl suitable habitat.

We acknowledge that barred owls may occur in habitats not suitable to spotted owls, resulting in a slightly conservative (i.e., lower) estimate of total numbers of barred owls in proposed study areas using spotted owl habitat as a surrogate. Conversely, we may have slightly overestimated barred owl numbers in those few situations where barred owls may not use habitats suitable to spotted owls, as has been suggested for some of the driest of the eastside and Klamath Province forests.

Comment: One commenter asked if we had any analysis of the potential negative effect of the removal on barred owl genetics.

Response: Few data are currently available describing the genetic makeup of barred owls across the invasion area. All evidence points to the source population of barred owls as being from the most northerly distribution of the northern barred owl subspecies. Because the invasion of the barred owl into the range of the northern spotted owl has been extensive and rapid, we do not anticipate that substantial genetic differentiation has developed within the population since their arrival. As described in this Final EIS (Section 3.2.2.2), removal of barred owls from a few study areas would affect, at most, an estimated 6.55 percent of the barred owls within the range of the northern spotted owl, and less than 0.2 percent of the range of the barred owl in North America. The rate of removal for most of the alternatives, including the Preferred Alternative, would be substantially less than this maximum. We do not anticipate that even the highest level of removal under any of the action alternatives will result in genetic shifts in the barred owl. However, to further inform this question, the Service anticipates that barred owls removed during this experiment would be used to verify the genetic makeup of this invading population.

K.2.10 Comments on Barred Owl Removal Calculations

Comment: Two commenters suggested that the assumption of four barred owl sites per spotted owl site used for estimating survey effort was not accurate in California, where the ratio of known spotted owls to barred owls is more like 1:1 or 1.5:1. They suggested using the amount of habitat as a better surrogate of effort.

Response: The use of four potential barred owl sites per spotted owl sites in our estimate of survey effort and cost was our method of capturing the amount of habitat used by both species. We did not use the 4:1 ratio to estimate barred owl populations (current or future) but rather used this to estimate the amount of area needing to be surveyed. Because the only data we have on cost is the cost of surveying spotted owl sites, we needed a way to calculate the cost of barred owl surveys related to spotted owl sites

Comment: One commenter noted that the Draft EIS suggests barred owls may be removed during the same season they reoccupy empty habitat. However, the methods described in the Draft EIS do not include surveys for barred owls during the barred owl removal period; these surveys may be necessary to determine locations of reinvading barred owls.

Response: We have not prescribed specific survey or monitoring requirements that researchers must follow when surveying treatment areas to locate resident barred owls, or barred owls reoccupying treatment areas following initial removal. Our assumption of a high rate of removal of reoccupying barred owls comes, in part, from anticipated removal immediately following the breeding season, when most barred owl adults are likely to be located close to their site center. We also anticipate that researchers will continue some surveying for barred owls in fall and winter prior to the subsequent breeding season. Implementation of fall and winter surveys to locate and remove barred owls in the treatment area(s) well in advance of the breeding season will improve the ability to detect barred owl effects on spotted owls. We anticipate that spotted owls will be more successful in reoccupying historic sites and successfully breeding if competing barred owls are removed well in advance of the breeding season. Optimizing conditions for spotted owl reoccupancy in response to removal of barred owls may also promote reduced duration and costs of the experiment and may, indirectly, result in fewer barred owls ultimately needing to be removed to successfully complete the research.

Comment: One commenter notes that the Draft EIS suggests that when barred owls are removed, spotted owls may quickly establish a nest site. Yet, available data indicate that either barred owls or spotted owls may reoccupy sites after barred owl removal, and in some cases barred owls reoccupied a site twice after initial removal (Diller 2012, pers. comm.). They asked how the Service considered this information in its analysis of the proposed experiment.

Response: The Service agrees that either barred or spotted owls may reoccupy vacated sites, especially during the early years of the experiment when barred owl numbers within the removal area are still high, or near the perimeter of the removal area during any year of the experiment. Follow-up removal to reduce the number of barred owls reoccupying cleared sites will almost certainly be needed. In our analysis of effects on barred owls themselves, we account for this additional between-year and within-year follow-up removal (Appendix F of this Final EIS). One objective of the experiment will be to acquire data to further refine this estimated removal rate prior to any future management planning, if needed.

K.2.11 Comments on Effects to Other Species

Comment: One commenter asked whether this action sets a precedent for removal of other subspecies of spotted owls that compete, or may someday compete, with the spotted owl, choosing one subspecies over another.

Response: This experiment does not set any precedent for the removal of another subspecies of spotted owl. This experiment is specific to the competition from the invading barred owls. Subspecies often have some low level of interaction with neighboring subspecies and the delineation between subspecies or their ranges may naturally change. We have no reason to believe that one subspecies competes with or is a threat to the other.

Comment: One commenter inquired about the effects of this action on California spotted owls.

Response: The range of the California spotted owl lies adjacent to but does not substantially overlap with that of the northern spotted owl. We are not proposing any study areas in the range of the California spotted owl, or in the immediate vicinity of that subspecies' range. We do not anticipate any effects to California spotted owls to result from any alternative in our proposed action.

Comment: Three commenters expressed concerns about potential effects on marbled murrelets in study areas within their range. They recommended avoiding marbled murrelet sites and not conducting removal activities during the murrelet nesting season where there is a high potential for habitat overlap.

Response: We provided an analysis of the potential effect of the proposed experiment on marbled murrelets. The Preferred Alternative includes areas within the range of the marbled murrelet. The primary concern is during the early portion of the primary removal period when use of shotguns on the forest floor may overlap with late season breeding murrelets. Because marbled murrelet habitat is usually high quality spotted and barred owl habitat, it is likely that at least some removal could occur within occupied murrelet sites. See Section 3.5.2 of this Final EIS for more detail on the potential effects.

