United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Ecological Services
Yreka Fish and Wildlife Office
1829 South Oregon Street
Yreka, California 96097

In Reply Refer To:
2022-0087135

November 20, 2023

Ms. Rachel Birkey
Forest Supervisor
Shasta-Trinity National Forest
3644 Avtech Parkway
Redding, California 96002

Subject: Transmittal of Biological Opinion and Conclusion of Formal and Informal Consultation for the South Fork Sacramento Safety and Forest Restoration Project, Shasta-Trinity National Forest, California

Dear Ms. Birkey:

This letter responds to your request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the South Fork Sacramento Safety and Forest Restoration Project (project) under section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). You informed us on August 18, 2023, that this project was granted authority to use the U.S. Forest Service's Western Fireshed Emergency Action Determination (Bipartisan Infrastructure Law, Section 40807). As such, it received expedited attention by the Service as a priority project. The project area falls within two high-risk firesheds, the Mount Shasta and Fisher firesheds identified in the Wildfire Crisis Strategy. The emergency actions approved under this project include vegetation and fuel management treatments designed to help address the risks in these firesheds by expediting the reduction of wildfire risk and improvement of forest health and resilience. The project is located on the Shasta-McCloud Management Unit of the Shasta-Trinity National Forest (Forest).

We received your request, dated August 4, 2023, on August 8, 2023. It included the final Biological Assessment (BA). The BA Appendices A-S had been previously received with Draft BA submittals, and were considered final at those times. Additional information to help inform our effects analysis was received from the Forest on August 23 (2023 NSO survey data), and on September 29 and October 4 (common stand exam reports).

The Forest made several determinations for the threatened northern spotted owl (*Strix occidentalis caurina*) and its designated critical habitat (BA pp. 55-58). In addition, the Forest determined the project is not likely to adversely affect the endangered Franklin's bumble bee

(*Bombus franklini*) and gray wolf (*Canis lupus*) (BA pp. 61, 63). Critical habitat has not been designated for Franklin's bumble bee and it is not designated for gray wolf in the action area.

This letter serves two purposes. First, it transmits our final Biological Opinion addressing the effects of the project on the northern spotted owl and its critical habitat, as well as effects to the Franklin's bumble bee. We find the project may affect and is likely to adversely affect these species, and designated critical habitat for the northern spotted owl. We conclude the project will not jeopardize the continued existence of these two species or result in the destruction or adverse modification of northern spotted owl critical habitat. Refer to Enclosure 1. We provided a Draft Biological Opinion to the Forest on September 26, and October 16, 2023. Enclosure 1 includes our standard consultation history.

Second, this letter provides our concurrence with the determination described in the BA for the gray wolf. The rationale for our concurrence is described below. We also include suggested conservation recommendations for the monarch butterfly, a candidate species under the Act.

Gray Wolf

The California Department of Fish and Wildlife (CDFW) is responsible for managing and tracking wolf activity. Established packs exist in Siskiyou (Whaleback Pack), Lassen (Lassen Pack), and Plumas Counties (Beckwourth Pack). At this time, there are no known den or rendezvous sites in the action area (CDFW website for Approximate Area of Wolf Activity).[1] The Whaleback pack's territorial boundary is approximately 40 miles from the project area (BA p. 60) and there are no current areas of wolf activity in or near the action area.

Wolves are habitat generalists and the Service considers the effects to reproducing packs and their pup-rearing activities of most concern. The project includes the use of heavy equipment such as feller-bunchers, skidders, loaders, processors, skyline logging systems, masticators, helicopters and other machinery that will create loud and continuous noise above ambient levels. This type of noise may also occur during road maintenance activities or other project activities using heavy equipment. Piling and burning woody material and brush and underburning and broadcast burning will produce smoke. The size of burn piles and their density in treatment areas, the extent of an area being broadcast-burned in one entry, fuel moisture levels, topography, and weather conditions influence how much smoke is produced and dispersion rates or inversions. Burning could result in smoke that either disperses quickly or heavy concentrations of smoke. The project design features discussed below include seasonal restrictions for noise- and smoke-generating activities and smoke management.

Security habitat is an important consideration when evaluating project effects on wolves. It provides seclusion from human disturbance and motorized roads and trails which can increase the potential for human-wolf interaction. Security habitat is often described in terms of road density because numerous studies show there is a negative correlation between road density and suitable wolf habitat (Thiel 1985, Mech *et al*. 1988, Mladenoff *et al*. 1995, Wydeven *et al*.

[1] CDFW gray wolf information website: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=202875&inline

2001). Road density alone is not an accurate variable for defining security habitat, however; and is actually less significant than traffic volume (e.g., roads themselves will not prevent wolves from inhabiting an area; Merrill 2000). Other studies show wolves may inhabit areas with higher road densities if habitat is adjacent to relatively unroaded areas (Mech 1989, Merrill 2000, Mladenoff *et al*. 2009).

The project area has a relatively high density of roads, averaging 2.6 mi/mi^2 (USDA-FS 2023a p. 5). The project does not include any new permanent road construction and access will mostly be through existing roads on the National Forest Transportation System. Existing unauthorized routes may be used in place of temporary roads and will be decommissioned following use (BA p. 15, Table 5). Unauthorized routes in meadows and other sensitive areas will also be decommissioned (BA pp. 5, 15). Given this, we do not expect any reductions or impacts to security habitat.

Based on our recent communication with CDFW, there are no concerns at this time regarding the project's effects influencing the Whaleback pack (K. Laudon, pers. comm., September 27, 2023). Continued communication with CDFW before and throughout implementation will be important as they continue to track the species movements within the state.

We find the project will have insignificant and discountable effects to the endangered gray wolf based on the following rationale:

- Project Design Features avoid or minimize impacts to reproducing gray wolves and their pups (BA pp. 54-55):
    - The Forest will maintain communication with CDFW regarding the possibility of gray wolf dens or rendezvous sites in the action area. Prior to and throughout each year of planned treatments, Forest or District biologists will contact CDFW to determine if there is confirmed wolf activity in or within one mile of the areas where project activities will occur.
    - If dens or rendezvous sites are known to occur or are discovered within one mile of the project during implementation, the Forest or District biologist will coordinate with CDFW to establish a buffer where work will not occur between the proposed activity and the den or rendezvous site.
    - The project does not include new permanent road construction that would reduce existing security habitat for gray wolves.
- The standard seasonal restrictions for noise- and smoke-generating activities are included (BA pp. 54-55):
    - Vegetation management activities that produce loud and continuous noise above ambient levels will not be implemented within one mile of any detected dens through June 30. A similar seasonal restriction will be implemented for active summer den and/or rendezvous sites through August 31.
    - Smoke-producing activities associated with pile burning or underburning within one mile of dens and rendezvous sites will employ firing techniques that provide good smoke dispersion and ventilation aloft or away from these sites. If the effects of smoke cannot be avoided or minimized to an insignificant or discountable level, the seasonal restrictions above will apply and prescribed

burning will be conducted outside the seasonal restriction period.

- If surveys show the wolf pups have been moved more than one mile from project activities, the seasonal restrictions may be lifted.
- Seasonal restrictions will be implemented unless specific topographic features, terrain or other factors clearly separate disturbance activities from the den or rendezvous site.

Based on the current known locations of established packs in California and implementation of the project design features, we concur with your determination that the project may affect but is not likely to adversely affect the endangered gray wolf. We expect any effects from loud and continuous noise or smoke to be insignificant and discountable to reproducing wolves or pup-rearing activities. Direct effects to reproducing wolves and pups are not expected, given the planned coordination with CDFW and the implementation of seasonal restrictions and disturbance buffers.

Monarch Butterfly

Candidate species under the Act are those for which the 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). On December 17, 2020, the Service published a 12-month finding concluding that listing the monarch butterfly (*Danaus plexippus*) under the Act is warranted but precluded (85 FR 81813; USDI FWS 2020a). This action gives the monarch butterfly candidate status and its listing will be reconsidered in 2024 or later.

The Service completed a Species Status Assessment (SSA) as part of our evaluation (USDI FWS 2020b). While candidate species are not afforded protection under the Act, we encourage their consideration in environmental planning to reduce or avoid adverse impacts. On February 10, 2023, the Service issued conservation recommendations for the western monarch butterfly (USDI FWS 2023). These are discretionary activities an action agency may undertake to avoid and minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species.

The western monarch butterfly breeds and migrates across multiple generations each year throughout the western United States. The action area is located in the Priority Area 2 summer breeding zone, north of the early breeding zone in California where monarchs are likely to breed or lay their eggs on milkweed (*Asclepias spp.*) after departing overwintering groves in mid-winter to early spring each year (Figure 1). Early emerging milkweed species are likely a limiting factor on the landscape in the early breeding zone.

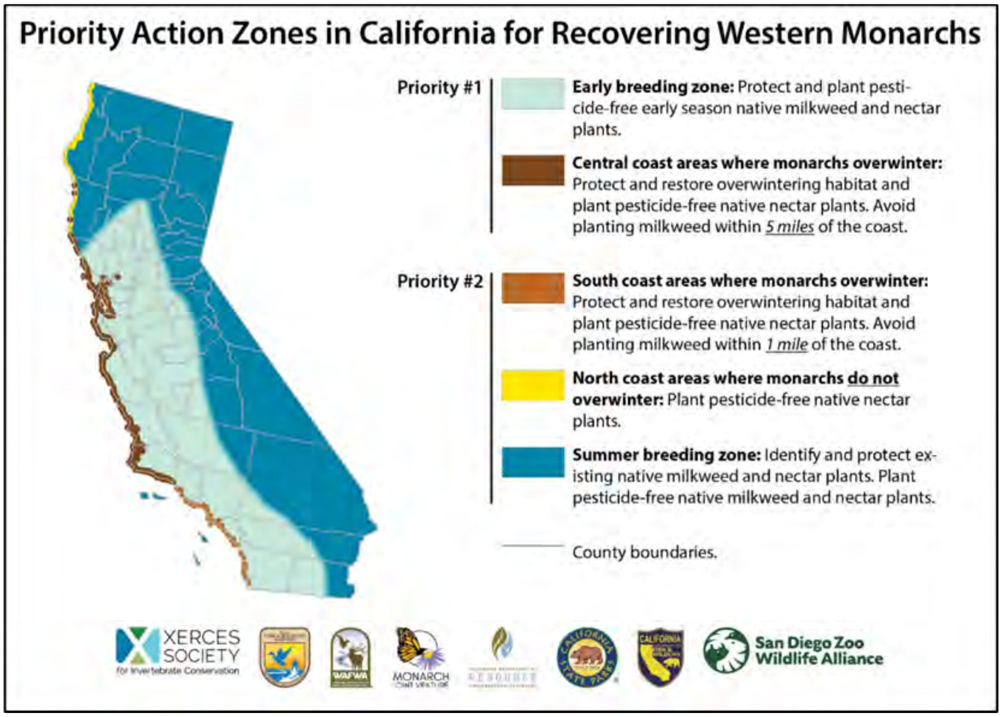

Figure 1. Priority monarch habitat restoration areas in California.

The action area contains showy milkweed (*Asclepias speciosa*) in dry meadows and along Castle Lake road and other roadways (BA p. 61). In addition to milkweed populations, the action area contains abundant wet meadow habitats and other areas that provide floral resources for pollinators (USDA-FS 2023b pp. 6-9).

The use of herbicides is not permitted to control noxious weeds or shrubs across the Forest (BA p. 61). Currently, there are no permitted livestock grazing allotments in the action area that would affect floral resources. Project Design Features for protecting meadow habitats and sensitive plant species, and minimizing the introduction of invasive plant species or noxious weeds, will also minimize impacts to monarch butterflies (Project Draft Environmental Assessment pp. B-17, B-20, B-22).

The Service suggests incorporating the following conservation recommendations to further minimize impacts to monarch butterflies and their habitat:

1. Use only native, insecticide-free plants for restoration and enhancement actions.
2. Enhance and maintain habitat in the Priority 2 zone of California (Figure 1) by identifying and protecting existing habitat and planting milkweed species and flowering plants appropriate for the location. [2]

[2] Western monarch milkweed seed finder website: https://www.xerces.org/milkweed/milkweed-seed-finder

3. Conduct management activities such as mowing or burning in breeding and migratory habitat outside the estimated timeframe when monarchs are likely present (see Figure 2).
4. To minimize the spread of the pathogen *Ophryocystis elektroscirrha*, do not plant non-native tropical milkweed (*Asclepias curassavica*). This pathogen can persist on tropical milkweed and infect monarchs because these plants do not die back in the winter. This pathogen can be lethal to monarchs. Remove tropical milkweed that is detected, and replace it with milkweed and nectar plants appropriate for the location.
5. Report milkweed and monarch observations from all life stages, including breeding butterflies, to the Western Monarch milkweed mapper.[3]

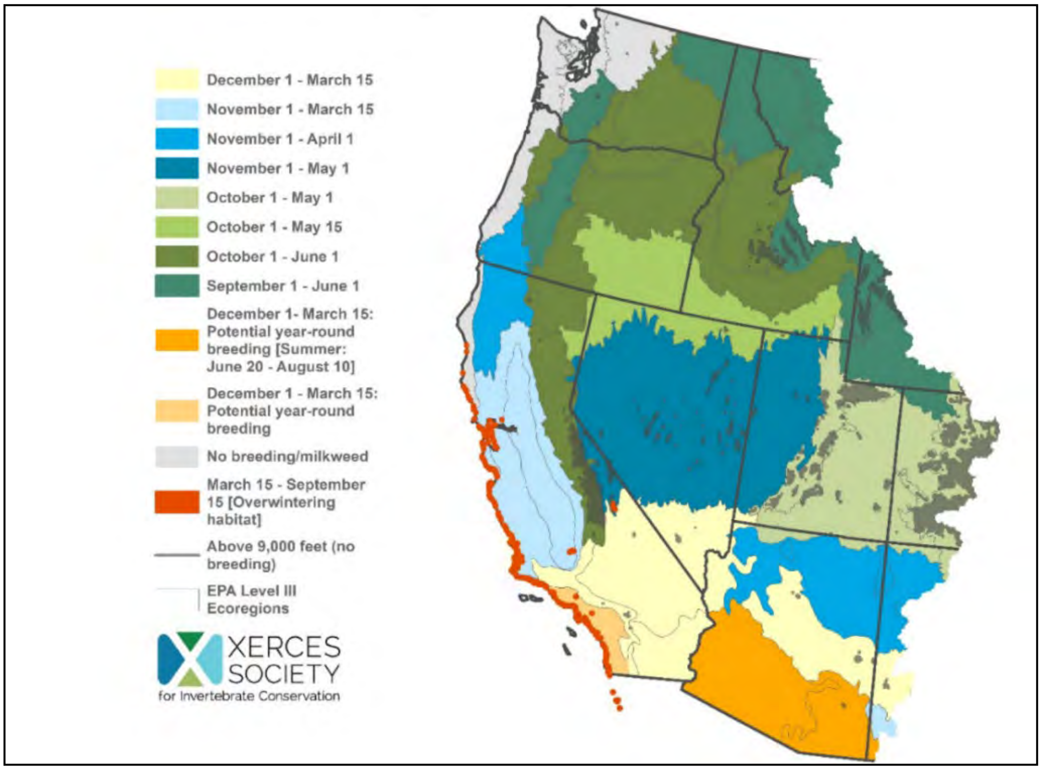

Figure 2. Recommended management timing for western monarch butterflies.

The timeframes in Figure 2 represents approximate recommendations of when to conduct management actions. They are based upon the best available current information and may be updated in the future. Each year and site is different, so when possible, please consider surveying milkweed plants for the early life stages of monarchs prior to burning or mowing.

[3] Western monarch milkweed mapper website: https://www.monarchmilkweedmapper.org/

Conclusion

This concludes informal consultation pursuant to section 7 of the Act for the project's effects on gray wolf. We consider all the Project Design Features included in the BA and referenced herein as part of our rationale for concurrence as conservation measures, as defined under the Act. Conservation measures are integral to and are considered part of the proposed action. We recognize and appreciate the Forest's efforts to minimize or avoid impacts to the candidate monarch butterfly. Implementation of the project design features to reduce or eliminate the introduction of non-native, invasive, or noxious plants or weeds and meadow restoration treatments will help conserve and improve habitat for this species.

This letter also transmits the enclosed Biological Opinion, which concludes formal consultation for the northern spotted owl, its critical habitat, and Franklin's bumble bee. The Biological Opinion also includes our Incidental Take Statement for the northern spotted owl, along with Reasonable and Prudent Measures and Terms and Conditions, and additional Conservation Recommendations.

It will be necessary to contact our office if: 1) the amount or extent of incidental take described in Enclosure 1 is exceeded; 2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation; 3) the action is modified in a manner causing effects to listed species or critical habitat not considered in this consultation; or 4) a new species is listed or critical habitat is designated that may be affected by the action (50 CFR 402.16).

Please contact Christine Jordan at (530) 841-3111 or by email at christine_jordan@fws.gov if you have any questions regarding this response.

Sincerely,

JENNY ERICSON

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Jenny Ericson
Field Supervisor
Yreka Fish and Wildlife Office

Enclosure 1 – Biological Opinion for the South Fork Sacramento Safety and Forest Restoration Project

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Biological Opinion

South Fork Sacramento Public Safety and Forest Restoration Project

2022-0087135-S7-001

Shasta-Trinity National Forest, California

Agency:
U.S. Fish and Wildlife Service
Region 8
Sacramento, CA

Biological Opinion Written by:
Yreka Fish and Wildlife Office

U.S. Fish and Wildlife Service
Region 8, Pacific Southwest Region

November 20, 2023

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Jenny Ericson, Project Leader

Yreka Fish and Wildlife Office

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BIOLOGICAL OPINION

INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) based on our review of the South Fork Sacramento Public Safety and Forest Restoration Project. Specifically, this BO addresses the effects to the threatened northern spotted owl (*Strix occidentalis caurina*) and its designated critical habitat and the endangered Franklin's bumble bee (*Bombus franklini*) in accordance with Section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

We received the consultation request letter and final biological assessment (BA) on August 8, 2023 (USDA-FS 2023a). The letter describes the BA and request for consultation are based on alternative 4 (project). The Shasta-Trinity National Forest (Forest) determined the project *may affect, and is likely to adversely affect* the northern spotted owl and its designated critical habitat. The Forest also determined the project *may affect, and is not likely to adversely affect* Franklin's bumble bee. Based on the analyses presented in the BA, its appendices, and additional data received through August 23, 2023, and our own review and independent analysis, the Service finds the project *may affect, and is likely to adversely affect* the northern spotted owl, its critical habitat, and Franklin's bumble bee. The Service also concludes the project is not likely to jeopardize the continued existence of either species or result in the destruction or adverse modification of designated northern spotted owl critical habitat.

This BO is based on information from the BA and the Forest's Draft Environmental Assessment (Draft EA), also made available to the Service on August 8, 2023 (USDA-FS 2023b). Service biologists have reviewed several draft specialist reports from the online project website to inform our understanding of the action area environmental baseline, and completed numerous field reviews on our own. The consultation history section below summarizes the standard consultation process for the project.

To align with the rangewide landscape-based framework Federal agencies use to manage the northern spotted owl on Federal lands, this BO routinely references the following key documents.

- The 2011 Revised Recovery Plan (Recovery Plan) for the northern spotted owl became effective on July 1, 2011 (76 FR 38575-38576; Service 2011). The Recovery Plan describes management concerns and threats to the species (e.g., the northern barred owl [*Strix varia varia*] and wildfire), which were not identified in previous recovery plans. It outlines specific recovery actions for conserving and recovering the northern spotted owl and its habitat. Those most pertinent recovery actions on lands actively managed by the Forest Service and other Federal Agencies are Recovery Actions 10 and 32.
- The 2012 Revised Designation of Critical Habitat for the northern spotted owl was published in the Federal Register on December 4, 2012, and became effective on January 3, 2013 (77 FR 71876-72068; Service 2012). The 2012 final rule describes the conservation role of and delineates critical habitat, identifies the rationale for the

designation, identifies the attributes (physical and biological features) of critical habitat, and identifies how effects to critical habitat can be determined. While critical habitat was revised in November 2021, the designations of units and subunits in California did not change. In addition, the described function of each subunit from the 2012 final rule did not change (USDI FWS 2021, 2012).

