

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 Tye Study Area in Alternative 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.