Comment: One commenter questioned whether removal of barred owls would lead to an explosion of the rodent population.

Response: Rodents were not in exceedingly high numbers prior to the arrival of barred owls, so we do not anticipate that removing barred owls would lead to an explosive growth of the rodent population. The natural forces that control population, such as other predators and limits to the food supply would continue to limit their populations.

Comment: One commenter pointed out that while removal of barred owls would reduce pressure on some species, the increase in spotted owl densities would reduce the effect. A second commenter stated that removal of barred owls would violate state law because an increase of spotted owls would decrease populations of the northern flying squirrel, a species protected under Washington law.

Response: We concur that reduced pressure from barred owls upon their removal would not necessarily remove predation on their prey species. Predation from the anticipated increase in spotted owl populations may replace some of the barred owl predation. The commenters suggested that species that are principal spotted owl prey, such as the flying squirrel, might see an increase in predation as the spotted owl population increases. While barred owls use a wider array of prey than spotted owls, northern flying squirrels represent the barred owl's primary source of biomass (Graham 2012, p. 2). Given the barred owls' ability to exist in greater density across the landscape, predation pressure on northern flying squirrels is not likely to increase with the replacement of barred owls by spotted owls. We revised Section 3.5.2.2 of this Final EIS to clarify this.

Comment: One commenter suggested that removing otherwise protected birds of prey could incite increased poaching of other avian species and reduce support for prosecuting such poaching.

Response: It is possible that some may try to use the careful and lawfully permitted removal of the barred owl, a protected raptor, as an excuse for poaching other raptors. Poachers are, by definition, already ignoring laws and this experiment is unlikely to change their actions. These actions remain illegal and this experiment will not reduce support within the legal community for prosecuting the illegal take of protected birds.

We have provided, and will continue to provide extensive public outreach to explain why this experiment is necessary for contributing to the recovery of a threatened species, the northern spotted owl. While any removal or impacts to protected species, especially raptors, may be difficult for some people to understand, it may still be an appropriate tool under specific circumstances. These are difficult decisions for everyone, but that does not make them wrong decisions.

K.2.12 Comments on Social and Ethical Concerns

Comment: One commenter suggested that lethal control may erode long-term public support for spotted owl recovery, and reduce confidence in endangered species programs.

Response: Given the need for this experiment as explained in the Final EIS and the lack of options to include a greater amount of nonlethal removal in this experiment, we believe this experiment is worth the risk to public support and confidence. Other commenters have noted that our lack of action to remove the obvious threat of the barred owls increases the risk to the spotted owl's survival as a species. Our measured and limited experimental approach underscores our efforts to seriously examine the efficacy of barred owl removal as a tool for spotted owl conservation prior to considering widespread management application. While some publics may lose confidence in our program, others may gain confidence in our willingness to consider necessary actions to protect a threatened species, even if unpopular.

K.2.13 Comments on Recreation, Visitor Use, and Visitor Experience

Comment: The National Park Service suggested that if removal were to occur in a National Park, they may choose to temporarily close some areas to minimize potential conflicts and for safety concerns.

Response: Our Preferred Alternative does not include study areas within National Parks. Appendix D of this Final EIS discusses public safety as part of the methodology for removal. Ultimately the principal investigator is responsible for ensuring basic safety and responding to specific concerns from land management agencies about particular areas or conditions where removal would take place.

Comment: One commenter stated their experience as visitors to public lands would be embittered by the knowledge that barred owls would be killed, particularly in National Parks and recreation sites. Another expressed concern about the negative effect of the sound of shotgun blasts on the visitor experience on a National Park.

Response: We understand that some people will be unhappy with any removal (killing or capture) of barred owls as part of this experiment. We have gone to great lengths to minimize our removal of barred owls while still meeting the purpose and need of a scientifically rigorous experiment. The Preferred Alternative does not include any removal in National Parks and National Recreation areas because other areas provided a better basis for this particular experiment.

K.2.14 Comments on Economics

Comment: One commenter opined that the economic analysis is inadequate because it states that safe harbor agreements may be pursued with non-federal landowners to reduce the impacts of spotted owl reoccupancy on timber harvest. However, the economic analysis does not explain or analyze the effects of the safe harbor agreement.

Response: While we described the potential for reduced effects as a result of safe harbor agreements, our analysis assumed the worst case (no safe harbor agreements) and analyzed the economic effects on state and private landowners based on this worst case scenario. Safe harbor agreements are voluntary and would be negotiated with individual landowners; therefore, we cannot reasonably anticipate the number and extent of agreements, so effects are not known at this time. Any safe harbor agreements would lessen the effects described in the economic analysis. We have clarified this in the Final EIS.

K.2.15 Comments on Experiment Costs

Comment: One commenter suggested basing cost on the amount of habitat to survey rather than spotted owl sites.

Response: In essence, we did base our costs on the amount of habitat available. We used the amount and distribution of habitat to determine the potential location of spotted and barred owl sites. We chose a site-based approach to the analysis because the data available on spotted owl survey costs are best described in terms of cost per site.

Comment: Two commenters expressed concerns with our analysis of the cost of barred owl removal and requested more explanation of the approach used.

Response: We expanded our explanation of the approach we used to estimate the cost of the studies to clarify the issues raised. This is found in Section 3.9.1 of this Final EIS

Comment: One commenter pointed out that spotted owl surveys on the Hoopa (Willow Creek) Study Area would likely continue with or without our conducting the barred owl removal experiment and suggested that our experiment costs should not include the spotted owl surveys on these areas.