- Information contained in the Record of Decision for Amendments to Forest Service and Bureau of Land Management (BLM) planning documents within the Range of the Northern Spotted Owl (USDA-FS and USDI BLM 1994). Also known as the Northwest Forest Plan (NFWP).
- A Rangewide Baseline Summary and Evaluation of Data Collected through Section 7 Consultation for the northern spotted owl and its Critical Habitat: from 2006 to September 25, 2023 (USDI FWS 2023).
- The 2018 Species Status Assessment for Franklin's bumble bee (USDI FWS 2018)
- The 2021 Listing Decision and Final Rule for Franklin's bumble bee (USDI FWS 2021).

CONSULTATION HISTORY

This section summarizes the consultation process for the project as well as recommendations the Yreka Fish and Wildlife Office (YFWO) provided to the Forest to minimize or avoid adverse effects and conserve listed species and their habitats.

March 3, 2021: Two YWFO biologists attended the first public meeting for the project (virtual). Forest staff provided an overview for improving public safety and reducing fire risk in the watershed.

April 30, 2021: We received an email from the Forest sent to various local individuals, non-profit groups, and state agencies. It described the plan to create a collaborative group for how public lands are managed. The email included several meeting dates, the first being June 9, 2021.

May 3, 2021: We emailed the Forest we would attend the June 9, 2021, collaborative meeting. We asked if separate meetings and field trips could be set up for consultation purposes. We expressed concern regarding potential impacts to NSO, and depending on elevation and scope, shared there could be effects to the 'proposed threatened' whitebark pine.

June 9 and August 12, 2021: YFWO biologists attended two collaborative meetings and provided recommendations to reduce and avoid impacts to NSO. These included avoiding treatments in high value NSO cores, limiting treatments in specific areas of home ranges, and recommending large snag retention during underburning.

May 26, 2022: Two YWFO biologists attended a virtual public meeting and informed the Forest we were preparing scoping comments. The majority of our concerns remained focused on the proposed treatments in NSO habitat, known sites and territories, and riparian corridors. Our response to the scoping request included prior recommendations from August 12, 2021.

June 23, 2022: The Forest wildlife biologist informed us via telephone that the Forest was developing alternatives to the proposed action. This included working with Ray Davis from the Northwest Forest Plan (NWFP) monitoring group regarding treatments in NSO habitat.

July 21, 2022: Two YWFO biologists attended a virtual meeting with the interdisciplinary team and Ray Davis. The focus of this meeting was for Davis to present information from the NWFP monitoring group on historic vegetation and fire regimes, current vegetation types in the action area, and fire refugia.

August 1, 2022: We received an e-mail from the Forest regarding next steps. We responded the same day, describing our interest to meet with the project interdisciplinary team regarding potential site-specific treatment modifications and options in important NSO sites and habitat. We suggested meeting in person to review maps and data, or in the field with a focus to those areas. We received a response the same day, indicating the interdisciplinary team had developed alternative 4 in response to scoping comments.

August 4, 2022: We received an email from the Forest informing us the interdisciplinary team is working on the NSO home range and fire refugia prescriptions based on work Ray Davis and the project fuels specialist and wildlife biologist have done. It described the need for some level of treatment in these areas.

August 9, 2022: Two YWFO biologists met with the interdisciplinary team and Ray Davis regarding alternative 4. Davis discussed the concept of fire refugia. Data was shared electronically, including maps and fire behavior modeling. The team described that thinning and/or prescribed fire is proposed in all locations. We asked about the NSO detections from 1986-2022 and described the importance of the two long-term occupied Scott and Soapstone territories to the local population. We asked what considerations were being given in terms of treatment placement and no-treatment areas. We summarized the recommendations for recovery actions 10 and 32 from the Recovery Plan and recommended using NSO detection data and habitat value to delineate non-circular core and home range areas to help define areas for no treatment. We asked about the owl habitat typing and field validation and if we could receive a habitat map for the action area. We recommended the Forest consider not treating in core use areas and higher value habitat and consideration of a narrower fuel management zone in key areas. Based on the information presented and discussed in this meeting, we informed the team the project and alternative 4 would likely have adverse effects and take of NSO.

August 23, 2022: The project biologist called to ask if we could provide recommendations for treatments in NSO foraging habitat. We sent recommendations this same day.

October 4, 2022: Two YWFO biologists attended a virtual meeting with the interdisciplinary team where they shared refinements for the project's alternatives. This included a discussion of fire refugia locations, various treatments in portions of the NSO cores and home ranges, and a revision to a new trail location for part of the Scott home range. Based on the scope and magnitude of treatments and locations, we informed the team that alternative 4 was still likely to result in adverse effects and take.

December 8, 2022: Monthly Level 1 meeting with the Forest which included a briefing and overview of the project initiation form and early draft Biological Assessment.

April 11 through July 31, 2023: The Forest submitted a BA on April 11, requesting review. We responded on April 27 with comments and questions and met via TEAMS on May 11 to discuss. Another BA was received on June 5 and we responded with additional questions on June 9. On June 11 and 12, the Forest sent us summaries of the stand exam data for the Deer Late-Successional Reserve, Castle Lake Managed Late-Successional Area, and fire refugia areas. On June 28, we received a revised BA and additional BA appendices. We provided comments and additional questions (with some repeated clarification questions from prior reviews) on July 11. We received a revised BA on July 21.

July 25, 2023: Three YFWO biologists attended a field visit with Forest staff including project wildlife biologists, the silviculturist and fuels specialist, and the District Ranger. We made four field stops. We discussed forest stand conditions and the proposed understory treatments (e.g., thinning <10" dbh trees and underburning) in the current Scott and Soapstone NSO cores. The fuels specialist provided clarification regarding a portion of the fuels modeling presented in BA Figure 12. We discussed the potential composition of NSO prey in the two NSO home ranges. Forest staff indicated the creation of forest edge habitat would increase NSO access to prey in meadows and they mentioned a lack of visible woodrat middens in the Scott core. We reviewed an area of the proposed fuel management zone treatment where NSO habitat would be removed. We also reviewed a small meadow in the Soapstone core to determine if there were floral resources for Franklin's bumble bee.

July 28, 2023: During a Level 2 meeting with the Forest Supervisor, the YFWO office learned the Forest requested approval from their Headquarters office in Washington D.C. for emergency action status for the project, referred to as an emergency action determination (EAD). At this meeting, we also learned the Forest was targeting September 30, 2023, to sign a Decision Notice for the project.

July 31, 2023: We emailed the Forest indicating the BA received on July 21, 2023, was considered sufficient. We also informed the Forest at this time we did not agree with the determinations in the BA and that we could schedule a meeting in the next month to discuss draft reasonable and prudent measures and terms and conditions for the NSO.

August 8, 2023: We received the final BA dated August 1, 2023, along with the consultation request letter. Three YFWO biologists met with four wildlife biologists from the Shasta-McCloud Management Unit this same day to visit the Fawn Creek and Gumboot meadows in the project area. This field review was to determine if there are substantial floral resources for Franklin's bumble bee. The Unit biologists demonstrated their survey and inventory methods for pollinators, following the Xerces Society Survey Protocol. We provided technical guidance for conducting habitat surveys to identify floral resources the bee relies on during their active flight period. We collectively determined that both meadow areas contain the diversity of floral resources sufficient for sustaining a colony during the active flight period. We also discussed how pollinator surveys cannot rule out the presence of the species, due to low detection probability, but also how surveys are helpful for learning the bumble bee species composition in the meadows. We recommended surveys continue prior to the meadow restoration treatments.

August 10, 2023: At the monthly Level 1 meeting, we asked if another field review with the Forest was feasible in the next two weeks. On August 14, we received a response indicating they were not available for another field review and asking us to reach out if further clarification was needed regarding information provided by the Unit biologists on August 8 about NSO detection locations in 2023. The YFWO Project Leader and Acting Deputy Project Leader also spoke with the District Ranger regarding the Forest's request for approval of the EAD.

August 11, 2023: The YFWO Project Leader and Acting Deputy Project Leader spoke again with the District Ranger and Forest Supervisor regarding the EAD timeline and the Forest's request to see a draft Biological Opinion before September 30, so the Forest could sign their decision document by that time. We targeted the date of September 26 to share a draft.

August 14,2023: To help inform our analysis in the draft Biological Opinion and environmental baseline for owl sites, we asked if there was a 2023 NSO survey update for the project that could be shared.

August 15, 2023: The YFWO Forest Resources Branch manager emailed the District Ranger requesting additional field trips to inform our analysis in the draft Biological Opinion. We received a response the same day indicating the Forest could not commit staff for field reviews at this time given the timeline for the Draft EA comment review and analysis.

August 18, 2023: The District Ranger notified the YFWO Project Leader by email that the EAD had been approved by the Forest Service's headquarters office in Washington, D.C.

August 23, 2023: The project biologist e-mailed us the 2023 NSO survey results.

September 11, 2023: The YFWO Project Leader shared the reasonable and prudent measures and terms and conditions with the Forest.

September 19 through September 29, 2023: Collaboration occurred between the District Ranger and the YFWO Project Leader to further refine the terms and conditions and conservation recommendations.

September 26 through October 13, 2023: YFWO shared the draft BO with the Forest on September 26. During this timeframe we discussed the refinement of habitat typing for the action area and reviewed and agreed on specific areas where the 2020 smoke management guidance could be used for burning hand piles and underburning between February 1 and July 9.

October 16 through November 17, 2023: YFWO shared a revised draft BO with the Forest on October 16. During this period, we discussed specific nuances regarding the 2019 Take Avoidance Guidance on private lands and our approach for analyzing effects in foraging and dispersal habitat. We also further refined the terms and conditions and conservation recommendations with the Forest. Despite minor variations in the analysis, our discussions with the Forest between September 11 and November 17 led to an improved understanding of the project while working to minimize the short- and long-term adverse impacts to the northern spotted owl.

The project files for this consultation can be made available, upon request, by contacting the YFWO in Yreka, California (see the transmittal cover letter for contact information).

1. Description of the Proposed Action

1.1. Location of Proposed Action

For purposes of this BO, the proposed action is the Forest's preferred alternative (Alternative 4; project) as described in the Draft EA (USDA-FS 2023b). The project area is located above Lake Siskiyou, approximately three miles west of Mount Shasta City, California, which includes the land along the Castle Lake Road, South Fork Sacramento Road (Forest Route 26), and southwest to Gumboot Lake. Watersheds overlapping portions of the project area include Wagon Creek and Sacramento River. A small amount of the Deer Late Successional Reserve (LSR) intersects the project area (49 acres). The project area also includes the entirety of the Castle Crags Managed Late Successional Area (MLSA; 1,910 acres) (Draft EA p. 65; BA-Appendix B).

The legal location for the project is: Township 40 North, Range 6 West, Sections 12-14, 23-26, 36; Township 39 North, Range 5 West, Sections 7-34; Township 39 North, Range 4 West, Sections 7, 8, 18, 19; Township 38 North, Range 5 West, Section 4 Mount Diablo. Elevations range from about 3,200 feet below Lake Siskiyou to 9,025 feet near Mount Eddy.

The project area is entirely within the 2012 East Cascades (ECS) Designated Critical Habitat Unit 8, subunit ECS-3 (East Cascades South) (50 CFR Part 17 Vol. 77 No. 233 pp. 719333, 71935; USDI FWS 2012).

1.2. Proposed Action

This description of the project is based on information from the Draft EA for alternative 4. The project will treat approximately 16,285 acres (USDA-FS 2023b p. 2). As described in the Draft EA, there is a need for treatment to improve public safety in the event of a wildfire, improve fire resilience of forests, and improve recreational opportunities (USDA-FS 2023b p. 6).

The Draft EA (pp. 6-8) states the project would improve public safety by:

1) Providing safer routes for forest visitors to exit and suppression personnel to enter the project area;
2) Creating strategic firebreaks in the form of fuel management zones (FMZs); and
3) Enhancing usability of roads and ridges for wildland fire management.

The Draft EA (pp. 6-8) states the project would improve fire resilience of forests by:

1) Reducing tree density and ladder fuels, and restoring a more resilient condition;
2) Reestablishing meadows to their historic footprint and function; and
3) Reducing surface fuels in key areas.

The Draft EA (p. 7) states the project would improve recreational opportunities by:

1) Developing new and expanding existing campgrounds while reducing resource damage from dispersed camping;
2) Redesigning day use areas within an emphasis on public safety; and
3) Construct new non-motorized multiuse trails and decommission old trailheads.

The BA describes the following project objectives (BA p. 4-Table 1):

1) Public Safety:
    a. Establishing Fuel Management Zones (FMZs) will provide defensible space and safe ingress/egress for the public and emergency personnel.
2) Fire Resilience:
    a. Restoring key landscapes so they are more fire-resilient including oak-conifer woodlands, meadows, and timber plantations.
    b. Restoring and maintaining NSO habitat inside known territories.
    c. Improving fire resilience outside known territories to protect NSO habitat.
    d. Conserving high value NSO habitat.
    e. Implementing prescribed fire and pre-treatment across the project area.

Proposed project objectives and related treatments are summarized in Table 1 below.

Table 1. Alternative 4 Treatments for the South Fork Sacramento Project.

Project Objective	Treatment Type	Acres
Public safety	Fuel Management Zone (FMZ) creation	6,473
Restoration and diversity	Restoration and fuels reduction	1,496
Fire resilience and habitat	Thin and fuels reduction	2,100
Habitat maintenance and restoration	Habitat thin and fuels reduction	3,140
Conservation of high value habitat	Understory thin and fuels reduction (fire resilience)	1,304
Fire resilience and restoration	Prescribed fire (fire resilience)	14,172 (acres overlap some treatments above)

Per the BA, the project includes the following activities:

1. Silviculture treatments by thinning trees to reduce stand density and burning treatments to reduce surface fuels to increase wildlife habitat and public safety.
2. Port Orford cedar (POC) treatments wherever POC trees occur or root disease is detected along waterways and road crossings.
3. Meadow restoration by reducing conifer encroachment, constructing beaver dam analogs, removing unauthorized roads, and restoring road closure features (e.g., strategic boulder placement or other methods to prohibit access).
4. Fuels reduction by removing fuels and prescribed burning.
5. Creation of new recreational non-motorized trails and trailheads.
6. Campground improvements by expanding and upgrading existing campgrounds and related parking areas.
7. Hazard tree removal wherever they are located.

The project activities are described in the BA (p. 4-Table 1) and Draft EA (pp. 7-9). The project treatments are summarized in Table 1 above.

The project will use existing landings as much as possible (BA p. 14, Table 5). The BA also describes constructing potential new landings if needed. All new landings will be approximately one acre in size and will not be created in NSO nesting, roosting, or foraging habitat as feasible (BA p. 53). If new landings are needed in NSO habitat, all green trees >24" dbh will be retained in these areas as safely feasible (BA pp. 14, 53, Table 5).

Permanent new road construction is not proposed. Access will mostly be accomplished by use of existing roads on the National Forest Transportation System. Existing unauthorized routes may be used in place of temporary roads and will be decommissioned following use (BA p. 15, Table 5). All of these roads will be left in a hydrologically stable condition with entrances blocked after project completion. The project will also decommission unauthorized routes in meadows and other sensitive areas (BA pp. 5, 15). No new or existing temporary roads are proposed in stream courses, geologically sensitive or unstable areas in riparian reserves, or meadows.

Project implementation is expected to begin in 2023. The estimated timeframe to complete all project activities is approximately 30 years (BA p. 6). Silviculture activities are expected to be completed within approximately three to five years. Fuel treatment activities are expected to be completed within one to three years after completion of silvicultural activities with additional burning every five to ten years, depending on site quality and vegetation type (BA pp. 6, 15, Table 5).

1.2.1. Silvicultural Habitat Thinning Treatment

This treatment will occur on 8,022 acres. Timber harvest and thinning is proposed in unmanaged or minimally managed natural stands. Most of the stands will be treated with either mechanical equipment or, in some cases, skyline yarding, cable assist tethering or helicopter (BA p. 15, Table 5). This treatment description does not include the fuel management zone treatment.

Due to their high-density levels, these stands are at risk of stand-replacing fire, insect infestation, and disease outbreak (BA p. 28). Thinning over-stocked stands is expected to reduce competition between trees, thereby reducing stress on large mature trees, increasing growth and vigor of mid-successional trees, and reducing or removing ladder fuels beneath and around residual large conifer and hardwood trees. Thinning the canopy and understory is intended to benefit habitat while retaining the largest dominant trees and removing ladder fuels under these overstory trees (BA p. 31). Throughout the project, large snags and 5-10 tons per acre of coarse woody debris (CWD) will be maintained where it currently exists. Snags felled for safety reasons will be retained on site to provide additional CWD (BA p. 31).

Certain stands have been identified as fire refugia due to their historic resilience to wildfire. These stands have similar characteristics to NSO nesting/roosting habitat because they contain higher tree and snag densities, and downed wood (BA pp. 12, 28, 31). Silvicultural treatments are expected to accelerate the growth and development of both NSO habitat and fire refugia (BA p. 5) due to the following actions:

- Inside NSO territories (composed of core areas and home ranges), some treatments in nesting, roosting, and foraging (NRF) habitat will include understory thinning of small trees (<10” dbh) to a 35-foot by 35-foot spacing between trees (BA p. 18, Table 7). Specifically, this treatment will occur inside three NSO core areas and parts of their home ranges (BA pp**.** 47-48, Table 15b, 15c). These treatments are intended to maintain NRF habitat and fire refugia in the territories (BA pp. 13, 18, Figure 4, Table 7, Appendix D).
- Other thinning treatments in NRF habitat in NSO cores and home ranges will focus on reducing fuels across different vegetation layers to reduce the likelihood of crown fire outbreaks (BA p. 30). Basal areas will range between 140-200 ft^2/ac in mixed conifer stands and between 160-200 ft^2/ac in true fir stands (BA pp. 18, 31, Table 7).
- Outside NSO cores and home ranges, mixed conifer stands will be treated to a range of 80-120 ft^2/ac and true fir stands will be treated to a range of 120-160 ft^2/ac (BA p. 31) and <10” dbh trees will also be thinned on a 35-foot spacing.
- Treatments in dispersal habitat will focus on reducing fuels across different vegetation layers to reduce the likelihood of crown fire outbreaks while striving for a stand average less than 11 inches dbh and basal area between 60-100 ft^2/ac (BA pp. 31-32).
- The project design includes specific treatment prescriptions and species retention preference for the following four stand types: mixed conifer, dispersal habitat, true fir dominated, and oak-conifer woodlands (BA p. 19).
- All silvicultural activities are expected to be completed within 10 years (BA p. 6). These treatments are typically completed with mechanical equipment that produces noise above ambient levels. The BA includes a fuller description including equipment use and season of work (BA pp. 5, 31-33).

1.2.2. Prescribed Fire and Mechanical Fuels Treatment

This treatment will occur on 14,172 acres, which overlaps with some of the other treatment types in the project area (BA p. 33, Table 5). Collectively, prescribed fire and broadcast burning will be used in all or most of an area with well-defined boundaries (approximately 66 percent of the project area; BA pp. 14-15, Table 5).

Pre-treatment in certain units will focus on removing small trees (<10” dbh) and shrubs that could act as surface and ladder fuels to transfer fire from the ground into overstory tree canopies. These fuels sources will be hand cut, piled, and pile burned prior to underburning treatments for a future date when conditions are favorable (BA pp. 5, 14, Table 5). Burn plan prescriptions may allow fire to spread from piles at low intensity to restore fire as a natural disturbance and consume additional surface fuels (BA p. 33). Throughout the project area, burning techniques will strive for a lower intensity fire to protect dominant trees and preserve CWD (BA p. 15, Table 5). The BA includes a fuller description including equipment use and season of work (BA pp. 5, 32-34).

1.2.3. Fuel Management Zone Treatment

This treatment will occur on 6,473 acres (approximately 30 percent of the project area; BA p. 15, Table 5). Fuel management zones (FMZs) will be established along roads and ridgelines across the project area in all burn severity levels to serve as strategic control features during future wildfires or underburning operations associated with the project. The FMZs will range in size and width along either side of the road depending on needs, terrain, and logical boundaries (BA p. 15).