Response: We have clarified that all ongoing spotted owl demography studies are separate studies and would likely continue with or without the barred owl removal experiment, dependent only on their funding agency or source. We included these costs to allow comparison between studies with and without ongoing efforts, but should have been clearer on this relationship. We have clarified this in the final EIS.

Comment: Two commenters questioned the increased cost to remove barred owls in later years. Both felt that while the number of barred owls would be lower in later years and the sites spaced further apart, the actual cost to remove barred owls across the study areas would be similar.

Response: We clarified the rationale for our estimation of cost for barred owl removal in Section 3.9.1.3 of this Final EIS. Based on the latest information we have also slightly revised our cost estimates for removing barred owls in later years of the experiment.

Comment: One commenter requested we describe the cost required to hire biologists qualified to positively identify barred owls versus other owls.

Response: The cost of hiring individuals capable of positively identifying all types of owls is included in the costs for barred owl surveys and removal efforts. Barred owls are not particularly difficult to distinguish from spotted or other owls found in the range of the northern spotted owl with adequate training or experience.

Comment: One commenter stated that the Service should assume a minimum 4-visit survey protocol when estimating costs of completing these studies.

Response: Our analysis of cost is based on the current protocol for ongoing demography studies and the protocol currently in use for spotted owl demography studies. We do not intend to change the protocol as it remains the expected approach.

Comment: One commenter stated that the cost estimates of completing nonlethal removal by permanent captivity underestimates the actual costs because capture, checking, relocation, and permanent housing for barred owls would require considerably more effort than lethal removal, and could jeopardize the rigor of the studies.

Response: In our cost estimates of nonlethal removal we included costs involving capture, initial transportation, and perhaps some of the health checking. Some of the transportation costs and all of the care costs would be the responsibility of the receiving entity, not the Service or this experiment. We anticipate, and clearly state, that even in the combined removal method we expect that nonlethal removal (capture and permanent captivity) would be a small part of the total removal. Using a combination removal method allows us to make the best use of the removed owls, allowing for a reduction, albeit small, in the number of barred owls killed and providing educational birds for institutions with the appropriate facilities and resources to utilize live birds.

K.2.16 Comments on Barred Owl and Spotted Owl Biology and Species Relationships

Comment: One commenter suggested that barred owls will have to be removed forever, because they will just keep reinvading the treatment areas and reoccupying spotted owl habitats.

Response: Information gathered through the proposed experiment will address the rate and extent of barred owl reoccupancy of the treatment areas during the experimental removal period. Data regarding reoccupancy of treated areas by barred owls is essential to making future decisions. In this EIS, we relied on the best available, yet limited, information regarding potential reoccupancy rate and acknowledge the future need for additional data. This information will allow the Service to analyze the feasibility, costs, location, and scale of doing long-term management of barred owls that best meets future management goals, if long-term management of barred owls is found to be appropriate, necessary, and feasible to conserve the spotted owl.

Comment: One commenter asked whether barred owls would emigrate from British Columbia to repopulate areas where we are removing them.

Response: For this experiment, we anticipate that barred owls from adjacent landscapes within the United States will reoccupy the removal area as a result of juveniles and subadults dispersing from nearby natal areas, or other adult "floaters" who continue to search for available mates and unoccupied territories. We are not proposing to remove all barred owls from the United States portion of the range of the northern spotted owl in this experiment, so reoccupying barred owls are more likely to come from adjacent areas within the United States than from Canada. Our closest study area, Cle Elum, is over 100 miles south of the U.S. Canadian border.

Comment: One commenter noted that while some spotted owls may remain on the landscape but be quiet and remain undetected, some spotted owls remain vocal even when barred owls reside nearby. They felt our statement that "Northern spotted owls may remain on the landscape but do not vocalize and remain undetected until barred owls are removed" was an overgeneralization.

Response: We did not intend to indicate that all spotted owls stop vocalizing immediately once barred owls move into an area. We have updated the statement in the EIS to note that in some cases spotted owls remain vocal, but also note that the number of vocal spotted owls appears to continue to decline as barred owl populations saturate the landscape.

Comment: One commenter questioned our statements about the effect that climate change may have on the generalist barred owl.

Response: We agree that the full implications of climate change on any species, humans included, are highly uncertain, particularly within the time frame of this experiment (approximately 10 years). We have altered the language in the Final EIS to reflect this uncertainty.

Comment: Several commenters requested that we collect additional information before contemplating a removal experiment, without explaining why the relevant information is necessary to meet the purpose and need.

Response: Additional information can be useful, but given scarce resources and lacking a compelling reason to collect additional information, we must remain with collecting the information identified as necessary to fulfill the purpose and need for the experiment, as we understand it.

Comment: One commenter apparently thought the barred owl was a subspecies of the spotted owl because they interbreed and because barred owls hold a significant portion of the spotted owl gene pool. They felt that this indicated the barred owls were a benefit to spotted owls.

Response: Barred owls and spotted owls are two separate species. While barred owls and spotted owls can and do occasionally hybridize, it is a very uncommon occurrence. As barred owl populations have continued to increase, we have not seen a large increase in barred owl-spotted owl hybrids, suggesting that barred owls are more likely to mate with barred owls when populations are sufficiently large for them to find mates. In most cases, pairs of barred owls end up displacing spotted owls from their territories. A minor level of hybridization between closely related species is common in the natural environment and does not define species.

Comment: One commenter suggested that because barred and spotted owls interbreed, the genetics of the spotted owl will not be lost even if the species goes extinct, and therefore we do not need to kill barred owls to save spotted owl genetics.

Response: Hybridization seems to be limited to early phases of barred owl invasion, when barred owls are scarce; few instances occur later, as barred owl numbers increase. The high number of barred owls and the low number of spotted owls on the landscape, as well as the declining populations of spotted owls, would dilute any potential for genetic continuance. Furthermore, under the ESA, genetic continuation does not constitute conservation or recovery of a listed species.

Comment: One commenter suggested that because barred and spotted owls interbreed, they are the same species and the current situation is simply natural evolution.

Response: Interbreeding between barred owls and spotted owls occurs occasionally in the wild, yet the number of documented instances is relatively low in comparison to the population size of either species. Much, though not all, of confirmed interbreeding occurred along the invasion front as the barred owl range expanded from north to south. Interbreeding between closely related species (both are members of the genus *Strix*) is not infrequent in the wild, yet both parent species remain distinct. For example, the domestic dog, coyote, and gray wolf are congeneric (species that share the same genus), and are capable of interbreeding. Nonetheless, these three species are considered to be distinct (Wayne *et al*. 1997, Vila and Wayne 1999), and should be maintained as separate species, each filling its functional role in the natural and human environment. The risk in the short term is the competitive exclusion of the northern spotted owl, precluding opportunities to manage for coexistence of the two species, or ensuring that its functional role on the landscape is perpetuated for future generations to enjoy. The focus of the current project is to address the immediate risk of competitive exclusion.

Comment: One commenter requested better empirical support for our statement that barred owls are more strongly correlated with spotted owl population trends than the presence of protected habitat and requested we define what we include in 'protected habitat'.

Response: Recent demographic studies (Forsman *et al*. 2011a, entire; Dugger *et al*. 2011, entire) have shown that declines in spotted owl populations are associated with both barred owl presence and habitat loss. In these publications, barred owls accounted for more of the change in demographic rates of spotted owls than did habitat. This does not mean that habitat is not important, but currently barred owls are driving the observed demographic trends. Appendix A, Section A.5 of this Final EIS is fairly explicit about how barred owls were associated with demographic rates in Forsman *et al*. (2011a, entire).

Comment: Green Diamond Resource Company provided a summary of information from their lands indicating a decrease in the apparent survival of spotted owls with a concurrent increase in barred owls.

Response: The Service has obtained and is including this new information into this Final EIS in Appendix A.

Comment: One commenter believed our statement that “barred owls have been found for less than a decade on most [southern Oregon and northern California] study areas” is wrong. According to the commenter, barred owls were first detected in the late 1980s and have been detected on most study areas by the early- to mid-1990s.

Response: The earliest records for barred owl detections in southern Oregon and northern California date back to as early as 1976. However, the main wave of barred owl range expansion and population increase currently affecting spotted owls in this area was documented from approximately the mid-1990s to the present, and the barred owl continues to expand its range and increase in population numbers. We have edited text in the Final EIS to clarify this issue and to correct an unintended perception that barred owls have only been in northern California for 10 years or less.

Comment: One commenter stated that it is inaccurate to assume that northern California has experienced lower numbers of barred owls and a slower barred owl colonization rate. They noted that in Redwood National and State Parks only 7 of the 40 spotted owl territories occupied in the early to mid-1990's remain occupied, even at sites with predominant old-growth redwood. They believe the Service should acknowledge that barred owls and spotted owls have not been able to coexist under these circumstances and there is a high likelihood that spotted owls are on the verge of extinction within Redwood National and State Parks.

Response: This information lends additional support to the hypothesis that the invasion has occurred so extensively and rapidly that the spotted owl and barred owl will be unable to co-exist, even in high quality habitat such as ancient redwoods, lending additional evidence to the urgency of conducting the proposed experiment.

Comment: One commenter asks us to consider information on habitat preferences, behavior, and foraging of barred owls found in a 1987 habitat suitability index (HSI) model for barred owls.

Response: The HSI model identified by the commenter was developed primarily from data and information obtained in the midwestern and eastern portion of the United States, is limited to breeding habitat, and is an unverified conceptual model (Allen 1987, pp. 6-7). Barred owls in the Pacific Northwest do not have the same habitat types available to select from as do barred owls in the eastern and midwestern U.S, thus the HSI model identified by the commenter is not fully applicable. We did utilize information in some of the documents used in the development of the HSI model, as well as many from more recent research. Research on barred owls in the Pacific Northwest (Wiens 2012, pp. 49-54; Singleton *et al*. 2010, p. 285) has shown that barred owls select habitat conditions similar to that used by spotted owls.

Comment: One commenter noted that the barred owl is a state-listed species in New Jersey and felt this might provide some insight as to the pressures that caused barred owls to immigrate to the west. They, and other commenters, believed that barred owls moved into the Pacific Northwest to avoid logging and other habitat loss in Canada. Other commenters suggested that we needed to understand why barred owls moved west and what pressures may have caused them to do so before we move forward with removal or management.

Response: The commenter seems to assume that barred owls moved west as a result of pressures in their native habitat. Species such as the barred owl that maintain year-round territories rarely move substantial distances once they settle on a territory. Movements of dispersing individuals (in search of available mates and territories) may be up to 50 miles or occasionally more. No available information suggests that individual barred owls could make movements of hundreds or thousands of miles, as suggested. The range expansion of the barred owl likely resulted from incremental movements by dispersing individuals across the newly available forest patches in the formerly unsuitable northern plains and southern boreal forest of Canada, into the more extensive forests of western North America. In essence, they were not pushed out, but rather lured west. Local movements by barred owls as a result of habitat loss probably occurred, but the western range expansion is unlikely to have been substantially influenced by these local movements. Rather, the Service anticipates that the multi-decade range expansion more likely resulted from the relatively extensive availability of suitable habitat resulting from inadvertent human modification of formerly unsuitable habitats.