Treatments to create FMZs consists of thinning forest stands and conifer trees ≥10” dbh to basal areas ranging from 60-80 ft^2/ac. Treatments will remove and reduce live trees, snags, downed wood, shrubs, and brush (BA p. 35). Green trees will be thinned so their crowns are not overlapping with the largest and healthiest trees retained. FMZs include understory thinning of smaller trees (<10” dbh) to a 35-foot by 35-foot spacing (BA p. 34). Surface fuels in the FMZs will be treated via a combination of mastication, chipping or piling, and pile burning and will be maintained as needed to retain the treatment’s effectiveness (BA p. 15). Underburning is also proposed. The FMZs will result in the creation of diffuse forest edge habitat (BA pp. 36-37). The BA includes a fuller description including equipment use and season of work (BA pp. 15, 34-27).

1.2.4. Port Orford Cedar Treatment

This treatment will occur on 90 acres. Host trees will be removed where the disease is detected, including in riparian areas (BA pp. 18, 38, Table 6). In areas where roads cross streams, Port Orford cedar trees will be removed or girdled 50 feet on either side of the stream up to 100 feet downstream (BA p. 38). The BA includes a fuller description including equipment use and season of work (BA pp. 5, 38).

1.2.5. Fire Resilience Treatment

This treatment will occur on 592 acres. Generally, this group of treatments involves thinning and reducing fuels in meadows, oak-conifer woodlands, plantations, and the Fawn Creek Basin Fuels unit to restore diversity and moderate fire behavior. The BA states plantations currently do not support NSO habitat due to their young age, small diameter trees and high tree densities that impede flight (p. 38). Mechanical and hand thinning methods may be used to treat plantations (592 acres), oak-conifer woodlands (83 acres), and meadows (164 acres) (BA pp. 14-16, 38-39).

Meadow restoration treatments will remove all conifers >3” dbh with the exception of large remnant trees. Where applicable, beaver dam analogs (BDAs) will be installed at key areas to restore riparian function using local natural source materials such as wood, rocks, or mud (BA p. 39). The BA includes a fuller description including equipment use and season of work (BA pp. 5, 38).

1.2.6. Recreation Improvement and Expanded Camping Opportunities

These actions include several separate treatments, summarized below:

- New trail construction will result in the creation of 47.4 miles of new non-motorized trails (BA p. 39, Appendix B, C).
- New trailheads in FMZs will be placed in areas that have been cleared or treated (BA p. 40). No specific acreage for these trailhead impacts is provided in the BA, but as the FMZ treatment is not located in meadow areas, and will remove NSO habitat, the effects

of new trailhead construction and development are considered irrelevant to habitat impacts.

- New campground construction will occur on 55.5 acres. This includes Rainbow Mill (45 acres), Old Nordic Center (10 acres), and Castle Lake (0.5 acre) (BA p. 17, 40, Appendix E and F) in addition to establishing designated camping sites at Gumboot Lake (BA-Appendix B).
- Expansion of existing campgrounds will occur on three acres at the Methodist Camp (BA p. 40).
- Dispersed camping areas that have been damaged over the years will be repaired (20 acres). Repair techniques include boulder placement to block access and revegetation (BA p. 17).

Hazard tree abatement will occur at intermittent locations, primarily along roads and in proximity to recreation areas. Hazard trees along ingress/egress roads and log haul routes (dead or dying trees that pose a hazard to firefighter and public safety) will be evaluated to ensure safe travel. Selected trees may be removed through commercial logging or felled and left on site as CWD, depending on site-specific prescriptions, land allocation, operational ability, and fuel reduction needs (BA p. 14, Table 5).

1.3. Conservation Measures and Project Design Features

When used in the context of the Act, "conservation measures" represent actions pledged in the description of a proposed action that will be implemented to further the recovery of a species (USDI FWS and USDC NMFS 1998). The project's thinning prescriptions for NSO habitat and the project design features (PDFs) to protect NSO and Franklin's bumble bee are considered conservation measures integral to the proposed action.

1.3.1. Project Conservation Measures

As described in the BA, conservation measures for the project consist of retaining unthinned patches in LSR stands and in high quality NSO NRF habitat (BA p. 53). Where thinning will occur in NRF habitat, basal area and canopy cover will be retained consistent with levels that maintain NRF habitat function (BA p. 51, Figure 10, 11). The conservation measures also include PDFs which consist of standard seasonal restrictions to reduce noise and smoke disturbance to NSOs; limiting NSO habitat modification during the critical breeding and nesting season, and retaining large logs and snags (BA pp. 23-24, 32, 37, 40, 51-52, Table 9).

Direction from the Forest's Land and Resource Management Plan emphasizes managing threatened and endangered species under existing recovery goals identified in individual species recovery plans (USDA-FS 1995 p. 3-28). In addition, Forest Plan standards and guidelines describe maintaining or enhancing habitat for threatened and endangered species consistent with individual species recovery plans (USDA-FS 1995 pp. 4-30). The conservation measures for NSO and their habitat are as follows:

Conservation Measure 1 (CM-1): Nesting/Roosting Habitat Maintenance (BA p. 53).

- Where nesting/roosting habitat is thinned in areas assigned the "foraging habitat" thinning prescription (BA Table 7, Appendix D), these stands or patches of nesting/roosting habitat will be marked to retain higher basal areas ranges in mixed conifer (140-200 ft^2/ac) or true fir stands (160-200 ft^2/ac). Basal area ranges in nesting/roosting habitat would be at least 150-200, if not higher. Identification of these habitat areas will be done by wildlife specialists, prior to marking. Per the BA, this is expected to occur mainly in the LSR and MLSA land allocations, as well as NSO home ranges where these treatments occur.
- Any temporary roads and new landings will be created outside of nesting/roosting habitat as feasible. If there is a need to construct new temporary roads in nesting/roosting habitat, removing trees >24" dbh will be avoided where possible. If new landings are needed in this same habitat, trees >24" dbh will be retained if they do not preclude safe use of the landing site.

Conservation Measure 2 (CM-2): Coarse Woody Debris Retention (BA p. 52).

- Where available in the LSR and MLSA land allocations and where it will not cause a safety hazard, the largest logs available will be prioritized for retention, particularly those in advanced states of decay (decay class 3-5). Retention will range from 6-10 logs per acre in mixed conifer stands, depending on aspect, and 8 logs per acre in white fir stands.
- Outside the LSR and MLSA land allocations, CWD and logs will be retained at a rate of 5-10 tons per acre, with a preference for those at least 20" in diameter and 10 feet long, or the largest size class available.

Conservation Measure 3 (CM-3): Snag Retention (BA p. 52).

- Where available in the LSR and MLSA allocations and where it will not cause a safety hazard, the largest snags available will be prioritized for retention. Snags felled for safety reasons will be retained to provide CWD. Snags with deformities such as cavities, basal hollows, cat faces, or broken or forked tops will be prioritized for retention.
- Outside the LSR and MLSA allocations, an average 1.5 snags per acre that are at least 15" in diameter will be retained.

Conservation Measure 4 (CM-4): Standard Seasonal Restrictions for NSO (BA p. 51).

To avoid or minimize disturbance or harm to nesting NSOs and their young during the critical breeding and nesting season, the Forest is including the standard seasonal restrictions for noise-generating activities and habitat modification:

- No activities that modify NRF habitat will occur between February 1 and September 15 within 0.5-mile of an active nest or in unsurveyed NRF habitat presumed occupied by nesting NSOs. This includes all vegetation management activities that maintain, degrade, downgrade, or remove NRF habitat such as thinning, installing larger fire control lines, or implementation of prescribed fire.
- No activities that create loud and continuous noise for two or more hours above ambient

levels will occur between February 1 and July 9 within 0.25-mile of an active nest or within 0.25 mile of unsurveyed NRF habitat presumed occupied by nesting NSOs. After July 9, nearby loud or continuous noise above ambient levels is not expected to disturb nesting adults to the point where they would stop incubating, feeding or caring for nestlings.

- Considerations of habitat patch size, continuity, and location are all important in determining if NRF habitat may be occupied.
- If surveys to protocol (or surveys using methods agreed upon with the Service) show no nesting activity within the above-specified distances, the seasonal restrictions may be lifted.

Conservation Measure 5 (CM-5): Smoke-producing Activities and Disturbance (BA pp. 51-52).

To avoid or minimize disturbance or harm to nesting NSOs and their young during the critical breeding season, the Forest is including the standard seasonal restrictions for smoke:

- No activities that produce smoke will occur between February 1 and July 9 within 0.25-mile of an active nest or within 0.25 mile of unsurveyed NRF habitat presumed occupied by nesting owls.
- Considerations of habitat patch size, continuity, and location are all important in determining if NRF habitat may be occupied.
- The exception for this project and the above seasonal restriction is as follows:
    - The smoke management guidance developed by the Forest and Service in 2020 may be utilized in specific areas between February 1 and July 9 within 0.25 mile of unsurveyed NRF habitat in order to burn hand piles or conduct strategic underburning in areas not likely to impact nesting NSOs and their young, as discussed and agreed to by the two agencies. These specific areas are considered a reasonable distance from NRF habitat that may be occupied, as well as long-term activity centers and nesting sites. See Appendix C of this BO for a map of the specific areas.
    - During smoke-producing activities in these specific areas, the Forest will employ firing techniques that provide good smoke dispersion and ventilation aloft or away from the unsurveyed NRF habitat.
    - If the effects of smoke cannot be avoided or minimized to a discountable level, no smoke-producing activities will occur between February 1 and July 9.
- If surveys demonstrate NSO are not nesting that year, the seasonal restriction for smoke-generating activities may be lifted.

The conservation measures that minimize or avoid impacts to Franklin's bumble bee and its habitat are as follows:

Conservation Measure 6 (CM-6): Meadow Soil Damage (BA p. 53).

- The Forest will minimize disturbance to soils in meadows. Ground-based mechanical operations will only operate in snow deeper than 12” or over 6” of frozen ground, under dry soil conditions, or away from equipment exclusion zones containing standing water or saturated soils.

Conservation Measure 7 (CM-7): Avoiding Spreading Noxious Weeds (BA p. 54).

- The Forest will avoid the spread of noxious weeds in the project area by cleaning equipment, avoiding staging equipment in infested areas, using weed-free materials, and conducting monitoring for infestations throughout the project area.

Conservation Measure 8 (CM-8): Bumble Bee Habitat Surveys (BA p. 54).

- The Forest will minimize or avoid damage in meadows containing bumble bee habitat characterized by substantial floral resources. This will be done as follows:
    - Determine the level and quality of floral resources in the project area.
    - Perform annual surveys for Franklin’s bumble bee in meadows containing floral resources prior to prescribed burning or heavy equipment operations.
    - Limit prescribed burning to no more than 1/3 of meadows in the project area during the calendar year.

1.3.2. Conservation Measure Summary

In the context of this BO, conservation measures may minimize the adverse effects of the proposed action in terms of limiting disturbance to nesting NSOs or their young during the critical breeding and nesting season; or to substantial floral resources, nesting, and overwintering habitat of Franklin’s bumble bee during the active flight period. They may also limit or minimize effects to NSO nesting, roosting, foraging, or dispersal habitats or in suspected high use areas. Despite the conservation measures, there may still be adverse impacts to NSOs, their habitat, and Franklin’s bumble bee or its habitat. Our findings for the effects of the action are based upon the project treatment descriptions as described in the BA and Draft EA, in combination with the conservation measures described above.

2. Purpose and Organization of this Biological Opinion

Because the Forest determined its proposed action “*may affect, and is likely to adversely affect*” the NSO and its critical habitat, it requested formal consultation with the Service. As described in chapter 1, we have also determined the project may affect, and is likely to adversely affect, Franklin’s bumble bee. For formal consultation, we issue a BO that evaluates the consequences of a proposed action and determine whether it is likely to jeopardize the continued existence of the species. If there are adverse effects to critical habitat, we also evaluate if the proposed action will destroy or adversely modify designated critical habitat. The requirement for all Federal actions to not jeopardize the continued existence of listed species, or destroy or adversely modify critical habitat, is described in Section 7(a)(2) of the Act. The regulatory definition of jeopardy and a description of the formal consultation process can be found at 50 CFR § 402.02 and § 402.14.

For this BO:

- The Status of the Species for the NSO and Franklin's bumble bee is summarized in Chapter 3; it is fully described for the NSO in Appendix A.
- The environmental baseline conditions for the California Cascades and California Klamath Physiographic Provinces and these Recovery Units for the NSO is described in Appendix B.
- The environmental baseline for the action area is described in Chapter 4.
- The Service's scientific basis for the effects of the action to the NSO and its habitat is described in Chapter 5.
- The effects of the action are described in Chapter 6.
- The effects of the action to NSO critical habitat are described in Chapter 7.
- The cumulative effects of the action are described in Chapter 8.
- Chapter 9 includes our summary and synthesis where we assess the risk posed to the NSO and its critical habitat from implementing the action. This summary and synthesis helps us determine whether the action is likely to jeopardize the continued existence of the species by reducing appreciably the likelihood of both the survival and recovery of the species in the wild, by reducing reproduction, numbers, or distribution.
- Chapter 10 includes our Section 7(a)(2) conclusion regarding jeopardy for the NSO and Franklin's bumble bee; and our conclusion regarding adverse modification of NSO critical habitat, using the information from Chapters 1-8, and Appendices A and B.

2.1. Action Area

The action area is defined as 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). For this analysis, the action area for the NSO consists of a 1.3-mile buffer of all proposed treatments (BA pp. 14-18, Table 5). It encompasses all proposed treatment areas, including the Forest-system roads and potential landing and skyline corridor areas that may be utilized to implement the proposed action. The 1.3-mile buffer distance is based on radio-telemetry data and is the estimated radius of an NSO home range for both the California Klamath and California Cascades provinces (Thomas *et al*. 1990, USDI FWS 2009). Because habitat in a 1.3-mile home range could be utilized to some extent during any given year by NSOs, the spatial bounding addresses potential impacts to known or undetected owls that could be affected by the proposed action. Areas potentially affected by noise or smoke disturbance (up to 0.25 mile from the source of noise or smoke-generating activities) are included within the 1.3-mile spatial bounding.

The NSO action area is approximately 47,411 acres and includes 5,819 acres of non-federal lands (see Figure 1). Approximately 13 acres of these lands are managed by the California

Department of Fish and Wildlife. There are no other state-managed or Tribal lands in the action area. Approximately 2,820 acres consists of private commercial timberlands and the remaining 2,986 acres consists of rural residential zones and homes, County-managed lands around Lake Siskiyou developed and managed for recreation, and the Lake Siskiyou Camp Resort.

For Franklin's bumble bee, the action area consists of project area meadows known to contain substantial floral resources. While the action area does not encompass a High Priority Zone (HPZ) for the bee (see chapter 3), the closest HPZ is approximately four miles northeast, within the foraging distance for the species. The Fawn Creek and Gumboot Meadow complexes comprise the action area.

2.2. Analytical Framework for the Jeopardy Determination

The main purpose of this BO is to examine whether the proposed action will jeopardize the continued existence of threatened or endangered species as described in Section 7(a)(2) of the Act or result in the adverse modification or destruction of designated critical habitat.

In accordance with 50 CFR § 402.14(g)(2) and (3), the jeopardy determination in this BO relies on the following four components (USDI FWS 2019 p. 45017; 84 FR 44976):

1. The *Status of the Species* evaluates the species' current rangewide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; the species survival and recovery needs; and explains if the species' current rangewide population is likely to persist and if recovery of the species will remain viable.

2. The *Environmental Baseline* evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species.

3. The *Effects of the Action* evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, in the action area; and how those impacts are likely to influence the survival and recovery of the species.

4. *Cumulative Effects* evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by adding the Effects of the Action and Cumulative Effects to the Environmental Baseline and evaluating it in light of the Status of the Species. This formulates our opinion as to whether the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species.

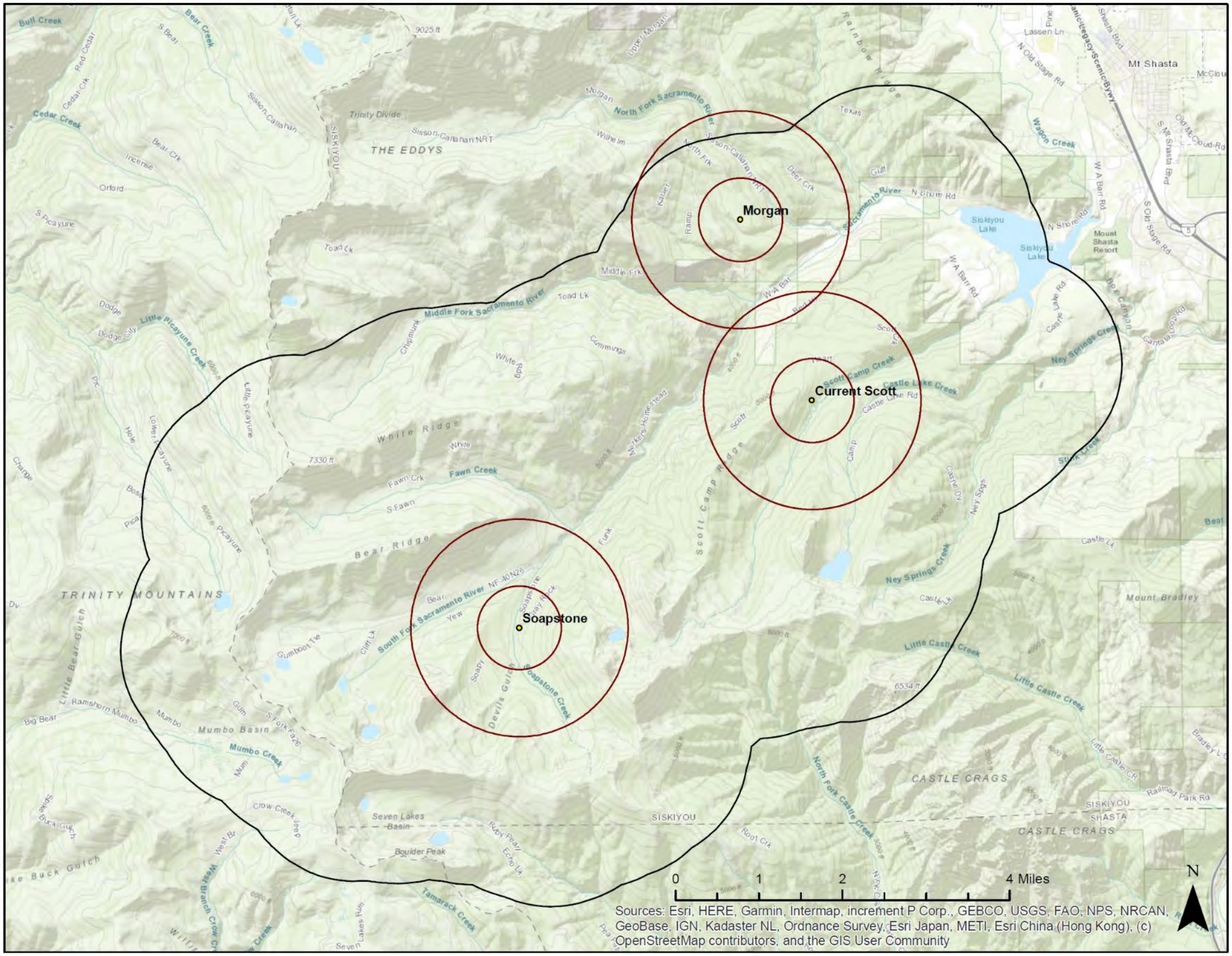

Figure 1. Northern spotted owl action area for the South Fork Sacramento Public Safety and Forest Restoration Project showing the current Scott and Soapstone and historic Morgan activity centers.

Recovery units can be useful for informing the effects of a proposed action and our jeopardy determination. When a proposed Federal action appreciably impairs or precludes the capacity of a recovery unit from providing for both the survival and recovery, the action may also represent jeopardy to the species as a whole. When using this type of analysis, a BO should describe how the consequences of the proposed Federal action not only affect the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole (USDI FWS and NMFS 1998 p. 4-36).

The Recovery Plan for the NSO identifies 12 physiographic provinces as recovery units (USDI FWS 2011).

- The description of the affected Recovery Units for NSO (California Cascades and California Klamath Province) is included in Appendix B.
- The analysis of the consequences of the action to the Recovery Unit's role is included in Chapter 9.
- The jeopardy analysis, which relies on the status of the species, the environmental baseline, the effects of the action, and the cumulative effects, is included in Chapters 9 and 10.

2.3. Analytical Framework for the Adverse Modification Determination

A final rule revising the regulatory definition of "destruction or adverse modification" of critical habitat was published on August 27, 2019 (84 FR 44976). The final rule became effective on October 28, 2019. The revised definition states:

> "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

In accordance with policy and regulation, the destruction or adverse modification determination in this BO relies on the following four components:

1. The *Status of Critical Habitat*, which describes: the rangewide condition of the critical habitat in terms of essential habitat features, primary constituent elements, or physical and biological features that provide for the conservation of the listed species; the factors responsible for that condition; and the intended value of the critical habitat as a whole for the conservation/recovery of the listed species.
2. The *Environmental Baseline*, which refers to: the current condition of critical habitat in the action area absent the consequences to critical habitat caused by the proposed action; the factors responsible for that condition; and the conservation value of critical habitat in the action area for the conservation/recovery of the listed species.
3. The *Effects of the Action*, which represents all consequences to critical habitat that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the conservation value of the affected critical habitat.

4. *Cumulative Effects*, which represent the consequences to critical habitat of future, non-Federal activities that are reasonably certain to occur in the action area and how those impacts are likely to influence the conservation value of the affected critical habitat.

For the purposes of making this determination, the Service evaluates if the consequences of the proposed Federal action on critical habitat, taken together with cumulative effects, when added to the current rangewide condition of critical habitat, are likely to impair or preclude the capacity of critical habitat as a whole to serve its intended function for the conservation of the listed species. The key to making this finding is clearly establishing the role of critical habitat in the action area relative to the value of critical habitat as a whole, and how the effects of the proposed action, taken together with cumulative effects, are likely to alter that role.

A "may affect, likely to adversely affect" determination for NSO critical habitat triggers the need for completing an adverse modification analysis and is warranted in cases where a proposed Federal action will:

1. Reduce the quantity or quality of existing NSO nesting, roosting, foraging, or dispersal (collectively, NRFD) habitat to an extent it would be likely to adversely affect the breeding, feeding, or sheltering behavior of an individual NSO;
2. Result in the removal or degradation of a known NSO nest tree when that removal reduces the likelihood of owls nesting within the stand; or,
3. Prevent or appreciably slow the development of NSO habitat at the stand scale in areas of critical habitat that currently do not contain all of the essential features, but have the capability to do so in the future. Such actions adversely affect NSO critical habitat because they impede development of older forest stands more capable of supporting NSOs than younger stands.

Adverse effects to an individual tree in NSO critical habitat will not trigger the need to complete an adverse modification analysis under formal consultation if those effects are not measurable at the stand level.

The 2012 final rule for NSO critical habitat indicates the destruction or adverse modification determination is made at the scale of the entire critical habitat network, however:

> "…a proposed action that compromises the capability of a subunit or unit to fulfill its intended conservation function or purpose could represent an appreciable reduction in the conservation value of the entire designated critical habitat. Therefore, the BO should describe the relationship between the conservation role of the action area, affected subunits, units, and the entire designated critical habitat. The analysis should not incorporate the effect of the proposed action on individual NSOs but, instead, on the life-history functions supplied by the primary constituent elements (PCEs) and the physical [or] biological features" (USDI FWS 2012 p. 71940).
>
> "A proposed action that compromises the capability of a subunit or unit to fulfill its intended conservation function or purpose (e.g., demographic, genetic, or distributional support for NSO recovery) could represent an appreciable reduction in the conservation value of the entire designated critical habitat" (USDI FWS 2012 p. 71943).

The 2021 revised rule for revised NSO critical habitat describes that the discussion in the 2012 final rule (77 FR 71876; pp. 71938-71944) still adequately addresses actions that may adversely modify critical habitat or be affected by the areas of critical habitat that remain designated.

An action may destroy or adversely modify critical habitat if it adversely affects the essential PBFs to an extent the intended conservation function or purpose of the critical habitat designation for the NSO is appreciably reduced.

3. STATUS OF THE SPECIES

This chapter summarizes and provides the current status of the species for the NSO and Franklin's bumble bee. More detailed information on the status of the NSO is included in Appendix A.

3.1. Status of Northern Spotted Owl

The following sections summarize the current status of the NSO. Refer to Appendix A for detailed information on the legal status, physical description, biology, and threats. Appendix A also includes information concerning rangewide habitat and population trends, along with various tables which incorporate the effects of all past human activities and natural events that led to the present-day status of the species (USDI FWS and USDC NMFS 1998, Davis *et al.* 2011, 2015, 2022).

3.1.1. Listing Status

The NSO was listed as threatened on June 26, 1990. The listing was due to widespread loss and adverse modification of its nesting, roosting, foraging, and dispersal habitats across the species' entire range and the inadequacy of existing regulatory mechanisms to conserve the owl (USDI FWS 1990, p. 26114). The 5-year review completed in 2019 documented its declining status (USDI FWS 2019). After this review, the Service concluded that uplisting the NSO to 'endangered' is warranted, but precluded, by higher priority actions to amend the List of Endangered and Threatened Wildlife and Plants (USDI FWS 2020a, pp. 81144-81152). The Service considers the owl functionally endangered (Appendix A).

3.1.2. Threats

The NSO has declined across large portions of its range since 1990. Immediate threats include habitat loss from timber harvest or severe wildfire and competition with barred owls, which invaded from eastern North America. The most severe declines are occurring in the northern portion of the range, where barred owls have been established for the longest time period of time. The current rate of decline of the NSO raises concerns about its long-term persistence throughout the Pacific Northwest (USDI FWS 2011, 2019).

The loss of NSO habitat on Federal lands since the 1990s due to timber harvest has been reduced on Federal lands over the past two decades under the NWFP. Wildfire is currently the primary cause of habitat loss on Federal lands, and the rate and severity of wildfire in portions of the range of the NSO are expected to increase in the future under projected climate change scenarios.

NSO habitat on private lands has continued to decline since the time of listing and has declined at a higher rate than on Federal lands; thus, Federal and state lands are expected to continue to provide the majority of habitat for the foreseeable future. With the exception of some of the larger private land blocks in northern California, NSOs are unlikely to persist in areas across their range without Federal lands (USDI FWS 2011, 2019).

3.1.3. Recovery Plan

The Revised Recovery Plan (Recovery Plan) for the NSO was published in June 2011. It identifies competition with barred owls, ongoing loss of habitat from timber harvest, loss or modification of habitat from uncharacteristic wildfire, and loss of amount and distribution of habitat from past activities and disturbances as the primary threats (USDI FWS 2011 p. II-2 and Appendix A). To address these threats, the recovery strategy includes: 1) developing a rangewide habitat modeling framework, 2) barred owl management, 3) monitoring and research, 4) adaptive management, and 5) habitat conservation and active forest restoration (USDI FWS 2011 p. II-2). The Service also completed a rangewide, multi-step habitat modeling process to help evaluate and inform management decisions and designate critical habitat (USDI FWS 2011 Appendix C).

There are 14 recovery actions that specifically address habitat loss and degradation. Two actions of primary importance for Federal land managers are recovery actions 10 and 32:

- Recovery Action 10: "Conserve NSO sites and high value NSO habitat to provide additional demographic support to the population." This recovery action addresses both nesting/roosting and foraging habitat. Interim guidance consists of a framework to help determine and prioritize high value habitat and NSO sites for conservation (USDI FWS 2011 pp. III-44 to III-45).
- Recovery Action 32: "Because recovery requires well distributed, older and more structurally complex multi-layered conifer forests on Federal and non-Federal lands across its range, land managers should work with the Service…to maintain and restore such habitat while allowing for other threats, such as fire and insects, to be addressed by restoration management actions. These high-quality NSO habitat stands 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 recovery action primarily addresses nesting/roosting habitat, but forest stands or patches meeting the described conditions are a subset of nesting, roosting *and* foraging habitat (USDI FWS p. III-67).

  Because maintaining or restoring forests with high-quality habitat will provide additional support for reducing key threats faced by NSOs, protecting these forests should provide them with high-quality refugia habitat from negative competitive interactions with barred owls that are likely occurring where the two species' home ranges overlap.

The Recovery Plan strongly encourages land managers to be proactive in the implementation of the recovery actions, including strategies that include active forest management. In other words, land managers should not be so conservative that, to avoid risk, they forego actions necessary to conserve forest ecosystems which are necessary to the long-term conservation of the NSO. But they should also not be so aggressive that they subject NSOs and their habitat to treatments where long-term benefits do not clearly outweigh the short-term risks. Finding the appropriate balance to this dichotomy remains an ongoing challenge for those engaged in NSO conservation (USDI FWS 2011 p. II-12).

Both the Recovery Plan and the 2012 (and 2021) critical habitat designations build on the NWFP and recommend continued implementation of the Plan and its standards and guidelines (USDI FWS 2011 p. I-1). This includes being consistent with the direction for Late-Successional Reserves.

In addition to recovery actions regarding habitat, there are 10 recovery actions specific to addressing barred owl threats. We have undertaken Recovery Action 30 – designing and implementing large-scale control experiments to assess the effects of barred owl removal on NSO site occupancy, reproduction, and survival. We are currently planning Recovery Action 31 to assist in management of and reducing the negative effects of barred owls to help meet Recovery Criteria (USDI FWS 2011 p. III-65).

Refer to Appendix A for additional detailed information on the status of the species.

3.2. Status of Franklin's bumble bee

3.2.1. Listing Status

The Service listed Franklin's bumble bee as an endangered species on August 24, 2021 (USDI FWS 2021a, 86 FR 47221). We completed a Species Status Assessment (SSA) in 2018 (USDI FWS 2018). The SSA contains a detailed account of the species and an assessment of the species' viability through an analysis of its resiliency, representation, and redundancy. No critical habitat is designated for Franklin's bumble bee and there are no designated recovery units for the species at this time.

3.2.2. Species Description

Belonging to the subgenus *Bombus*, Franklin's bumble bee is corbiculate (females have pollen baskets on their hind legs) (Williams *et al.* 2008, entire). It is short-tongued with a short head, an adaptation for extracting nectar from flowers with short corollas (Koch *et al.* 2012 p. 98; Williams *et al*. 2014 p. 19). Franklin's bumble bee can also "rob" nectar from flowers with longer corollas, by biting holes in the base of the corolla to access the nectar.

In the field, they can most easily be distinguished from other similar species (e.g., *B. occidentalis*, *B. vosnesenskii*, *B. caliginosus*, *B. vandykei*, *B. fervidus*, *B. insularis*, *B. flavidus*), by the inverted U-shape pattern of the yellow hairs on the anterior thorax surrounding a central black patch and extending beyond the bases of the wings, and a lack of yellow hairs on the abdomen (Xerces Society and Thorp, 2010, pp. 5-6, Williams *et al.* 2014, p. 19). In addition, the hairs on the round face are predominantly black, there are yellow hairs on the top of the head, and there are white hairs in two spots at the tip of the abdomen (Xerces Society and Thorp 2010, pp. 5-6).

3.2.3. Biology and Habitat

The specific life history characteristics, habitat, and behavior of this rare and difficult to find species has not been studied. While little is known about Franklin's bumble bee reproductive biology, specific habitat needs, or unique behavior, this information is available for *Bombus* in general and for some closely related species. These include the western bumble bee (*B. occidentalis*), rusty patched bumble bee (*B. affinis*), and yellow-faced bumble bee (*B. vosnesenskii*), among others. As such, we are relying on these closely related species, including those that co-occur with Franklin's bumble bee, to inform the biological characteristics of this species.

Franklin's bumble bee is primitively eusocial, living in colonies made up of a queen and her offspring of non-reproductive female workers, reproductive males, and reproductive new queens (gynes). Colonies of Franklin's bumble bee may contain 50 to 400 workers, in addition to the founding (foundress) queen (Plath 1927, Thorp *et al.* 1983, McFarlane *et al.* 1994). Their nesting biology is unknown (Xerces Society and Thorp 2010), but they likely nest underground in abandoned rodent burrows or similar cavities that offer resting and sheltering places, food storage, nesting and room for the colony to grow (Plath 1927, Hobbs 1968, Thorp *et al.* 1983, Thorp 1999). It may also occasionally nest on the ground (Thorp *et al.* 1983) or in rock piles (Plowright and Stephen 1980).

The active flight period is from mid-May to the end of September (Thorp *et al.* 1983, p. 30); though a few individuals have been encountered in October (Southern Oregon University Bee Collection records, in Xerces Society and Thorp, 2010, Appendix 1 p. 39 as cited in USDI FWS 2018 p. 17). Colonies have an annual cycle, initiated each spring when solitary queens emerge from hibernation and seek suitable nest sites (Thorp, pers. comm., 2017). Access to blooming flowers and a suitable nest site enables the queen to rear the first workers of a new colony on her own. A "continuous supply of floral resources is required to support the nest-founding stage…because each queen must forage for food as well as tend the nest, potentially limiting her mobility" (Lanternman *et al.* 2019, p. 149). In the early stages of colony development, the founding queen (foundress) is responsible for all food collection and care of the eggs and larvae. As the colony grows, workers assume the duties of food collection, colony defense, nest construction, and larval care while the foundress remains within the nest and produces eggs.

Near the end of the colony cycle, gynes and fertile males are produced. Males patrol selected territories and mark them with queen-attracting scent. After mating, queens feed to build up fat before entering hibernation. At the end of the colony cycle, all the workers and the males die along with the founding queen; only the inseminated hibernating gynes are left to carry on the line into the following year (Duchateau and Velthius 1988).

3.2.3.1. Habitat

Bumble bees are generalist foragers; they gather pollen and nectar from a wide variety of flowering plants (Xerces Society 2013, pp. 27-28). Unlike honeybees, they are efficient at collecting pollen. They vibrate their flight muscles while inside a flower, causing pollen to fall from the plant anthers and stick to the bumble bee's copious body hairs. This behavior of "buzzing" is also known as sonication (Williams *et al*. 2014).

Franklin’s bumble bee has been found at a broad elevational range in a wide variety of habitat types. The Service considers a defining habitat characteristic for Franklin’s bumble bee to be the presence of substantial floral resources (SFRs). These are defined as a diverse and constant supply of insecticide-free native flowering plants that provide both pollen and nectar throughout a Franklin’s bumble bee colony’s active flight period (May 15 through September 30; Xerces Society and Thorp 2010, p. 11). Since forage resources must be available throughout this period, a varied assortment of plant species with staggered floral senescence must be present in abundance (i.e., no monocultures). This is typically exemplified by existing meadow systems (i.e., larger open meadows in proximity to seeps and other wet meadow environments).

Studies of other *Bombus* species typically exhibit foraging distances of less than 1 km (0.62 mile) from their nesting sites (Dramstad 1996, Osborne *et al.* 1999, Knight *et al.* 2005, Wolf and Moritz 2008, Rao and Strange 2012, Hatfield, pers. comm., 2017). Franklin’s bumble bee may have a foraging distance of up to 10 km (6 miles) (Thorp, pers. comm., 2017), but the subgenus’ typical dispersal distance is most likely 3 km (2 miles) or less (Goulson 2010, Hatfield, pers. comm., 2017). They have been observed collecting pollen from lupine (*Lupinus* spp.) and California poppy (*Eschscholzia californica*) and collecting nectar from horsemint or nettle-leaf giant hyssop (*Agastache urticifolia*) and mountain monardella (*Monardella odoratissima*) (Xerces Society and Thorp 2010). Franklin’s bumble bee may also collect or rob both pollen and nectar from vetch (*Vicia* ssp.) (Xerces Society and Thorp 2010).

Little is known about the overwintering habitats of Franklin’s bumble bee foundress queens, but habitat would include micro-habitats such as ground cavities, rotting logs, loose soil, and other protected sites for queens to hibernate. They also require nearby floral resources and suitable nest sites for emerging queens the following spring.

Franklin’s bumble bee needs consist of floral resources throughout the colony cycle, and areas for breeding, shelter, and overwintering which could consist of underground rodent burrows or similar cavities, the interior of rock piles, or decaying logs (USDI FWS 2018 and 2021a).

3.2.3.2. High Priority Zones

High Priority Zones or HPZs are areas more likely to support Franklin’s bumble bee. To date, 23 HPZs have been identified and mapped across the species range by Service and species experts. They contain all known historic observation locations of Franklin’s bumble bee, in addition to modeled habitat characteristics and floral resources most likely to support the species in its historic range. Each HPZ includes a 3 km buffer around each historic observation to account for the typical dispersal and foraging distance (USDI FWS 2018). Thus, by design, HPZs are meant to encompass the highest quality habitat surrounding each historic observation while also accounting for a buffer area the species is most likely to utilize for foraging, nesting, dispersal, and overwintering. While the HPZs are not definitive, they are a biologically based decision support tool based on the best available information for the species to date. They will be updated as additional survey and habitat data is collected (J. Everett, pers. comm., April 28, 2022).

3.2.4. Threats and Reasons for Listing

The causal factors behind the decline of Franklin's bumble bee are not well understood. The 2021 final rule for the bee describes the threats as pathogens, pesticides, and small population size which are ongoing and rangewide. These threats are likely to continue to act individually and in combination to decrease the species viability (USDI FWS 2021a). Pesticides include insecticides, herbicides, and fungicides. Agricultural intensification, urban development, livestock grazing, and wildfire can also result in impacts to habitat throughout the range of the species. Managed bees (those moved around the landscape seasonally to provide pollination services to a wide variety of crop types) are a threat because they compete for floral resources and can increase disease. Franklin's bumble bee is also vulnerable to inbreeding and the production of sterile males because of its small population size (USDI FWS 2018).

Importantly, it is likely that several stressors or threats act additively and synergistically (Goulson *et al.* 2015, p. 5). The combination of multiple stressors is likely more harmful than one acting alone (Sih *et al.* 2004, Coors and DeMeester 2008, Gill *et al.* 2012). There is recent evidence that the interactive effects of pesticides and pathogens could be particularly harmful for bumble bees (Baron *et al.* 2014, pp. 463-465; Fauser-Misslin *et al.* 2014, pp. 453-455) and other bees (Alaux *et al.* 2010, pp. 775-777; Vidau *et al.* 2011, pp. 3-5; Aufavre *et al.* 2012, pp. 2-3 Pettis *et al.* 2012, pp. 155-156).

3.2.5. Rangewide Status

Franklin's bumble bee is restricted to the Klamath Mountain region of southern Oregon and northern California (Frison 1922, Stephen 1957, Plowright and Stephen 1980, Thorp *et al*. 1983, Williams 1998, Xerces Society and Thorp 2010). It has been observed at a range of elevations from 162 m (540 feet) to over 2,340 m (7,800 feet). It has been found in an area that is about 306 km (190 miles) from north to south, and 70 miles 113 km (70 miles) east to west, across Douglas, Jackson, and Josephine counties in southern Oregon, and Siskiyou and Trinity counties in northern California (Thorp 1999, 2005c, International Union for Conservation of Nature 2009).

There is a high degree of uncertainty pertaining to current occurrence of populations. The last sighting of any Franklin's bumble bee was in 2006 on Mt. Ashland in southern Oregon, and there are no known current populations distributed across any level of ecological conditions or spatial extent, despite numerous survey efforts in high quality habitat where historical locations were reported (USDI FWS 2018, p. 3, 42). The risk of extinction is high, the suspected threats to the species persist, and the number of remaining bumble bees is presumably very small (USDI FWS 2021a). However, the species is small, difficult to detect, and there are large areas of habitat that may support the species have not been surveyed.

The SSA notes that where surveys have been repeated at locations where Franklin's bumble bee was observed in the past, the species has not been detected since. However, the lack of systematic surveys across the historical range precludes the assumption the species is extinct (86 FR 47221). As discussed in the 2021 final rule listing Franklin's bumble bee as endangered, "there are numerous instances of species rediscovered after many years, even decades, of having been believed extinct (e.g., Scheffers *et al*. 2011, entire). As one example of such a case, the

Fender's blue butterfly (*Icaricia icarioides fenderi*) of Oregon was believed extinct after the last recorded observation in 1937 until it was rediscovered in 1989, 52 years later (Hammond and Wilson 1992, p. 175; Hammond and Wilson 1993, p. 2)" (86 FR 47221).