While it would be interesting to know precisely why barred owls began to move west, what broke the barrier that kept the species apart for millennia, there is simply no information that will allow us to determine this and no way to study this today, over 100 years after the event. We considered the best available information, and provided this in Appendix A of this Final EIS, where we explain why this information in not necessary prior to this experiment.

Comment: Several commenters questioned whether the barred owl should be considered an invasive species, noting that we did not reach a conclusion on this point. Some felt we should determine if it is an invasive species before we proceed with experimental removal. Two commenters suggested that the barred owl should not be considered a non-native invasive species because they believe the owls arrived naturally in the northwest.

Response: A review of the literature and relevant Federal rules shows an absence of commonly held definitions for species that occur in areas where they have not previously been found. Some references define "nonnative" or "invasive" as species that are introduced by humans. Others are vaguer and define nonnatives as species that were not historically or aboriginally present. Human activities have likely played an indirect role in the barred owl expansion, and we believe that the literature supports viewing them as a nonnative. Certainly they did not occur in the Pacific Northwest prior to broad human changes in the landscape of the Great Plains and boreal forest after 1800, which allowed them to cross what had been an ecological barrier (see the following comment for greater detail). Whether barred owls are considered "native" or "non-native," however seems a moot point. Evidence is strong that sharply declining spotted owl populations are related to increasing densities of barred owls in spotted owl territories. The risk to spotted owl populations of doing nothing about this threat is extremely high while the risk to barred owl populations is negligible and extremely short term.

Comment: Several commenters suggested that overrunning of spotted owls by barred owls is a natural event, part of evolution, and should be allowed to continue without intervention. One commenter did not believe that the information was adequate to show that barred owls are a threat to spotted owls as opposed to a normal natural condition.

Response: In its review of the available information regarding causes for the relatively recent (last 100 years) range expansion by the barred owl into western North America, the Service was unable to find definitive evidence of either direct or indirect human intervention. However, despite lack of definitive evidence, there exists substantial compelling evidence that the barred owl range expansion resulted from recent human changes to the northern Great Plains and southern boreal forest. These recent human changes include near extirpation of bison and beavers, virtual elimination of Native American habitat management through fire, and development of forest patches (e.g., shelter belts) in formerly treeless prairie converted to agriculture, among others. Although no evidence exists that humans actively relocated barred owls, inadvertent creation of suitable habitats across the central portions of North America as a result of relatively recent human activities arguably led to a range expansion of barred owls through formerly inhospitable habitats. Part of the compelling evidence of indirect human intervention in the barred owl range expansion results from the coincident timing of range expansion with major changes to existing habitats, initiated during the last decades of the 19th century.

Available evidence suggests that immediate response, initially in the form of designed experiments to determine the true effects of barred owl competition with spotted owls, is appropriate. Failure to respond risks, at a minimum, the extirpation of the northern spotted owl throughout much of its range, and greatly increases the time and cost of eventual recovery of this listed species. At worst, failure to respond risks extinction of the northern spotted owl and loss of its ecological role and function within late-successional forests throughout its historic range. While conducting the proposed experiment would result in short-term adverse effects to a species of questionable nativity (barred owl), and maintain options for future management, failure to conduct the proposed experiment would risk the permanent loss of a keystone species of the Pacific Northwest.

Comment: One commenter noted that the experiment does not answer all questions on spotted and barred owl interactions, such as examining conditions under which co-existence may occur. They consider this experiment a waste of funds that would be better spent on research into co-existence.

Response: The commenters assume that the proposed research project will provide final answers to the myriad questions that could provide information to this issue. Rather, the Service intends to gain specific information that will inform future management decisions. Our proposed removal experiment does not prevent others from initiating or continuing studies on co-existence. The commenters seem to assume that funds spent on this experiment would be available for other spotted owl and barred owl studies if we do not implement this experiment. As we seek funding for this experiment, we are not tapping into funds that are already earmarked for spotted or barred owl studies. We have no reason to believe that the monies spent on this experiment would be available for other types of barred owl studies in the absence of this work.

Comment: One commenter stated that it may be impossible to remove a generalist predator, such as the barred owl, from anything more than a small area to recover another species.

Response: We concur with the commenter that removal of a well-established, generalist predator may be difficult, though not impossible. One purpose identified in the Purpose and Need of the Final EIS is to determine the effectiveness of removal and the effort required to keep barred owl populations low. We do not anticipate complete removal will be possible. The intent of the removal, however, is to reduce the barred owl influence on spotted owls to the maximum extent practicable to maximize the likelihood of detecting positive response by spotted owls in the removal area. The information from this experiment will help us determine our capability to use removal as a management tool, including the conditions and area over which this may be an effective tool for the conservation of the spotted owl.

K.2.17 Comments on Adequacy of Draft EIS

Comment: The EPA stated that they did not identify any environmental impacts that should be avoided in order to fully protect the environment for any of the action alternatives.

Response: We concur.

K.2.18 Comments on the Need for Review of Experimental Design

Comment: One commenter recommended that we comply with the Animal Welfare Act by ensuring that the study plan is reviewed and approved by an Institutional Animal Care and Use Committee.

Response: It is our intent to follow all Federal laws that apply to this experiment. This will include compliance with the Animal Welfare Act.

Comment: One commenter recommended that we create an independent scientific review team to monitor the entire experiment and inform the public.

Response: The Service has a Scientific Integrity policy that provides policy and guidance about how to handle such matters. We will certainly share any reports or other information gained from reasonable and necessary oversight of our activities, but the commenter provides no other supporting reasons for establishing a special oversight group other than to offer an opinion that it "will be critical to the credibility of the results..." They provide no support as to why special oversight is needed here that is not required for other similar studies or activities requiring animal handling.

Comment: The National Park Service supported the proposed experiment, including potential implementation on National Parks, though expressed some concerns related to access, crew safety, and impacts to visitors if the studies are not managed well. They recommended that if National Parks are involved, we include the U.S. Geological Survey in design and review of this experiment.

Response: While we appreciate the National Park Service's recommendations, our Preferred Alternative does not include any National Parks. Issues of access, crew safety, and effect of other users of the lands will be fully considered in the development of the final experimental design.

Comment: The Society for Conservation Biology, The Wildlife Society, and the Ornithological Council recommended that we conduct an expedited peer-review of the Preferred Alternative in the final EIS as a mitigation measure. They also recommended that details of any final study plan be peer-reviewed prior to implementation to ensure the best possible experimental design. Specifically they recommended that the peer review should include: (1) thoroughness of literature review, (2) basis of underlying assumptions, (3) statistical design, (4) ability and capacity to carry out planned control activities, and (4) whether the methods generate the data needed to answer the experimental questions.

Response: We intend to have details of the final study plan widely reviewed, both within and outside the Federal agencies. A formal peer review is not the most effective method to conduct this review. Through public comments and discussions with Federal agencies and scientists, we have conducted extensive scientific review of the information included in the Preferred Alternative. We believe this fulfills the need for review at this stage. The Preferred Alternative is not a detailed study plan, but rather a description of the experiment. The detailed study plan developed from the final decision is the most appropriate stage for additional detailed scientific review.

K.2.19 Comments on Compliance with Law and Policy

Comment: One commenter asked if there was legal or policy support for choosing one species over another?

Response: The Endangered Species Act requires the Service to work for the recovery of threatened or endangered species, such as the northern spotted owl. The Migratory Bird Treaty Act focuses on conserving species covered by several Migratory Bird Treaties. We have evaluated the effect of the proposed experiments on the barred owl and found they do not compromise the conservation of barred owls. We have also identified the value of this experiment for the survival and recovery of the northern spotted owl. Therefore, we have met the legal and policy requirements for both species. It is not uncommon to manage one species to protect another species, particularly when the species managed is common and the focus species is rare or endangered.

Comment: One commenter suggested that if we determine the barred owl is a pest we should work with APHIS to have the animal classified as such under federal and state laws.

Response: The fact that we may find it necessary to manage one species to protect or conserve another does not mean that we consider the managed species a "pest". In this case we are only addressing the effect of barred owls on one species, spotted owls, and only within the northern spotted owl range, a portion of Oregon, Washington, and northern California. The barred owl is historically native in the eastern and Midwestern U.S. and portions of Mexico. Even within its expanded range, it may not represent a threat or risk to species and ecosystems in most areas. Therefore it is not appropriate for us to recommend classification of the barred owl as a pest.

Comment: The National Park Service noted that any nonlethal removal (capture and move to captivity) from lands they manage would require consultation with their Biological Resources Management Division and need approval from their Institutional Animal Care and Use Committee.

Response: Our Preferred Alternative does not include any removal from National Park Service managed lands. However, we will consider the need to have any nonlethal removal reviewed by an appropriate Institutional Animal Care and Use Committee.

Comment: One commenter pointed out that if we conduct removal in a National Park Wilderness, we will need to conduct an analysis to show that such activities are appropriate and use the minimum tool or force needed to accomplish the objectives.

Response: We concur that this analysis will be necessary and would be completed if removal occurs within National Park Wilderness. However, the Preferred Alternative does not include any National Park Wilderness.

Comment: One commenter stated that we did not explain how our alternatives were consistent with the Migratory Bird Treaty Act, though they did not describe the specific elements we failed to evaluate.

Response: This EIS provides the NEPA analysis necessary for the Migratory Bird Office to make a decision on whether to issue the permit. Thus, the EIS must meet the review requirements of the Migratory Bird Treaty Act (MBTA), as well as NEPA. To meet its obligations under regulations implementing MBTA, the Service must analyze the effects that issuance of the permit will have on migratory birds. We have estimated the numbers of barred owls to be removed under each action alternative, and the effects of that removal on the barred owl population size and extent of the species' range, in Section 3.2 of this Final EIS. We determined that the extent and numbers of barred owls removed under each alternative would have only small-scale and short-term impacts to barred owls when considered either regionally (i.e., within the range of the northern spotted owl) or range-wide in North America. We concluded that the proposed barred owl removal experiment would not substantially reduce the future population size or distribution of barred owls. The Service's internal review of the Draft and Final EIS included managers from the Service's Migratory Bird program, who are tasked with deciding whether to issue the permits under the MBTA. We continue to engage Migratory Bird Program staff to ensure that this EIS provides the information necessary for the Service's Pacific Region Bird Permit Office in Portland, Oregon, to determine whether a permit to allow the take of barred owls as part of an experimental program is consistent with the intent and requirements of MBTA.

Comment: The National Park Service noted that if National Parks were included in the experiment, a National Park Service Scientific Research and Collecting Permit would be required. This would require each affected Park to conduct a review of effects and may require additional NEPA compliance. The permit, if issued, might also contain some park-specific terms and conditions.

Response: Under the Preferred Alternative, no areas managed by the National Park Service are included in the experiment.