4. ENVIRONMENTAL BASELINE FOR THE ACTION AREA

The preamble to the implementing regulations for section 7 of the ESA provides good context for understanding the meaning of the term "Environmental Baseline". The preamble (51 FR 19926) states: "[i]n determining the "effects of the action," the Director first will evaluate the [rangewide] status of the species or critical habitat at issue. This will involve consideration of the present environment in which the species or critical habitat exists, as well as the environment that will exist when the action is completed, in terms of the totality of factors affecting the species or critical habitat. The evaluation will serve as the baseline for determining the effects of the action on the species or critical habitat."

The 2019 Revised Regulations implementing the ESA updated the definition of environmental baseline (USFWS 2019; 84 FR 44976, 45016) to refer to "the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action." 50 CFR §402.02.

The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities, or existing agency facilities that are not within the agency's discretion to modify, are part of the environmental baseline. 50 CFR § 402.02.

In this chapter we address our current understanding of NSO habitat conditions in the California Cascades and California Klamath Physiographic Provinces, the influence of barred owls, and other potential stressors in the action area. The current conditions of NSO habitat in these recovery units and at the rangewide scale is presented in Appendices A and B. In combination with these Appendices, the information presented here provides a context for understanding any of insignificant, discountable, beneficial, or adverse effects of the proposed action, as well as a context for understanding any cumulative effects as defined under the ESA that are reasonably certain to occur in the action area.

4.1. Action Area Setting

As described in chapter 2, the action area is approximately 47,411 acres. It is split between the California Cascades and California Klamath Province, within the East Cascades South NSO Relative Habitat Suitability modeling region (USDI FWS 2011). Elevations range from 3,000-8,000 feet. The action area is located entirely within the Headwaters of the Sacramento River

Ecosystem Analysis area (USDA-FS 1995 and 2001).[1] The watershed consists of approximately 65,000 acres of mountainous, rugged terrain on both Federal, state, and private lands. There is some checkerboard ownership of private commercial timberlands in the southern portion of the action area at a range of 4,000-6,000 feet elevation, and other scattered parcels in the eastern part of the action area. There are rural residential parcels and county-managed lands around Lake Siskiyou in the northern portion. The remainder of the action area consists of National Forest lands, wholly managed by the Shasta-Trinity National Forest.

As described in the 1995 and 2001 Headwaters Analysis, the environmental baseline conditions in the action area are the result of past timber harvest activities of various types and severities of impact, and a century of fire suppression on both public and private lands that have led to the vegetation species composition and stand structure changes in the action area. There are nine timber sales described in the analysis document with NSO survey history (or years not surveyed) between 1985 and 1994 (USDA-FS 2001 p. 24; Table 3-7). Many of the roads in the action area were constructed or reconstructed to conduct these operations, including railroad logging in the early 1900s, the 26 road in the 1940s, and several other road systems (USDA-FS 2001 pp. 35-36).

Natural processes such as geology, including the unique Trinity Ultramafic Sheet, insects and disease, wildfire, and abiotic factors such as aspect and elevation, also contribute to habitat conditions in the action area.

The action area consists of early-, mid- and late-successional Klamath mixed-conifer forest stands and abundant riparian corridors at the mid and lower elevational ranges. Conifer species include Douglas-fir, sugar pine, incense cedar, Port Orford cedar, and ponderosa pine. White fir, red fir and lodgepole pine are more dominant in the upper-mid to higher elevation areas, with sparser shrub-dominated vegetation areas or rocky openings distributed at the highest elevations and along ridges. The open serpentine soil areas associated with the Trinity Ultramafic Sheet contain a higher abundance of Jeffrey pine and incense cedar. Most mid and lowers slope riparian corridors consist of mixed-conifer species, willow, alder and Big Leaf maple and Pacific yew. There are approximately 592 acres of plantations (USDA-FS 2023c p. 11). In addition, the action area contains oak-conifer woodlands at the northern extent, scattered small meadow openings throughout, and larger meadow complexes at the higher elevations.

4.2. NSO Habitat

Both the Recovery Plan and 2012 final rule for NSO critical habitat describe nesting, roosting, foraging, and dispersal habitat conditions (USDI FWS 2012 pp. 71884-71885, USDI FWS 2011 p. A-10). The Recovery Plan further defines nesting, roosting, and foraging in the interior California Coast and Eastern Cascades modeling units (USDI FWS 2011 Appendix H). Nesting and roosting habitat provides structural features for nesting, protection from adverse weather conditions, and cover to reduce predation risk for adults and young. In many cases the same habitat may also provide for foraging (USDI FWS 2012 p. 72051).

[1] The 2001 version consisted of minor adjustments to syntax, grammar, and formatting problems. All of the data and information found in Version 2 are based on 1995 watershed analysis methodologies, data, and policy and the content was not updated in 2001 (USDA-FS 2001 p. i).

Both the amount and spatial distribution of nesting, roosting, foraging, and dispersal habitat influence reproductive success and long-term population viability of NSOs. Population growth can only occur if there is adequate habitat in an appropriate configuration to allow for the dispersal of owls across the landscape. This includes support of dispersing juveniles, as well as nonresident subadults and adults that have not yet recruited into the breeding population.

NSO survivorship is likely greatest when dispersal habitat most closely resembles nesting, roosting, and foraging habitat, but owls may use other types of habitat for dispersal on a short-term basis. Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy cover to provide protection from avian predators and at least minimal foraging opportunities (USDI FWS 2012 p. 71884).

4.2.1. NSO Habitat in the California Cascades and California Klamath Provinces

The distribution and quality of NRF and dispersal habitat in these provinces is strongly influenced by the local physiographic and climatic conditions, as well as the history of forest management on Forest Service lands and private commercial timberlands, and fire.

4.2.1.1. Nesting/Roosting Habitat

In these provinces, nesting habitat is typified by a multi-layered, multi-species (including hardwoods) canopy dominated by large overstory trees; moderate to high canopy closure (70-100 percent); a high incidence of trees with large cavities and other types of deformities; numerous large snags; an abundance of large down logs; and open space within and below the upper canopy that allows for maneuvering (Thomas *et al.* 1990; USDI-FWS 2011, 2012). Nesting platforms (mistletoe brooms, broken top trees with leaders or snags) must be present.

Basal area and canopy closure in nesting habitat typically ranges from 150-240+ ft^2/acre and 70-100 percent but there may be gaps and heterogeneity. There are large amounts of coarse woody debris >20” in diameter with larger, embedded logs and stand decadence. The importance of Douglas fir is largely attributed to the interaction between it and dwarf mistletoe (*Arceuthobium douglasii*) infection, and resulting “brooms” that provide nesting structure. The use of sugar pine mistletoe brooms as nesting or roosting platforms is well documented in the California Klamath and California Cascades provinces and predominant, remnant Douglas fir, sugar pine and larger diameter, broken topped white fir are considered the important components of nesting habitat. Roosting habitat is similar, but most roost sites have lower canopy cover and closure (~60 percent). Slope position, distance to water, aspect are all important abiotic factors contributing to habitat quality and use.

4.2.1.2. Foraging Habitat

Foraging habitat is defined as mixed-conifer stands ranging from 125-200+ ft^2/acre and an average stand diameter of ≥16” dbh trees. Higher basal areas lead to increased foraging habitat quality (USDI FWS 2012 p. 72051). The presence of trees ≥20-26” dbh is considered an important attribute of foraging habitat (USDI FWS 2009; Irwin *et al.* 2007, 2012, 2015). Canopy cover ranges from 40-100 percent (USDI FWS 2009 p. 53; Irwin *et al*. 2020, 2015, 2012, 2007; Zabel *et al.* 2003, 1992). Foraging habitat also consists of large accumulations of fallen trees and other downed wood, and sufficient open space beneath the canopy for flight (USDI FWS 2012 p.

72051).

4.2.1.3. Dispersal Habitat

Dispersal habitat helps maintain stable populations by filling territorial vacancies. Both locally and across the range, it provides an important linkage function among blocks of higher value NRF habitats, facilitates gene flow, and is essential to NSO conservation (USDI FWS 2011, 2012). In cases where nesting, roosting, or foraging habitats are insufficient to provide for dispersing or nonbreeding owls, dispersal habitat must provide protection from avian predators and minimal foraging opportunities (USDI FWS 2012 p. 71884).

These areas may include younger and less diverse forest stands than foraging habitat, but should contain some roost structures for temporary resting, canopy cover that provides shelter and cover from predators, and foraging habitat for dispersing juveniles, subadults or single adults (USDI FWS 2012 p. 72052), Sovern *et al.* 2015). The Service further defines dispersal habitat as stands with at least 40 percent canopy cover and 11” dbh trees, the presence of and capability to support roost sites, and some understory composition that contributes to prey base and minimal foraging opportunities (USDI FWS 2011, 2012, Forsman *et al*. 2002, Thomas *et al*. 1990).

Thomas *et al.* (1990) suggested that management practices, such as visual and riparian corridors, streamside management zones, geologic reserves and other special management zones can provide habitat attributes conducive to dispersal between habitat areas. Dispersing juveniles appear to select stands with relatively high canopy closure of about 66 percent (Sovern *et al.* 2015). Similar findings for the presence of older trees and denser canopy closure are described for the Oregon Coast range and parts of Washington (Miller *et al.* 1997, Buchannan *et al.* 1995, Herter *et al.* 2002). Successful juvenile dispersal is also likely dependent on locating unoccupied suitable habitats in close proximity to other occupied sites (LaHaye *et al.* 2001). Fledglings of both sexes generally disperse from nest cores from September to November (Forsman *et al.* 2002; Gutiérrez 1985). Juveniles use temporary dispersal locations before acquiring a home range territory and the median natal dispersal distance from fledging to a permanent settlement is about 10 miles for males and 15.5 miles for females (Forsman *et al.* 2002). NSO can and will disperse across a wide range of forest conditions and levels of habitat fragmentation, and where corridors of forest exist within fragmented landscapes, these areas primarily serve to support relatively rapid movements rather than colonization (USDI FWS 2011).

There are some differences between how NSO habitat is assessed and quantified on federal lands based on conservation and recovery standards for the species and the metrics used to assess habitat conditions for take avoidance in cores and home ranges on private lands. Table 2 displays the structural attributes used to classify NSO habitat that were developed specifically for NSO take avoidance on private timberlands in California’s Northern Interior Region and apply to NSO core and home ranges (USDI FWS 2019 pp. 4, 17; 2009 pp. 60-61, 2008).

The Service developed the initial take avoidance guidance as a tool for the California Department of Forestry and Fire Protection (CAL FIRE) and the California Department of Fish and Wildlife (CDFW) to utilize when reviewing Timber Harvest Plans (THPs; USDI FWS 2008). The 2008 guidance was updated in November 2019. Both the 2008 and 2019 guidance was informed by the Service’s science support document, completed in 2009 (USDI FWS 2009). This document describes the research and literature to support the recommended habitat levels to avoid take in NSO cores and home ranges. The 2019 revisions clarified the use of NSO surveys and their applicability and addressed analyses of habitat conditions in non-circular home ranges for take avoidance on private lands. The 2009 science support document informs our guidance for the evaluation of take of NSO on private timberlands in California's Northern Interior Region, and is referenced in the November 2019 revised Attachments A and B (USDI FWS 2019a pp. 5, 6, 14).

Table 2. Values for selected structural parameters to classify NSO habitat in cores and home ranges for evaluation of take on private lands.

Parameter	Functional habitat type			
	High-quality nesting/roosting	**Nesting/roosting**	**Foraging**	**Low-quality foraging**
Basal area[1]	≥210 ft^2 /acre	Mix ranging from 150 to ≥180 ft^2 /acre	Mix ranging from 120 to ≥180 ft^2 /acre	Mix ranging from 80 to ≥120 ft^2 /acre
QMD[2]	≥15 inches	≥15 inches	≥13 inches	≥11 inches
Large trees[3] per acre	≥8	≥8	≥5	NA
Canopy closure[4]	≥60%	≥60%	≥ Mix ranging from 40 to 100%	≥40%
Other Notes	Multi-layered, multi-species forest structure with fairly open understory through which owls can fly		Foraging habitat must generally have some higher quality habitat nearby (within 0.5 mile)	NA

[1] Square feet per acre

[2] QMD = quadratic mean diameter of trees >5 inches dbh

[3] Trees >26 inches dbh

[4] Canopy closure = percent cover of overstory trees

The differences in habitat definitions used for take avoidance determinations on private lands versus desired habitat conditions for NSO conservation is problematic. For example, outside of cores and home ranges, the habitat parameters described in Table 2 for "low quality" foraging represent the Service's definition of dispersal habitat (e.g., 11" dbh trees with canopy cover ≥40 percent). These younger and more open habitats are not considered foraging habitat for NSO but do allow for dispersal and minimal foraging opportunities because they support prey production (USDI FWS 2009 p. 54).

It is more appropriate to use NSO habitat definitions based on recovery standards than those used for take avoidance on private lands when assessing the effects of the action on federal lands. Take of owls on private lands is prohibited, and CAL FIRE must not approve a THP that results in habitat conditions that do not support a breeding pair. When the THP review authority was transferred to CAL FIRE in 2008, the Service provided CAL FIRE with guidance that describes habitat thresholds below which take of NSO may occur. Therefore, the 2019 guidance represents the bare minimum amount and quality of habitat required to avoid take of NSO and does not reflect the habitat conditions recommended for NSO recovery, based on the scientific literature.

4.2.1.4. Non-Habitat

Areas classified as non-habitat do not provide NSO nesting, roosting or foraging habitat conditions. They also do not contain the minimum dispersal habitat elements and are not considered capable of developing those habitat elements due to species composition, stand age or tree size or general soil conditions that prohibit development into dispersal or NRF habitat. This includes smaller diameter ponderosa pine stands, as these are forest types rarely used by NSO (Thomas et al. 1990, Zabel et al. 1992, Irwin et al. 2007, 2012, USDI FWS 2009, 2011, 2012). It also includes large open meadows, early- and mid-seral/pole size stands of small diameter trees, lodgepole-dominated stands, and non-forested lands, such as brushfields, grasslands and barrens.

4.2.2. NSO Habitat in the Action Area

Within the action area, NSO habitat is relatively continuous in the central, eastern, and northern portions with higher elevation areas containing little to no habitat, or patches of dispersal. Stand conditions are heterogenous and may occur in relatively small or isolated patches. This is partially due to the natural variability of stand configurations in dry forest types, but also due to past vegetation management on Federal lands in the action area. The BA describes past timber harvest and open stand conditions, as well as fire history (BA pp. 7-9).

To inform our independent analysis, we reviewed portions of the Scott and Soapstone home ranges and cores to further assess NRF, dispersal, and non-habitat conditions. The focus was to review areas we did not see during the July 25 field visit with Forest staff (see chapter 1). In the northern portion of the Scott home range, we identified small patches of habitat in riparian areas that meet Recovery Action 32 stand criteria, including several small clusters of large trees and stands of nesting/roosting habitat (mapped as foraging habitat in BA-Appendix C). We also reviewed areas mapped as foraging or non-habitat in the southwestern portion of the home range near and along riparian areas. These stands more closely resemble nesting/roosting habitat on account of the larger overstory trees (≥28” dbh), abundant large legacy trees, taller tree height, multiple canopy layers, and large downed wood. Other areas we assessed more closely resembled foraging habitat, on account of relatively dense stands with uniform tree size, shorter tree heights, and a lack of canopy layers, large legacy trees, and downed wood. During our review in the Scott home range near Methodist Camp, we found some habitat patches mapped as foraging or non-habitat along riparian areas also more closely resemble nesting/roosting habitat. Similarly in the Soapstone home range, some areas mapped as foraging or non-habitat along riparian areas more closely resemble nesting/roosting habitat given the larger overstory trees, abundant large legacy trees, taller tree height and multiple canopy layers.

Based on these field reviews and observed minor inconsistencies, we completed a revised NSO habitat analysis for the action area. We evaluated NSO habitat conditions in the action area through field review, analysis of aerial imagery, the Forest’s 2022 NSO EVEG habitat layer (USDA-FS 2022a), Oregon State University fire refugia modeling, the 2022 nesting cover class habitat data developed by the Northwest Forest Plan monitoring group (USDA-FS 2022b), and our relative habitat suitability model (USDI FWS 2012). While conducting our review, we also utilized the common stand exam data provided by the Forest. With this information, we are able to summarize the amount of NSO habitat and non-habitat in the action area (Table 3).

Table 3. NSO habitat in the action area for the South Fork Sacramento Project.

Habitat type	Acres	Percent of Action Area
Nesting/Roosting	3,201	7%
Foraging	12,590	27%
Dispersal	10,007	21%
Non-habitat	21,613	46%
Total	**47,411**	**100**
Total Dispersal (NRFD)	*25,798*	*54%*

4.3. Abiotic Factors and Barred Owls

While NRF habitat acreages are useful, acreage amounts do not reflect other factors that affect NSO habitat use or their influence on their survival or reproduction. In the southern portion of the NSO range, it has been shown that highest fitness is achieved where a mosaic of large patches of late-successional habitat are interspersed with other vegetation types that increase the amount of edge habitats (Franklin *et al*. 2000, Franklin and Gutiérrez 2002, Zabel *et al*. 2003, Olson *et al*. 2004).

Homogeneous expanses of older forests, while generally supporting greater adult survival than younger forests or small patches of older forests, do not support a stable or increasing population (Franklin *et al*. 2000, Olson *et al*. 2004, Dugger *et al*. 2005). A mosaic of different vegetation and successional stages may offer stable prey resources for NSOs while providing adequate protection from predators (Franklin *et al*. 2000).

The Service has also utilized landscape-level analyses to examine the influence of abiotic factors on site selection. Based on a review of 36 NSO activity centers, we found occupied sites were associated with basin-like topography, the lower half of slopes, and streams (Johnson *et al*. 2006). Past research has also demonstrated NSOs prefer or 'select for' lower-slope or mid-slope positions for nesting and roosting, especially if these areas also contain perennial streams (Solis and Gutiérrez 1990, Blakesley *et al*. 1992, Lahaye and Gutiérrez 1999). These abiotic factors coincide with conditions that favor forest growth and historically were relatively resistant to fire. Both long-term, occupied NSO sites (Scott and Soapstone) are located within mid slope positions near Scott Camp Creek and Soapstone Creek, with multiple other riparian corridors, seeps, springs, and perennial and intermittent streams in their cores and home ranges.

As described in Appendix A, the confounding effects of interspecific competition with barred owls are changing NSO habitat use and selection patterns. While this has not been directly observed in the action area to date, other NSO pairs on the Shasta-Trinity National Forest and on other Forests have shifted their locations in response to competitive interactions with barred owls when barred owls occupy a portion of the NSO territory (e.g., refer to the Algoma, Gemmill Thin, Bear Country, Pumice Vegetation Management, and Juanita Restoration project consultations). See also Appendix A regarding additional information on barred owl impacts to NSO site occupancy and shifts.

Surveys or stand searches for NSO have been continuous in the action area because of annual monitoring and surveys for this project (see section 4.4 below) and barred owls were also recently detected in the action area in 2018, 2019, and 2022 (CNDDB 2023). See section 4.4 below for more information.

Whether NSOs will be able to persist in areas with barred owls is unknown. The current and past evidence suggests NSOs are more likely to be displaced into drier areas with steep slopes and more marginal habitat conditions at higher elevations because barred owls prefer riparian areas with gentler terrain (Gutiérrez *et al*. 2007, USDI FWS 2008, 2011). The compounding effects of barred owls and extensive vegetation management in areas occupied by NSOs exerts even more pressure on NSO survival and recovery.

4.4. Status of the Northern Spotted Owl in the Action Area

Spotted owls are 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 (USDI FWS 2012a). The 2012 NSO survey protocol defines an activity center or AC as a location or point representing "the best of 'detections'" such as nest stands, stands used by roosting pairs or territorial singles, or concentrated nighttime detections. The ACs are within the core use area and are represented by this central location (USDI FWS 2012a p. 31).

The action area contains five NSO ACs. The Service considers the Soapstone and current Scott ACs as currently occupied, based on the most recent available survey data and the other three ACs are considered historic (USDI FWS 2019a pp. 3, 4, 11). These consist of Morgan, historic Scott, and Boulder (CNDDB 2023). The Boulder AC is located at the southern extent of the action area, no treatments are located in the core or home range, and current survey data is not available. Both Soapstone and current Scott ACs are considered occupied by territorial pairs.

The Service uses a 0.5-mile radius circle surrounding an AC to delineate the core area likely to be used disproportionately during the nesting season, or by resident single NSOs. In the California Klamath Province, a 1.3-mile radius circle centered on the AC delineates the median size of an annual home range or territory that receives year-round use (USDI FWS 2009), with higher use of the core area by nesting pairs during the breeding and nesting season. Further, habitat in the interior portion of the NSO range in California is often more heterogeneous than in coastal areas. For these reasons, home ranges and core use areas for NSO in the interior are often more accurately depicted by non-circular polygons that often follow drainages where higher quality habitat is present compared to upslope areas (USDI FWS 2019a p. 17). This approach is more biologically based than using the traditional circular core and home range area analysis configuration, as it can provide a more accurate representation of the habitats owls are using, and include various nest locations as they can often shift nest sites. While it is recognized that actual core use areas likely conform to the distribution of high-quality habitat and are therefore noncircular, the circular core area represents a reasonable approximation of the area within which territorial NSO defend and obtain most resources (USDI FWS 2009).

The NSO survey history, barred owl detection data, and habitat conditions for the two home ranges is described below and in Table 4 and 5.

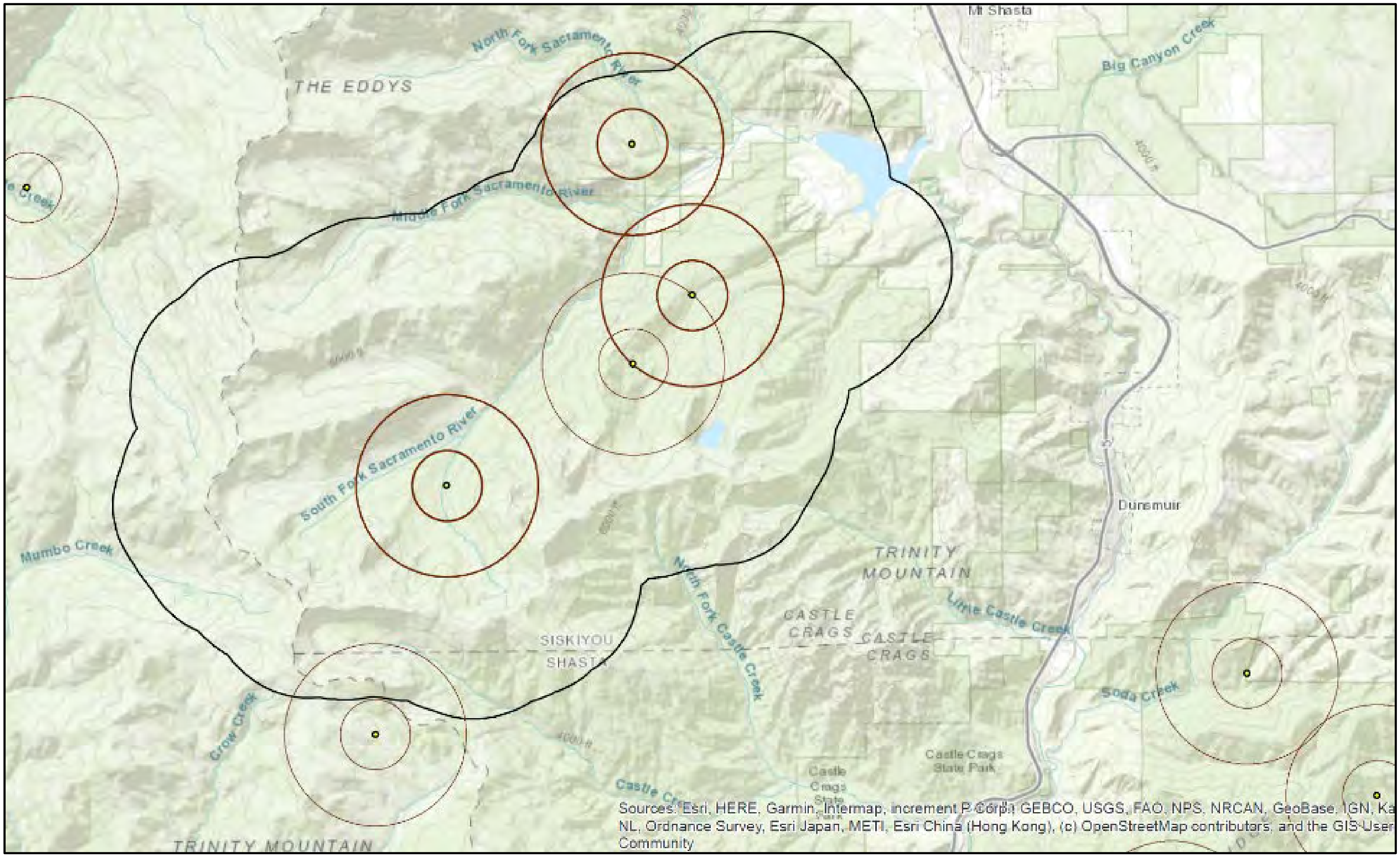

Figure 2. Northern spotted owl action area showing current and historic NSO activity center locations.

4.4.1. Territorial and Nonterritorial Spotted Owls

NSO populations consist of territorial resident owls, for which we have documented occupancy throughout much of the owl's range and who are present in the action area at TRI0435. Nesting NSO pairs will actively defend their nests and young from predators (Forsman 1975, Gutiérrez *et al*. 1995). Territorial defense is primarily carried out by hooting, barking, and whistle type calls. While NSOs are territorial, the home ranges of adjacent pairs can and do overlap (Forsman *et al*. 1984, Solis and Gutiérrez 1990) suggesting the area defended by the territorial pair (core) is smaller than the area used for foraging.

Populations also include nonterritorial and non-breeding adults or floaters. While floaters are not territorial, they will remain as residents in the territory of a pair, or move among territories (Gutiérrez 1996). They have special significance in populations because they may buffer the territorial population from decline (Franklin 1992). These nonterritorial owls are present on the landscape and use closed canopy forest habitat to support transient and colonization phases until they recruit into the breeding population. However, nonterritorial owls are difficult to detect during surveys because many either do not respond to surveys or respond in very tenuous fashion such that they are difficult to capture or resight (Forsman *et al*. 2002, Gutiérrez 1996).

Nonterritorial spotted owls generally persist in the population and use a series of temporary home ranges to systematically sample or "prospect" the underlying network of resident territories along a somewhat erratic dispersal path (Forsman *et al*. 2002). Because they are difficult to detect, the number and distribution of nonterritorial and dispersing owls are poorly known for any given NSO population.

Given the habitat configuration and current occupancy in the action area, it is possible that floater owls may utilize portions of the action area. The area of most likely use by nonterritorial NSOs or as owls disperse includes the northwest portion of the action area, associated with the Morgan activity center.

4.4.2. NSO Survey History

The BA (p. 20) describes, "A survey buffer of 1.3 mi. around the project boundary was established and has been surveyed each year since 2019. In addition, other NSO activity centers near proposed activities that were identified during past survey efforts have also been monitored. There have been four seasons of protocol surveys from 2019-2022. Three historical activity centers (Morgan/FS-001/SIS001, Scott/FS-005/SIS0268, and Soapstone/FS-018/SIS0268 [*sic*]) are found in the project area. Scott and Soapstone are currently occupied. Morgan has not been observed active since the 90's." Table 8 in the BA includes survey information for the historic Morgan, historic Scott, and current Soapstone and Scott AC locations (BA p. 22) and information from it is included below (Table 4).

Survey efforts and detections throughout the action area have occurred from 1986-2023, though not every year included protocol-level surveys or stand searches as the initial NSO survey protocol was not developed until 1993. Prior to 2021, the historic Scott AC was located approximately one mile southwest of its current location (Figure 2 2 and 3). While a nest site was not located in or near this location during multiple survey efforts since the first detection of a pair in 1999, numerous daytime stand searches, follow-up surveys, and nighttime calling efforts detected owls in this general location (Table 4, CNDDB 2023).

Table 4. Survey and status history for NSO ACs in project area (derived from BA Table 8).

Activity Center Name*	Status Verified	Undetected	Single	Pair	Young Verified
Morgan FS001/SIS0010	1986, 1987, 1988, 1990, 1991, 1994, 1995, 1996, 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2007, 2008, 2020, 2021, 2022	1998, 2007, 2008, 2020, 2021, 2022	2001, 2005	1986, 1987, 1988, 1990, 1991, 1994, 1995, 1996, 1997, 1999, 2002, 2003, 2004	1987, 1988, 1990, 1991, 1994, 1995
Current Scott FS005/SIS0268	2021, 2022	NA	NA	2021, 2022	2021, 2022
Soapstone FS018/SIS0231	1990, 1992, 1993, 1994, 1995, 1997, 1999, 2004, 2005, 2015, 2018, 2019, 2020, 2021, 2022	1990, 1999, 2022	1994, 1995, 1997, 2005, 2021	1992, 1993, 2004, 2015, 2018, 2019, 2020	2015
Historic Scott FS018/SIS0231	1990, 1994, 1996, 1999, 2001, 2002, 2003, 2004, 2005, 2008, 2009, 2019, 2020	2004	1990, 1994, 1996, 2002, 2003, 2005, 2008	1999, 2001, 2009, 2019, 2020	No young verified in historic AC location

4.4.3. Barred Owl Survey History

Surveys for barred owls have not been conducted in the action area. They have been recently detected by the Forest during project-level surveys and by private lands survey efforts in 2018, 2019, and 2022 (CNDDB 2023). In 2018 and 2019, the detections occurred in the northern extent of the action area near Deer Creek, west of Rainbow Ridge. In 2022, there was one detection near Ney Springs Road and Box Canyon just outside the action area. Prior to these detections, the last mapped detection in the action area is from 2010 near Gumboot Lake. Additional detections have occurred approximately 2 to 7 miles outside the action area between 2014 and 2019 (CNDDB 2023). To date, barred owls have not been detected in the current or historic Scott, Soapstone, or Morgan core use areas or home ranges. Detection locations from CNDDB are shown in Figure 3 below, though the detection near Box Canyon and Ney Springs road is not mapped (see BA p. 21-Figure 7).

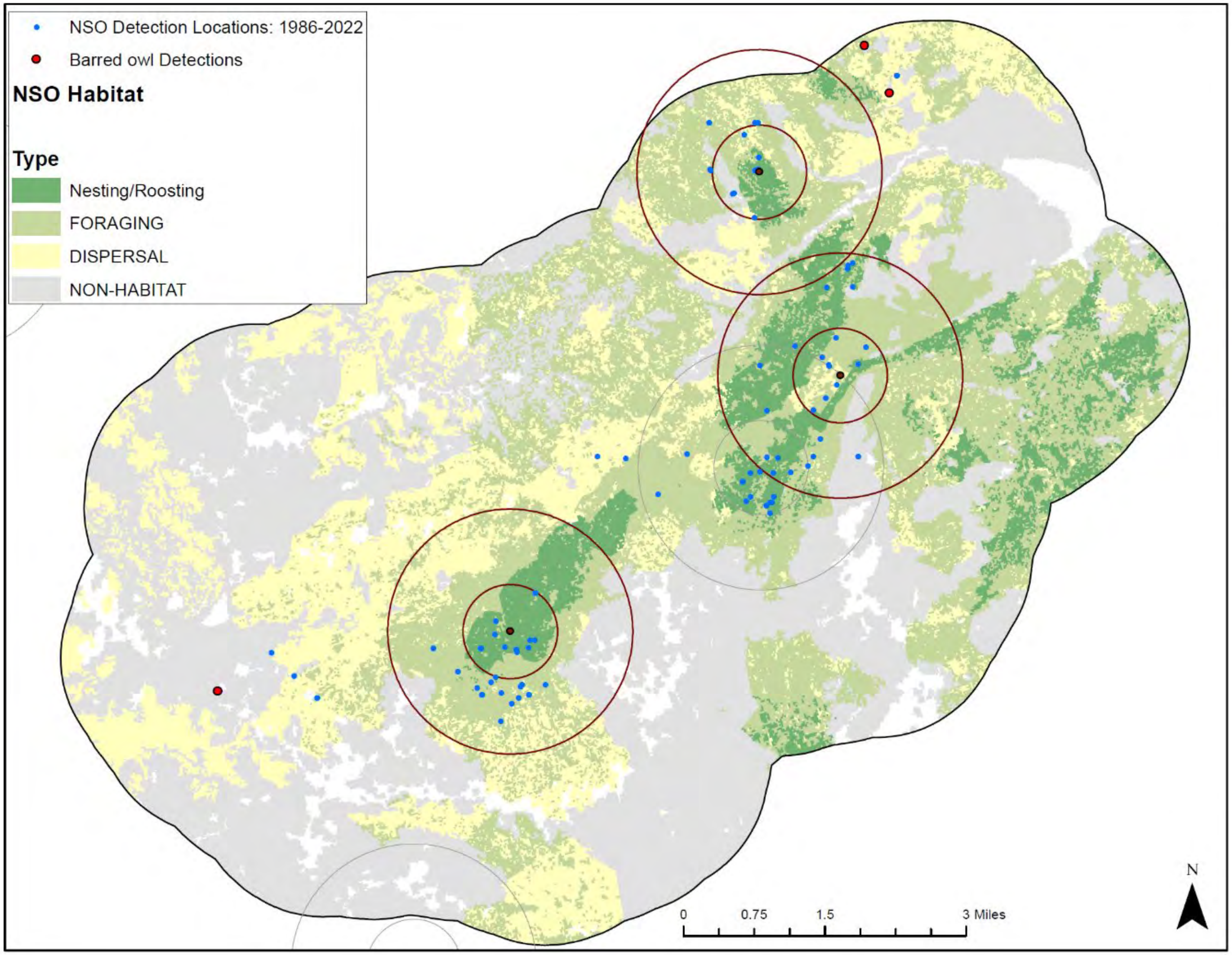

Figure 3. NSO habitat in the action area with current and historic activity centers, NSO and barred owl detections.

4.4.4. NSO Habitat Levels at the Territory and Core Scale

None of the current home ranges are below the recommended levels of 1,336 acres of NRF habitat in the home range but the current Scott and Morgan core use areas are below the recommended 400 acres of NRF in the core to support long-term survival, occupancy, reproduction, and fitness (USDI FWS 2009). Despite being below these levels, the Scott site (including the historic detection locations) continues to be occupied by NSOs (see Table 4 above). The owls associated with the Scott and Soapstone activity centers demonstrate high site fidelity and the survey data shows they are utilizing higher value habitat areas and the best available habitat in the action area (see BA Appendix I).

Table 5. NSO NRF and Dispersal habitat in cores and home ranges in the action area

AC Number	Activity Center Name	Core (0-0.5 mile)				Home Range (Entire)			
		Foraging	NR	Dispersal	Total NRF	Foraging	NR	Dispersal	Total NRF
SIS0010	Morgan	223	130	54	**353**	1,480	305	760	**1,785**
SIS0268	Scott	266	120	55	**386**	1,732	919	232	**2,651**
SIS0231	Soapstone	163	334	4	**497**	1,576	600	716	**2,176**

4.5. Existing Conditions in the Action Area-Franklin's bumble bee

We evaluate a separate action area for this species because where the effects of the action may occur to Franklin's bumble bee is smaller than that for the northern spotted owl. Based on our field reviews, there are approximately 145 acres of meadow areas that contain substantial floral resources (SFRs) for the bee. These meadows also contain abundant nesting and overwintering habitat consisting of abandoned rodent burrows, bunch grasses, rock piles, and large downed wood within 100 meters of the SFRs. Overwintering habitat consisting of loose, well-drained soil and other materials in shaded areas under trees is also abundant.

There are no historic observations of Franklin's bumble bee in the action area and it is located outside of a high priority zone (see section 3.2.3). The closest high priority zone is approximately four miles to the northeast, within the six-mile foraging and dispersal distance for Franklin's bumble bee (Thorp, pers. comm. 2017, USDI FWS 2018, 2021a).

The action area is within the range of the species, however, and contains SFRs. Pollinator surveys were conducted in portions of the Fawn Meadow complex in 2022 (BA p. 63) and in 2023 and did not detect this species. The meadows range in elevation from 5,600-6,700 feet and consist of the larger Fawn Creek Meadow and Gumboot Meadow complexes.

4.6. Previous and Current Federal Activities in the Action Area

The environmental baseline in the action area includes past and ongoing management actions on Federal lands that may affect NSO habitat. This consists of past timber harvests (USDA-FS

1995, 2001), tree planting, commercial and pre-commercial thinning, prescribed burning, hazard tree abatement, and mastication of vegetation. The effects of all previous actions to vegetation are accounted for in the environmental baseline and existing conditions for NSO habitat in the action area (Table 3).

The baseline also consists of ongoing recreation use and impacts, including human-caused fires. There have been no large, recent fires in the action area, increasing its importance in terms of NSO conservation and recovery. Numerous fire starts have occurred over the last 33 years (BA p. 36) with lightning accounting for 25 percent and human-caused ignitions accounting for the remaining starts. The combined acreage of these fires was less than 100 acres, with the largest event (1996 Pocket Fire) growing to 50 acres before it was suppressed (BA p. 36).

The BA (p. 13) describes the current USDA Forest Service-permitted activities in the action area. This includes 24 acres for the Methodist Camp Special Use Permit. A portion of these 24 acres overlaps with high value NSO habitat in the Scott home range. Additional special use permits include the University of Nevada Reno-Limnology Lab Special Use Permit (0.4 acres near Castle Lake that does not influence NSO habitat), and 52 acres for the Archery Range at the northern extent of the action area in a mix of dispersal and foraging habitat. The 3,249-acre Bear Creek Allotment also overlaps the action area and contains potential habitat for Franklin's bumble bee. This allotment is currently vacant (BA p. 13).

Other ongoing Federal activities, such as hazard tree abatement along roads or in developed recreation areas, or vegetation management in developed recreation areas, typically causes less drastic habitat change. Fuelwood gathering may occur in the action area. Woodcutters are required to have a fuelwood permit and must follow the associated regulations in that permit and the accompanying Shasta-Trinity National Forest Fuelwood Cutting Map (see https://www.fs.usda.gov/detail/stnf/passes-permits/?cid=FSEPRD535891 for more information). These ongoing activities are typically highly dispersed (wood cutting, hazard tree abatement) or are concentrated at developed recreation sites. While they can result in the removal of habitat for NSO and their prey (e.g., dead and down logs, trees or snags with structure, small trees and brush) they are not expected to significantly affect habitat function at a stand scale or across the action area. This is due to steep embankments, barriers to access, and the limited distance that can be traveled from the road edge to cut and collect firewood.

4.7. Past and Current Private Actions in the Action Area

Approximately 12 percent (5,819 acres) of the NSO action area is in non-Forest Service ownership. It consists of 13 acres of CDFW state lands and 5,806 acres of private or County managed lands. Approximately 2,820 acres are in private commercial timberland ownership with the remaining 2,986 acres in smaller rural residential zones and homes, lands around Lake Siskiyou developed and managed for recreation, and the Lake Siskiyou Camp Resort.

Private property does not overlap any of the current NSO core areas or home ranges in the action area. There is an estimated 169 acres of nesting/roosting habitat, 856 acres of foraging habitat, and 776 acres of dispersal habitat on the private, County-managed, and state lands located in the action area.

Past actions on non-Forest Service ownership in the action area have primarily been vegetation management under timber harvest plans (THP) approved by CAL FIRE. Forest management has also occurred through Exemption Notices under 14 CCR § 1038 of the Forest Practice Rules. It is also likely that small fuels reduction activities around home sites and right-of-way clearing have been conducted. There have been no activities conducted under § 1038 Emergency Notices within the action area.

To evaluate past and current actions on private lands in the action area, CAL FIRE's CalTREES THP database was reviewed to identify forest management actions under THPs, Non-Industrial Timber Management Plans (NTMPs), and Exemption and Emergency Notices (see https://caltreesplans.resources.ca.gov/caltrees/Default.aspx for more information). Additionally, we used GIS information from CALFIRE's database (https://forest-practice-calfire-forestry.hub.arcgis.com/) that was provided by the Forest.