K.2.20 Comments on Experimental Design

Comment: One commenter noted that we may be able to conduct removal on a smaller portion (e.g., one-third or one-quarter) of a large study area and still have a sample size large enough to detect a difference between the treatment and control areas.

Response: In the Final EIS we indicated that removal would be conducted on "up to one half" of each study area. This would allow the principle investigator to propose using a portion of the study area. We concur that this is most likely if we chose a large study area such as the Oregon Coast Ranges. We considered this in the development of the Final EIS Preferred Alternative. Our use of only a portion of the combined Oregon Coast Ranges and Veneta Study Areas reflects this.

Comment: One commenter asked if removal would be limited to the study area boundaries or applied to entire valleys, including areas outside the study area boundaries.

Response: Removal would only occur on up to one-half of the area within the final study area boundaries. No removal would occur under this permit outside of the boundaries described and mapped in the EIS.

Comment: One commenter stated that we should track the time and resources to conduct the experiment as input for future decisions on barred owl management.

Response: Because one of the purposes of this experiment is to "estimate the cost of barred owl removal . . ." (Section 1.3 of this Final EIS) we believe we have already covered this suggestion.

Comment: One commenter suggested that we should monitor forest management activities within the study areas during the experiment and attempt to account for these effects in the analysis.

Response: We will consider including this in the analysis of the results of the experiment to the extent we can do so within our budget.

Comment: One commenter recommended that we continue to rigorously monitor barred and spotted owl populations for several years after the removal efforts cease so we can determine the consequences of terminating removal efforts.

Response: While we would like to commit to monitoring spotted and barred owl populations following the cessation of removal methods, our ability to do so will depend on funding. All but the Union/Myrtle portion of the Preferred Alternative study areas are also part of long term spotted owl monitoring efforts and we anticipate that these monitoring studies will continue during and after our removal experiment. In effect, we will have post-removal monitoring on three of the removal areas as long as the spotted owl demography studies continue. There are no current plans to drop any of these studies.

Comment: One commenter stated that the experiment is a waste of money because of its poor design, though they provided no evidence or explanation of design flaws or concerns.

Response: In the absence of details, we are unable to respond to the assertion that the experiment is of poor design. Many scientists have been involved in the development and review of the general experimental design and all have found this to be a strong approach.

Comment: One commenter stated that barred owls should be studied using radio telemetry to increase scientific knowledge.

Response: Radio-telemetry studies have been completed and may also be funded in the future. However, radio-telemetry studies generally do not provide data specific to the questions posed in this proposal and, hence, would not address the purpose and need for the removal experiment.

Comment: One commenter recommended we develop management alternatives including removal and other research as part of a larger, feasible, adaptive management strategy.

Response: We acknowledge the need to integrate management alternatives into a long-term management strategy, with a strong adaptive management approach. However, we still need the initial data from the barred owl removal experiment to assist in developing a larger management strategy.

Comment: One commenter stated that the Service should study factors that contribute to co-existence between barred owls and spotted owls. They consider that the adverse effects of barred owls on spotted owls are already well documented and co-existence is the only long-term feasible strategy.

Response: We agree that long-term management would benefit from understanding factors that could improve the ability of spotted owl to co-exist with barred owls. However, the strongest evidence we have to date suggests that barred owls are able to outcompete northern spotted owls throughout their range. Because the barred owl invasion and the corresponding decline of spotted owls is happening at an extremely rapid rate, with no time for coexistence to manifest, the Service feels it prudent to explore experimental removal at this time. The experiment will only operate on less than 7 percent of habitat for the spotted owl and only for up to 10 years of barred owl removal, leaving plenty of opportunities for other studies to examine any co-existence that is documented.

Comment: One commenter stated that the proposed experiment may not inform more effective management if no effect is detected because the experiment scale is too small, the timeframe too short, the sample size too small, and the unique conditions on each study area will confound the results.

Response: We disagree. Negative information is still valuable information. We have analyzed the experimental conditions (size, number and distribution of study areas, and timeframe) to provide for experimental rigor and to allow us to make scientifically defensible conclusions regarding the effects of barred owl removal on spotted owls. We have also clearly stated that the experiment may extend beyond the estimated duration, up to 10 years of removal, if needed to reach scientifically defensible results. If the study areas show no effect after up to 10 years of removal, we will have learned that removal is not an effective management tool in this situation.

Comment: One commenter noted that effects to spotted owls from barred owls are species-specific, and not dependent on the location within the spotted owl's range, so we may not need replication across the spotted owl's range.

Response: While the interaction between spotted and barred owls may be species specific and therefore similar across the range of the spotted owls, there are differences between the study areas that could lead to different responses by spotted owls to barred owl removal. For example, in the northern part of the range barred owls have been present for long periods of time and are near or at saturation densities. Spotted owl territorial populations have been greatly reduced for several years. There are concerns that the remaining non-territorial spotted owl population may be too low to respond to the presence of unoccupied sites when barred owls are removed. It may require years for the remaining small population to re-establish and reproduce to provide spotted owl colonizers to take advantage of the barred owl removal. Study areas distributed across regions where barred owl history, barred owl population density, habitat, climate, and shared prey base differ can ensure that we detect regional differences, rather than making a general assumption, based on data from a single, unique study area, that there is no regional effect.

K.2.21 Comments on the Need to Address Habitat in Addition to or Instead of Barred Owl Competition

Comment: One commenter noted that the barred owl was not listed as a major threat in the listing of the northern spotted owl in 1990 and therefore it was unreasonable to assume that removing this newer threat will solve the problem. The effects causing the earlier decline, in particular habitat loss, remain and will continue to drive a decline in spotted owls.