As of November 14, 2023, there have been 206 acres of forest management projects completed by Michigan California Timber Company, Sierra Pacific Land and Timber Company (SPI), and Oxbow Timber I LLC under THPs since 2015 (see Table 6). Approximately 56 acres of NSO habitat were removed by these activities, including 17 acres of foraging, and 39 acres of dispersal habitat. An additional two acres of nesting/roosting, three acres of foraging, and two acres of dispersal habitat were downgraded or degraded. The NSO habitat for the entire action area accounts for the effects of actions that have already occurred and represents the best available information for the current baseline habitat conditions in the action area.

In terms of ongoing actions on non-federal lands, there are 357 acres of currently approved THPs under Shasta Cascade Timberlands LLC (SCT), SPI, and Rome Creek Timber LLC ownership (2-22-00122-SIS, 2-15-067-SIS, and 2-19-00049-SHA) (see Table 6). These THPs are considered ongoing private actions, yet effects in NSO habitat may not have occurred yet, as they are not completed to date.

Table 6. Summary by harvest type for past completed and currently approved timber harvest plans that overlap the action area.

Harvest Type	Completed acres	Approved acres	Total acres
Alternative Prescription	111	0	111
Clearcut	64	144	208
Fuel Break/Defensible Space	0	100	100
Road Right of Way	0	0	0
Selection	11	114	124
Shelterwood Removal Step	22	0	22
Total	**207**	**357**	**564**

Additionally, there were 2,588 acres of approved Exemption Notices on SCT and SPI lands, which included the harvest of dead, dying, and diseased trees; fuelwood; and split products. All but one of these notices overlapped with completed or approved THPs. Forest management under these exemptions could result in removal of NSO habitat, but we consider the cumulative effects to be insignificant and discountable to affecting breeding, feeding, or sheltering behaviors of NSO and their ability to disperse on the landscape. This is because the majority of the actions will occur at higher elevations with a low likelihood of use by NSO and none of the exemptions overlap known NSO home ranges. Currently, all of these Exemption Notices have expired.

5. Scientific Basis for Effects to the Northern Spotted Owl

This chapter is specific to the NSO and summarizes the Service's scientific basis for describing the degree of effects from habitat modification, noise and smoke disturbance, and barred owl interactions.

5.1. Scientific Basis for Estimation of Effects from Habitat Modification

The preceding chapter describes the existing conditions and amounts of nesting, roosting, foraging, and dispersal habitat in the action area of the project. It also includes definitions of NSO habitat from the Recovery Plan, 2012 final rule, from the Service for California's dry interior. Additional information regarding NSO detections and habitat quality and use in the action area are also described. In summary, the NSOs in the project action area are using what may be considered lower value nesting/roosting habitat conditions, given the overall variability, patchiness, and within-stand heterogeneity. There are some discrete stands or areas of nesting/roosting habitat, but more frequently these habitat elements are intermixed within stands of foraging habitat. The more continuous areas of NRF habitat, combined with NSO detection information, are considered high value habitat as described for recovery actions 10 and 32 in the Recovery Plan.

When evaluating the degree of impact to NSOs, several factors are considered. We assume adverse effects, and perhaps take, could occur if an action reduces the quantity or quality of existing nesting, roosting, foraging, or dispersal habitat to an extent it would be likely to impair breeding, feeding, or sheltering behaviors of an individual NSO. A close review is made to assess if an action (or combined actions) reduces the availability or quality of NRF habitat in a territory below current levels, or below the Service's recommended minimums for survival and fitness (USDI FWS 2009, 2019). We also consider other best available research, data, and information on territorial occupancy and survival.

The function and quality of NSO habitat is influenced by landscape position, distance to the nest or roost site, and other abiotic features. If significant changes occur to habitat in these areas, these effects may reduce the quality of the habitat and compromise NSO fitness in the short- or long-term. Actions in a core use area will have stronger effects to NSO compared with areas further from the activity center (USDI FWS 2009). While it is recognized that actual core use areas likely conform to the distribution of high-quality habitat and are therefore noncircular, the circular core area represents a reasonable approximation of the area within which territorial NSO defend and obtain most resources (USDI FWS 2009). While fragmented forest landscapes are more likely to be used by NSO in the transience, or dispersal, phase to move rapidly between denser forest areas (Courtney *et al.* 2004, USDI FWS 2012), survival is negatively correlated with forest fragmentation (Schilling *et al*. 2013). The probability of occupancy increases when core areas contain a range of available habitat for NSOs, and the survival and fitness of NSOs increases with larger patch sizes of older forest or a higher proportion of older forests (Franklin *et al*. 2000, Dugger *et al*. 2005).

Based on research in the California Klamath Province, the Service recommends analyzing habitat conditions around an NSO activity center at three scales: nest stand (100 acres), core area (500 acres), and home range (approximately 3,398 acres). The most critical scales are the nest stand and the core use area. Additionally, "the strongest type of information relevant to the evaluation of take relates the fitness of NSO to characteristics of their habitat" (USDI FWS 2009). Fitness translates to the ability of individuals of a species to survive and reproduce. Generally, the Service recommends land managers: 1) avoid habitat modification in nest stands; 2) maintain 80 percent NRF habitat in a core use area (a preferred combination of 250 acres nesting/roosting and 150 acres foraging habitat); and 3) maintain 40 percent NRF habitat in the larger home range.

These habitat guidelines are based on research that associates the amounts of NRF habitat at these scales with higher survival and reproductive success rates of NSO pairs or higher fitness (USDI FWS 2009). When a treatment objective includes the maintenance of nesting/roosting or foraging habitat, it is important to maintain a diversity of basal area and canopy closure levels (e.g., skips of 'no treatment' interspersed with gaps of treatment). Maintaining a range of small, intermediate, codominant, dominant, and predominant trees with ranges of canopy closure and vertical and horizontal structure and small open patches (1-2 acres) under a thinning prescription helps to maintain habitat function over the extent of the stand.

When habitat amounts are below, or fall below due to treatment, the values described above for the core area and home range, fitness may be compromised when additional habitat losses or widescale degradation occurs. Even though the Service uses the term 'threshold' to describe these values, no absolute threshold exists and, in some instances, successful reproduction and occupancy may be occurring in sites with lower habitat levels. The recommended values are used for our analysis of a project's effect to NSO and their numbers, reproduction, and distribution in the action area. This includes effects on NSO young, juveniles, resident singles and nonterritorial owls. Our evaluation of take from habitat modification is a quantitative and qualitative assessment of the actual amount and distribution of habitat available to the NSO in the core and territory, and a reasonable certainty that NSO will be harmed.

Our conclusions regarding the effects of project treatments in NSO habitat are drawn largely from comparing pre- and post-treatment conditions with stand parameters that define NRF habitat and dispersal habitat on federal lands (USDI FWS 2011, 2012). This includes the number of residual large trees, canopy cover, and stand complexity. Stand complexity is further informed by the level of understory and midstory layering, canopy closure and presence of roosting sites, structure for nesting, and snags and down logs. Abiotic factors also contribute to the 'quality' of habitat (e.g., distance to perennial or intermittent streams, aspect, slope position, elevation, and other factors that contribute to preferable microclimate conditions).

Spotted owls whose home ranges are thinned tend to move away from the treated stands (Gutiérriez *et al*. 2008). Additionally, spotted owls tend to use selectively-managed stands when there are trees ≥21" dbh, large coarse wood, and dense canopy (Zabel *et al*. 1992). In a radio telemetry study of NSOs in Oregon, timber harvest caused NSO to abandon their home ranges, depending on the intensity of the harvest (Forsman *et al*. 1984, USDI FWS 2009). In areas that experienced heavy thinning where canopy closure was reduced to less than 50 percent, NSOs were either no longer detected or moved to adjacent unharvested old growth stands. In contrast, NSOs were detected in or immediately adjacent to lightly thinned stands which had retention patches where no thinning occurred (Forsman *et al*. 1984, USDI FWS 2009).

NSOs may completely avoid heavily thinned areas or use them less. We assume this is due to a reduction in foraging opportunities and consequential reduction in fitness. As central place foragers, nesting NSOs are sensitive to activities that occur in their core use areas and especially their nest patches (Miller 1989, Swindle 1997, Meyer *et al*. 1998).

The analysis in this BO uses the following terms to categorize the estimated degree of change (or effect) to habitats used by NSO, and the potential of the change to alter habitat amounts and function:

- *Degraded* describes the effect when treatments have a negative impact on the quality of habitats known to be used by NSOs by removing or reducing the habitat elements, but not to the degree that the pre-treatment habitat function changes. For example, foraging habitat remains functional as foraging habitat and nesting/roosting habitat remains available for nesting and roosting behaviors, but with a reduced quality. This effect can also occur in dispersal, capable, or post-fire foraging habitats, depending on the expected degree of impact(s) from the treatment. Thinning to the lowest basal area and canopy cover thresholds in nesting/roosting, foraging, and dispersal habitat can still "maintain" the habitat function, but the simplification and loss of understory and midstory trees, logs, snags, and larger trees reduce the habitat's quality. In addition, an initial treatment may be expected to degrade habitat function, but follow-up fuels treatments or thinning and under burning may collectively downgrade or remove (defined below) habitat.

  Degraded conditions can potentially lead to adverse effects (e.g., reduced availability of prey leading to higher energy expenditure by NSOs while foraging), especially when this effect occurs at a moderate to large scale, in a continuous area (i.e., a large proportion of a core area, home range, or action area), or in important habitat areas (e.g., in cores, along streams, at lower slope positions).

- *Downgraded* describes the effect when treatments reduce nesting, roosting, or foraging habitat elements to the degree the habitat will not function in its pre-treatment capacity, but it will continue to function at the next lower habitat level. For example, reducing basal area and canopy cover and closure in nesting/roosting habitat below the minimum values and quality that contribute to this life-history function are typically considered to downgrade the habitat to foraging classification.

- *Removed* describes the effect when treatments remove and reduce habitat elements to the degree the habitat no longer functions in its pre-treatment condition as nesting, roosting, or foraging. For example, when canopy cover, basal area, understory and midstory, snags, and downed logs are removed from intact NRF habitat, dispersal habitat, or post-fire foraging habitat by treatments that significantly reduce the value of the habitat, it is not considered to be downgraded but removed. Salvage logging after fires or other natural disturbances can also be considered to remove NRF and dispersal habitat or post-fire foraging habitat, given the degree of change that can occur.

The streamlining process and Memorandum of Understanding (MOU) between the Forest Service and Service describes how project activities should be designed in such a way as to minimize or avoid adverse impacts to listed and proposed species and designated critical habitat. This helps to further conservation of the NSO and other listed species in accordance with section 7(a)(1) of the ESA and its applicable implementing regulations (USDI FWS *et al*. 2013).

This early involvement typically includes interagency discussions regarding NSO survey data and occupancy history in the action area, field reviews with Service biologists to assess the availability and location of higher value habitat either being used by NSO, and/or available for NSO, and delineating areas to help meet recovery actions 10 and 32. Discussions occur regarding key locations to conserve from any treatment (in accordance with the Recovery Plan), and other forest restoration treatments in NSO habitat are typically designed to retain and enhance key habitat elements important to NSOs, such that most effects are frequently categorized as "degrading" habitat.

A *degrade* occurs because some habitat metrics (e.g., canopy cover, basal area, within-stand layering) are slightly reduced. Large snags, downed wood, and other habitat elements may also be removed or felled. Even with these reductions, the change in habitat function may still be considered a *degrade* if the overall range of habitat elements that contribute to functioning NRF habitat remain on the landscape, only at a reduced quality. As noted above, significant follow-up treatments of lower canopy trees, downed wood, snags, or other habitat elements during mastication, thinning and pruning, or underbring can have a cumulative impact and effectively downgrade or remove nesting/roosting, foraging, or dispersal habitat.

Residual stand conditions may no longer support NSO if critical stand elements are removed or significantly reduced. In these instances, habitat function may be downgraded or removed. Conversely, habitat function can be retained and improved. For example, thinning older plantations or implementing low-intensity underburning may convert dispersal or low-quality foraging habitat into foraging habitat because the density of smaller trees (<14" dbh) are reduced while larger and intermediate size class trees are retained. The residual stand conditions are highly dependent on the variability of the initial stand conditions and the effect and scale of the subsequent treatments (Weiskittel *et al.* 2007).

Our evaluation process also considers the high degree of variability in foraging habitat used by NSOs, as described in research publications. Foraging activity is positively associated with tree height diversity (North *et al*. 1999), canopy closure (Irwin *et al*. 2000, Courtney *et al*. 2004), snag volume, density of snags larger than 20" dbh (North *et al*. 1999, Irwin *et al*. 2000, Courtney *et al*. 2004), density of trees ≥31" dbh (North *et al*. 1999), volume of coarse woody debris (Irwin *et al*. 2000), and young forests with some structural characteristics of old forests (Carey *et al*. 1992, Irwin *et al*. 2000). Habitat use is also influenced by prey availability. NSOs forage in areas where prey occurrence is more predictable in older forests and near ecotones of old forest and brush seral stages (Ward 1990) and the availability or abundance of prey can in turn influence reproductive success (Rosenberg *et al*. 2003).

The significance of the changes to NSO habitat from the project, and our determination of whether these changes are likely to adversely affect NSOs or their critical habitat is based on our analysis of existing site conditions and the location, magnitude and intensity, and duration of the actions. Our analysis of the effects of the action and consequences to NSO and their habitat is based on our knowledge of NSO biology and the best scientific and commercial information available on NSO habitat use in the California Cascades and California Klamath Provinces. We compare the estimated post-treatment stand conditions with descriptions of forest structure associated with NRF and dispersal habitat, in combination with the magnitude of the action. In addition, we consider our local observations regarding long-term NSO site occupancy and reproduction and the observed use of various landscapes by NSOs to make our conclusions about the effects.

5.2. Scientific Basis for Estimation of Effects from Noise and Smoke Disturbance

The effect of sight and sound related disturbances to NSOs are not well studied. The effect of noise on birds generally is extremely difficult to determine due to the inability of most studies to quantify one or more of the following variables: 1) timing of the disturbance in relation to nesting chronology; 2) type, frequency, and proximity of human disturbance; 3) clutch size; 4) health of individual birds; 5) food supply; and 6) outcome of previous interactions between birds and humans (Knight and Skagan 1988).

The following factors may influence NSO response and degree of response to a disturbance:

1) Timing of the disturbance in relation to nesting stages (e.g., egg laying, incubation, hatching, fledging)
2) Type, frequency, and proximity of disturbance
3) Variation in clutch size
4) Health of an individual
5) Variation in food supply
6) Outcomes of previous interactions which can influence the perceived level of threat (Knight and Skagan 1988)

Further, the effect of noise on NSO is hard to establish since it is difficult to quantify and categorize disturbance (i.e., type, frequency, proximity) as well as the response variables (i.e., behavior, reproductive success, survival). Other pertinent factors can include the ambient or background sound levels, as well as how sound is influenced by topography, vegetation, and even humidity. The factors that influence how noise is reduced as it travels (attenuation) vary greatly from site to site. We have very little site-specific detail on the ambient or baseline noise levels, or attenuation factors at any given NSO site.

Additional factors that confound the issue of disturbance include the individual bird's tolerance level and differences in how species perceive noise. Information specific to behavioral responses of spotted owls to disturbance is limited. Research indicates recreational activity can cause Mexican spotted owls (*S. o. lucida*) to vacate otherwise suitable habitat for their nesting or roosting behaviors (Swarthout and Steidl 2001) and helicopter overflights can reduce prey delivery rates to nests (Delaney *et al*. 1999). Additional effects from disturbance, including altered foraging behavior and decreases in nest attendance and reproductive success, have been reported for other raptors (White and Thurow 1985, Andersen *et al*. 1989, McGarigal *et al*. 1991).

Despite these challenges, research conducted on a variety of bird species suggests disturbance can have a negative effect on nest site selection, fitness, productivity, or overall reproductive success (Swenson 1979, Tremblay and Ellison 1979, White and Thurow 1985, Andersen *et al*. 1989, Belanger and Bedard 1989, Long and Ralph 1998, Piatt *et al*. 1990, Henson and Grant 1991). Such studies have shown that disturbance can affect productivity in several ways including interference of courtship (Bednarz and Hayden 1988), nest abandonment (White and Thurow 1985), egg and hatchling mortality due to exposure and predation (Drent 1972, Swenson 1979), and altered parental care (Fyfe and Olendorff 1976, Bortolotti *et al*. 1984). Disturbance can also have an effect prior to incubation by influencing the choice of a nesting site (Long and Ralph 1998). Disturbance can also affect productivity through nest abandonment (White and Thurow 1985).

The few studies that have examined NSO responses to several types of disturbance (e.g., helicopters, small chainsaw, hikers) suggest owl behavior can be disrupted by elevated noise levels. When exposed to such stimuli, responses included flushing, altered prey delivery rates by adults to their young, and decreased prey handling behavior (Delaney *et al.* 1999; Delaney and Grubb 2001; Swarthout and Steidl 2001, 2003).

There is a gradient of potential outcomes to sight or sound disturbances, ranging from no detection to harassment (i.e., potential for likelihood of injury). Harassment is defined [50 CFR §§ 17.3] as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering." Human activity exceeding ambient levels for proximity, frequency, duration, or intensity may result in a negative response from NSOs.

Exposure to disturbances can also increase predation risk. Flushing may increase the likelihood of predation or injury by advertising the nest location or causing a nestling to leave the nest too soon (Ruddock and Whitfield 2007). Predation by raptors, corvids, and other owl species is thought to be the largest cause of spotted owl mortality (Forsman *et al.* 1984 and 2002, Layman 1985, and Verner *et al.* 1992). Human presence alone, in some instances, may also attract corvids. For example, nest predation by ravens has been demonstrated after survey efforts called the female NSO out of the nest cavity during the day (Forsman *et al.* 1984).

Northern spotted owls may also respond physiologically to a disturbance without exhibiting a significant behavioral response. In response to environmental stressors, vertebrates secrete stress hormones called corticosteroids (Campbell 1990). Although these hormones are essential for survival, extended periods with elevated stress hormone levels may have negative effects on reproductive function, disease resistance, or physical condition (Carsia and Harvey 2000, Saplosky *et al*. 2000). In avian species, the secretion of corticosterone is the primary non-specific stress response (Carsia and Harvey 2000). The quantity of this hormone in feces can be used as a measure of physiological stress (Wasser *et al*. 1997). Recent studies of fecal corticosterone levels of NSO indicate that low intensity noise of short duration and minimal repetition does not elicit a physiological stress response (Tempel and Gutiérrez 2003; Tempel and Gutiérrez 2004). However, prolonged activities, such as those associated with timber harvest, may increase fecal corticosterone levels depending on their proximity to NSO core areas (Wasser *et al*. 1997, Tempel and Gutiérrez 2004, Hayward *et al*. 2011). The highest Fgc response to noise disturbance was in male NSOs in May when they are solely responsible for feeding themselves, their mates, and nestlings (Hayward *et al*. 2011). NSO sensitivity varies with the distance, location (e.g., ground-based, skyline, or helicopter logging systems), and timing of activities relative to the nest or roost site, as well as differences in individual NSO responses (Delaney *et al*. 1999, Delaney and Grubb 2001, Swarthout and Steidl 2001 and 2003, Tempel and Gutiérrez 2003).

Project activities such as timber removal and hauling associated with commercial thinning using ground-based, skyline, and helicopter methods, piling and pile burning, landing and road construction and use, mastication, and other mechanical fuels work requires the use of heavy equipment (mechanical harvesters), power tools, chainsaws, or large vehicles. All of these activities and equipment introduce an increased level of sound, smoke, and human activity into the environment that is above ambient levels for the action area.

When this equipment is used during the critical breeding season in a place that can potentially impair essential behavioral patterns (related to breeding, feeding, or sheltering), harassment can occur. Where the potential for disturbance rises to the level of harassment, the disturbance is mitigated using seasonal restrictions that prevent operations during the breeding season. Smoke and noise are more likely to significantly disturb and negatively affect NSOs during the critical breeding season (February 1 to July 9) due to the presence of unhatched eggs, young that cannot avoid the disturbance, adults that are reluctant to leave their nesting site, and disruption of foraging activities affecting both adults and young.