Response: This experiment should be able to determine if barred owls have added to the impacts that are causing the ongoing declines in spotted owl populations. If barred owl removal can lead to a decrease in the rate of decline of the spotted owls, even if it would not fully reverse the decline, it could provide conservation benefits for the spotted owl. The 2011 Revised Recovery Plan for the Northern Spotted Owl lists three primary threats to the spotted owl, including historic and ongoing habitat loss, and includes many recovery actions related to habitat conservation. For example we recently designated increased acreage of critical habitat for the spotted owl. We are not replacing habitat based conservation with barred owl efforts, but rather adding work related to this new and intense threat.

Comment: One commenter suggested that our focus on barred owl removal will result in less attention being paid to habitat protection and will allow currently protected habitat to be logged.

Response: The Service continues to work on threats to habitat, including the recently revised designation of critical habitat for the northern spotted owl. We believe that conservation of the spotted owl is dependent on addressing both habitat needs and barred owl competition. Our effort to study removal of barred owls does not change our focus on addressing habitat loss.

Comment: One commenter noted that the Service is emphasizing barred owl removal instead of habitat protection in order to meet spotted owl recovery goals. The commenter points to published recommendations for additional habitat protections and also notes that our document states that habitat loss could resume in the study areas after the experiment is completed.

Response: The Service is committed to addressing both the habitat threat and the barred owl threat to the spotted owl, as discussed in detail in the Revised Recovery Plan for the Northern

Spotted Owl (USFWS 2011, Chapter II). Our commitment to appropriate habitat protection is reiterated in the recently adopted final rule revising the designation of critical habitat (USFWS 2012, entire), which resulted in an increase in critical habitat designated for the northern spotted owl. The barred owl removal experiment and habitat protection are not mutually exclusive efforts, and failure to address either issue could compromise the future of the spotted owl.

The Purpose and Need for this EIS identifies the barred owl threat specifically as the focus of this proposed experiment, and is not intended to de-emphasize the need to address habitat threats. The proposed research project does not propose to change habitat management as part of the experiment; current management practices, including allowable timber harvest, will continue during the experiment. However, additional spotted owl sites located during the experiment will receive protections consistent with known sites (normally found during project "clearance") as part of ongoing forest management practices.

Comment: One commenter suggested we increase corridors for barred owls and spotted owls.

Response: We have no evidence suggesting that connectivity is limiting the spotted owl in its recovery, other than for unrelated long-term connectivity between the Oregon Cascades and Coast Ranges. Increasing connectivity is unlikely to hinder invasion by the barred owl or reduce their competition with spotted owls.

K.2.22 Comments Supporting Barred Owl Removal

Comment: Several commenters supported the careful, experimental removal of barred owls, and encouraged the Service to initiate the experiment and achieve credible results soon. They noted that the spotted owl is an important native creature, and appears to be defenseless against the barred owls' attacks and competition. Some felt it is important to test the hypothesis that barred owls are contributing to the decline of spotted owls in forest reserve areas, and the feasibility of barred owl removal to provide flexibility in future management decisions. Several noted the need to acquire the information in a relatively short time frame (5 years or less). Several supported conducting a demographic experiment (rather than occupancy) with pre-treatment data. Their support did not imply future endorsement of any specific technique, methodology or other barred owl management action.

Response: The Service agrees. It has been our intent to complete the removal experiment and analyze the results as soon as possible. In our Preferred Alternative (Section 2.2.3.1 of this Final EIS), we adopted a demographic experimental approach on four areas with substantial pre-treatment data. This provides for a rigorous scientific experiment with results in a relatively short time frame. Once results of this experiment are available, the Service will decide, in collaboration with its partners, on the feasibility and need for proposing long-term management of barred owls. If the Service proposes such management, the proposal would include all necessary NEPA review and public involvement.

Comment: One commenter noted that one advantage of doing the experiment is to gain flexibility in future management before spotted owls decline to a critical level.

Response: The Service agrees. The continued decline of the spotted owl may significantly increase the amount of time, the degree of effort, and the costs necessary to recover the spotted owl if we fail to act in a timely manner. While the Service has not yet identified a "critical level" of population size or distribution, wildlife populations in general respond more rapidly to favorable conditions if starting from a more abundant and well distributed population size than from reduced, more patchily distributed populations. The Service anticipates that responding to the barred owl threat at this time maintains more options for future management and recovery of the northern spotted owl.

Comment: One commenter supported the experiment as long as the removal efforts occur outside of National Parks at this time. They left open future support of removal in National Parks once the results of the study area.

Response: The Service acknowledges the concerns regarding the potential impacts to National Parks, if selected for the proposed experiment. We have analyzed the potential effects in Sections 3.6 and 3.7 of this Final EIS. However, we were reluctant to completely preclude barred owl removal from the National Parks as part of our analysis in the Draft EIS, for three primary reasons. First, we anticipate that establishing removal areas solely outside of the parks, and using parks strictly for experimental controls, would substantially confound the results of the experiment. This effect would be due to the potentially significant differences in habitat between parks and nearby non-park areas. Second, without experimental data acquired from the studies, that includes barred owl removal within the parks, the Service would not have the information needed to ensure long-term decisions on barred owl management would be fully applicable to situations where more pristine habitat conditions are found, and would be forced to make long-term barred owl management recommendations based primarily on conditions occurring in more intensively managed landscapes. Finally, by including both removal and control areas from relatively pristine landscapes, some information could be garnered to address the question of cohabitation in high quality habitat. In the end, for reasons of feasibility and access, the Preferred Alternative does not include any removal within National Parks.