In summary, negative effects to individual NSO fitness from prolonged elevated stress hormones can result in reduced survival and reproduction, or the inability to forage successfully and provide for young. We consider a disturbance response to be equivalent to an individual NSO showing recognition or avoidance of a sight or sound by hiding, defending itself, or postponing a feeding visit to its young. This is considered below the level of harassment. Harassment is linked to situations where birds are unable to avoid a disturbance without increasing the likelihood of critical energy expenditure, accidents, or vulnerability to predation. For NSOs, harassment can occur when birds are nesting or have dependent young.

Examples of harassment include:

- An adult aborts a feeding visit and the young does not receive the prey item
- An adult or juvenile is flushed from an active nest during the reproductive period
- An adult does not feed its young for a daily feeding cycle

Based on the best available information, take of NSOs may occur when:

- The action-generated sound level substantially exceeds ambient conditions (increased by

20-25 decibels above ambient levels)

- The total sound level, including the combined existing ambient and action-generated sound, is very high (exceeds 90 decibels)
- The visual proximity of human activities occurs within 330 feet or less to an active nest site (USDI FWS 2020b, pp. 2, 4)
- Heavy smoke inundation occurs in or near a nest site (USDI FWS 2008)

Sound levels of lesser amplitude or human presence at farther distances from active nests have the potential to disturb these species but have not been clearly shown to cause behaviors that meet the definition of harassment (USDI FWS 2006, 2020).

The NSO is native to fire-adapted ecosystems and are found in forests with relatively frequent fire-return intervals. They also have low reproduction rates and relatively high adult survival rates. One could assume that with this life-history strategy, adults may have a higher tolerance for smoke than juveniles or nestlings (USDI FWS 2008). When assessing potential effects of smoke on NSOs, it is important to recognize topography and weather. Smoke often accumulates in depressions or along stream channels and other low-lying areas. When the relative humidity approaches 90 percent, common during many nights, fog formation is stimulated by the presence of smoke. The smoke response to topography along with the humidity interaction could have direct or indirect effects to owls. For example, Irwin *et al*. (2006) showed NSO use patterns can sometimes be concentrated along riparian areas or lower portions of slopes. Therefore, nocturnal foraging could be directly negatively effected by impairing an owl's ability to hunt in preferred foraging areas.

In general, smoke effects on NSOs could include little to no behavioral reaction, avoiding smoke (i.e., leaving an area), reduced foraging efficiency, non-lethal lung irritation, or debilitating or lethal lung damage. Other factors include impacts to reproductive status (i.e., nesting or non-nesting), age and mobility (e.g., adult or nestling), duration and proximity of fire, presence of a smoke-trapping inversion or conditions that promote quick dispersion, and slope position of the core area. The NSOs response to dense smoke conditions during daylight hours may also increase their susceptibility to predators. Prescribed fire project design criteria can limit or prevent the severity of impacts (USDI FWS 2008). In assessing effects of smoke associated with prescribed burning on adult NSOs, light to moderate smoke that is mixing or venting well is probably of little consequence. This is because adults have the mobility to move away from smoke and they would most likely not be affected by smoke from prescribed fire operations. However, flightless nestlings or the parental bond of adults staying with young may be adversely affected by the disturbance from dense smoke, particularly from fuels with high moisture content (USDI FWS 2008).

5.3. Scientific Basis for Estimation of Direct Injury or Mortality

Forest management activities can result in direct mortality of NSO adults, eggs, or young, especially during the critical breeding (February 1-July 9) and nesting season (February 1-September 15). Such cases are rare, but direct mortality from tree felling has been documented (Forsman *et al*. 2002). The potential for NSOs to be struck and killed or injured by falling trees during harvest, or to be exposed to high levels of smoke during prescribed burning, is generally confined to the area closest to the nest tree or nest stand.

We expect nesting NSOs may be negatively affected by heat and smoke from prescribed fire activities, including area-burning or burning of concentrated piled material where fire is allowed to creep between piles. Heat and smoke may disturb nesting NSOs or their young by causing them to avoid important foraging areas or flee the nest area prematurely, thereby reducing fitness and increasing the probability of predation. The limited available information is largely anecdotal however and has resulted from wildfire rather than prescribed fire. In one study, post-fire NSO locations appeared to shift outside the burned area; however, adult and juvenile NSOs were recorded in their territory during July, even when low intensity ground fire and thick smoke were present (Bevis *et al*. 1997). The study concluded that smoke alone did not result in NSOs leaving their territories (Bevis *et al*. 1997); however, these findings could indicate the reluctance of adults and young to leave their territories during the nesting season regardless of potential physiological effects due to high site fidelity. One of the adults died several weeks post-fire and was emaciated. It is unknown whether the cause of death was due to smoke-related injury or trying to sustain a juvenile owl in burned habitat (Bevis *et al*. 1997).

Information from several wildfires suggest NSOs can be affected by heavy and continuous smoke. During the 1988 Shady Beach fire, both adults and one juvenile were observed leaving their nest grove, which was inundated by smoke intrusion, and moving into an open area. A juvenile owl with lung damage from smoke inhalation was also found on the road during the 1994 Hull Mountain fire. In other instances, burning near NSO nests with recently fledged young has not resulted in any direct observations of owls leaving their nest groves. Recorded cases of NSOs staying in partially burned areas may indicate slash burning or understory, controlled burns are relatively insignificant factors for NSOs (Ruhl 2007).

It is long recognized that smoke and smoke-related noxious gases can be harmful to avian species. This susceptibility to inhaled toxins is a consequence of the unique and efficient respiratory system of birds, as each breath of inhaled air is passed twice through the lungs. The gaseous exchange mechanism in the blood vessels is highly effective and birds are able to draw more oxygen out of the air (essential for their high metabolic rate) when compared with mammals (Welty 1980). The severity of effects from wood smoke on avian species depends on the magnitude of the smoke. Dyspnea, manifested by tail bobbing and open-mouth breathing, are abnormalities that can result from “heavy” smoke inhalation, if the birds do not otherwise succumb to lethal effects of smoke. Smoke inhalation also initiates both thermal and chemical damage to lung tissue, which can cause edema and ulceration (Verstappen and Dorrestein 2005).

During timber harvest or prescribed burning, individual adult NSOs can reasonably be expected to move away from an area and avoid injury and harm. Nesting adult NSOs tending to reproductive activities, such as incubation or brooding young, may be reluctant to leave the area (Delaney *et al.* 1999). Therefore, nesting adults are vulnerable to injury. NSO young, whether in or out of the nest, may also be vulnerable to effects of tree felling or smoke inhalation. They may disperse prematurely from the nest or nest grove in response to the disturbance, and be subject to predation, starvation, or injury. Because young must be constantly brooded by an adult for up to two weeks after hatching, parental abandonment of the nest because of disturbance could lead to mortality of the young.

5.4. Scientific Basis for Estimation of Barred Owl Competition

Although habitat remains a key consideration for spotted owl recovery, the 2011 Recovery Plan for the Northern Spotted Owl (USDI FWS 2011a, pp. III-62-68) identifies competition from the barred owl as an important threat to the spotted owl, and the Service now recognizes it as the most pressing threat to species' recovery. Habitat is clearly important for spotted owls (e.g., Weins *et al.* 2014; Yackulic *et al.* 2019), but the effects of barred owls on spotted owl demography are so large all spotted owl demographic trends in all demography study areas analyzed in Franklin *et al.* (2021) were negative regardless of habitat quantity or the relative suitability of habitat. For example, barred owls have now largely displaced NSOs in Olympic National Park, and Mount Rainer National Park, which contain large areas of older forest and do not allow commercial timber harvest (Lesmeister *et al.* 2018; Mangan *et al.* 2019). Davis *et al.* (2022) estimated that the range wide carrying capacity for NSO (maximum number of owl sites that could be contained in a given landscape based on biological and physical features) on federal lands has increased by 3.5 percent from 1993 to 2017, but territory occupancy had declined by approximately 62 percent.

Interspecific competition between barred owls and spotted owls is the primary driver of spotted owl population decline seen throughout their range (Franklin *et al.* 2021). Interspecific competition has been defined as "an interaction between members of two or more species that, as a consequence of either exploitation of a shared resource or of interference related to that resource, has a negative effect on fitness-related characteristics of at least one species" (Wiens 1989, p. 7). Barred owls exert pressure on NSOs through interference competition, where barred owls deny spotted owls access to resources (e.g., older forest for breeding) through territorial interaction and through exploitation competition where barred owls use some or all of the resources necessary for spotted owl fitness (e.g., prey species), thereby reducing their availability (Wiens *et al.* 2014; Yackulic *et al.* 2014, p. 275).

While barred owls utilize similar resources as spotted owls, they are considered generalist predators and consume a wider variety of food. Thus, barred owls are able to occupy habitat in much higher densities than spotted owls. This packing effect is likely to negatively affect the food supply of the remaining 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. Strong effects of barred owls on spotted owls (e.g., occupancy, survival, reproduction, population size) is now firmly described in the literature (Bailey *et al.* 2009, Dugger *et al.* 2016, Dugger *et al.* 2011, Kelly *et al.* 2003, Kroll *et al.* 2010, Olson *et al.* 2005, Sovern *et al.* 2014; Yackulic *et al.* 2014, Yackulic *et al.* 2019, Anthony *et al.* 2006, Diller *et al.* 2016, Dugger *et al.* 2016, Forsman *et al.* 2011, Glenn *et al.* 2011 and Franklin *et al.* 2021). Barred owls likely out-compete spotted owls for resources (Van Lanen *et al.* 2011 p. 2199) and could influence major changes in the trophic structure of local ecosystems (Holm *et al.* 2016, entire) at the territory scale.

At the spotted owl territory scale, barred owl effects on spotted owl presence, survival and reproduction are numerous, and well documented. Barred and spotted owls share similar habitats and are competing for food resources (Hamer *et al.* 2001, p. 226, Gutiérrez *et al.* 2007, p. 187; Livezey and Fleming 2007, p. 319, Wiens *et al.*, 2014, pp. 24 and 33, Holm *et al.* 2016, Long and Wolf 2019, Irwin *et al.* 2020). At all spatial scales, barred and spotted owls are competing for habitat (Hamer *et al.* 1989, p. 55; Dunbar *et al.* 1991, p. 467; Herter and Hicks 2000, p. 285; Pearson and Livezey 2003, p. 274; Wiens *et al.* 2014, pp. 24, 33).

Dugger *et al.* (2011, entire) modeled extinction and colonization rates for spotted owl pairs in the South Cascade Demographic Study Area where barred owls were detected within some home ranges. They found that extinction rates for spotted owls increased with decreasing amounts of old forest in the core area, and that the effect was 2-3 times greater when barred owls were detected. They also found that colonization rates for spotted owls decreased as the distance between patches of old forest increased (i.e., increased habitat loss and fragmentation) and that barred owl presence similarly decreased the rate of colonization of spotted owl pairs. They concluded that conserving large blocks of contiguous old-forest habitat was important for reducing interference competition between the two owl species. They mapped old-forest habitat as generally >100 years of age with trees >35 cm dbh (Dugger *et al.* 2011, Appendix A).

The strong correlation between barred owl colonization concurrent with spotted owl site extinction indicates spotted owls, at the population level, are unable to out compete for resources at the range wide scale (Franklin *et al.* 2021, p. 15-18, Wiens *et al.* 2021, p. 7). Barred and spotted owls exhibit both exploitation competition over prey and habitat, and interference competition through territory exclusion (Yackulic *et al.* 2014, p. 275.) In this case, "useable" habitat is primarily older, late-successional, forest-habitat. Franklin and others (2021) warn that while habitat loss had little influence on population trends on the range wide scale, this is likely an important factor in localized areas (p. 15).

Based on best available evidence, the Service considers competition from the barred owl the most significant and pressing threat to the continued existence of the spotted owl. The most recent spotted owl demographic analysis identified barred owl presence as the most influential parameter in models of spotted owl site extinction and range wide demographic declines, and that the effects of barred owl occupation are now noticeable in the demographics in all study areas in Washington, Oregon, and California (Franklin *et al.* 2021, p. 17). However, the degree of the demographic response varies by study area, with the most substantial declines in the Washington and Oregon Coast Range populations. Spotted owl declines were less noticeable in the Oregon Cascades, southern Oregon, and California populations through 2013 (Dugger *et al.* 2016, p. 71; Yackulic *et al.* 2019, p. 3); however, the recent review of data through 2018 indicate these populations are now exhibiting clear declines coincident with barred owl colonization (Franklin *et al.* 2021, pp. 15-17).

Information presented above and below indicates that both barred owls and spotted owls prefer older forest habitat, although spotted owls are more reliant on older forests for roosting foraging and breeding. The NSO Recovery Plan recognized this mutual preference, and greater spotted owl reliance, on older forest by stating: "Because barred owls compete with spotted owls for habitat and resources for breeding, feeding, and sheltering, ongoing loss of habitat has the potential to intensify the competition by reducing the total amount of these resources available to the spotted owl and bring barred owls into closer proximity with the spotted owl." (USFWS 2011a, p. I-9). To help reduce or minimize this threat, the USFWS developed Recovery Action 32 (USFWS 2011a, p. III-67) which recommends conserving and restoring older, multi-layered forests across the range of the spotted owl. As discussed below, several researchers have found, and/or recommended, protection of older forest habitat as a prioritized element of spotted owl conservation and recovery when barred owls are present (Wiens *et al*. 2014, pp. 30, 38).

Barred owl-specific surveys have not been conducted for the project, but they have been detected during NSO survey efforts and are likely to occur in the action area (BA p. 21, Figure 7). In this consultation we evaluate whether NRF habitat removal and degradation in the form of silvicultural thinning treatments, surface fuels reduction treatments, underburning, and connected actions could exacerbate competitive interactions between NSOs and barred owls by further reducing the amount of NRF habitat available for both species.

6. Consequences of the Project on Northern Spotted Owls and Franklin's Bumble Bee

This chapter describes the effects of the action on the northern spotted owl (NSO) and its habitat including interference competition with barred owls, and the effects of the action on Franklin's bumble bee and its habitat. The 2019 Revised Regulations implementing the Act redefined the "effects of the action". The effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action, and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. We base our assessment of effects on the information in the final BA, Draft EA, and other draft specialist reports, stand data, and GIS information for treatment areas that we have to date. Our analyses of treatment effects in NSO habitat are based on our independent habitat analysis.

Our analysis in chapters 9 and 10 regarding species numbers, reproduction, and distribution is based on the effects information in chapter 6. We also address the effects to NSO in the action area relative to their overall importance in both the California Cascades and California Klamath Recovery Units. Franklin's bumble bee does not have designated recovery units at this time.

Determining the significance of changes to NSO habitat likely to be caused by the proposed action, and whether these changes are likely to adversely affect NSO or their critical habitat, must be based on an analysis of site-specific conditions, type of treatment(s), and the scale of dependent factors (e.g., nesting/roosting, foraging, or dispersal). NSO response to modification of nesting and roosting habitat is likely influenced by relative changes in important structural features such as canopy closure, under and midstory layering, microclimate, availability of dense clumps of larger trees, and nesting structures such as mistletoe brooms, defective trees, and large snags. The removal of defective trees and snags that could serve as nesting structures may reduce nesting opportunities and the simplification of canopy layering can degrade the thermal and protective properties found in multi-storied stands.

As described in chapter 5, forest and vegetation management can result in adverse effects to NSO through several mechanisms. This includes noise or smoke disturbance, direct injury or mortality, and habitat loss or modification. The extent to which effects are minimized or avoided by the conservation measures described in section 1.3 of this BO is also discussed. For the NSO, the descriptions of and determinations for effects incorporates information from chapters 4 and 5 regarding NSO habitat on federal lands, our scientific basis for the effects from noise and smoke disturbance, habitat modification, and competitive interactions with the invasive barred owl. The information in chapters 4 and 5 is based on the best available research, literature, data, and direct observations.

6.1. Treatment Summary

For NSO, Table 7 displays vegetation management treatments by habitat type. Except for plantation thinning, most of the treatments occur in NSO habitat. We address the effects from the proposed recreation actions on NSO and its habitat in section 6.4.8. For Franklin's bumble bee, approximately 145 acres of meadow restoration areas contain substantial floral resources the species may use (see Table 11). The action area does not overlap with a high priority zone, but if the species is present, the meadow restoration, trail construction, and road decommissioning activities may affect it or its nesting or overwintering habitats. As the Forest may not have the capacity or resources to treat each area as described, or conduct all the treatments as mapped, the effects to both NSO and Franklin's bumble bee habitat may be less than anticipated in this chapter (C. Napper, personal communication, November 7, 2023).

6.1.1. Vegetation Management Summary

Chapter 1 describes the initial timber harvest and vegetation management actions for each treatment type, based on information in the BA. For initial treatments, the forest stands, plantations, oak-conifer woodlands, meadows, Port Orford cedar, and shrublands will be treated with mechanical ground-based equipment or whole tree yarding. Manual thinning or lopping and scattering may also be used in some areas or in the meadows. Treatment areas with slopes greater than 35 percent will be treated using cable or skyline yarding systems, cable assist tethering, or helicopter methods.

As the BA does not describe where these different treatment methods may be used (e.g., where new skyline corridors or openings would be required or an acreage estimate), our effects analysis takes into consideration the greatest probable impacts. Equipment to complete initial vegetation management treatments includes chainsaws, mechanical timber harvesters, excavators, bulldozers, tracked chippers, cable yarders, rubber-tired or track-mounted skidders, or masticators (BA pp. 14-16).

The BA describes the initial thinning treatments and follow-up activity and surface fuels reduction treatments (BA pp. 14-16). This could include masticating, chipping, manual lopping and scattering, and/or piling and burning smaller trees, shrubs, coarse woody debris, and limb breakage from timber harvest. The <10" dbh trees and shrubs that could act as surface and ladder fuels to transfer fire from the ground into the residual overstory tree canopies will be reduced or removed (BA pp. 5, 14, Table 5). These treatments will occur prior to prescribed fire activities.

During prescribed fire activities (e.g., pile burning, jackpot burning, underburning/broadcast burning), downed wood will be retained, as feasible, at a range of 5-10 tons per acre. Burning techniques will be utilized to achieve low intensity fire behavior to help preserve residual trees and downed wood. These burning techniques are expected to minimize the loss of the remaining

NSO nesting, roosting, and foraging habitats, and prey habitat which includes mycorrhizal fungi. Collectively, prescribed fire and broadcast burning will be used in all or most of an area with well-defined boundaries across the project area (BA pp. 14-15, Table 5). Prescribed fire may be implemented using drip torches, fuzees, vary pistols, or by helicopter.

6.1.2. Snag and Down Log Retention Summary

According to the BA, large snags and 5-10 tons per acre of coarse woody debris (CWD) will be retained where snags or this level of CWD currently exist. Snags felled for safety reasons will be retained on site to provide additional CWD (BA p. 31). Approximately four percent of the treatments are located in the Forest Plan's LSR or MLSA land allocations where larger size classes and amounts of snags and down logs will be retained (see section 1.3 of this BO).

Conservation measures for LSR and MLSA land allocations include retaining logs 15" in diameter and 10 feet long, though larger size classes are preferred (e.g., 20" diameter). Conservation measure CM-2 for mixed conifer stands in the LSR and MLSA allocations will retain 10 logs of the largest size class on north and east aspects, with 6-7 logs retained on south and west aspects. In white fir or red fir stands, 8 logs per acre of the largest size class will be retained on all aspects. Outside of the LSR and MLSA land allocations, large coarse wood (≥ 20" diameter and 10 feet long) will be retained at a rate of 5-10 tons per acre, as feasible.

The BA indicates all thinning treatments will retain the largest snags wherever possible, though snag retention metrics may not be met equally on every acre. Snags prioritized for retention include those with broken, forked, or flat tops, or with large boles, limbs, and cavities. Outside of the LSR and MLSA land allocations, an average of 1.5 snags per acre >15" dbh and 20 feet in height will be retained where available (BA p. 32). Conservation measure CM-3 for mixed conifer stands in the LSR and MLSA allocations describes retaining 6 snags per acre in mixed conifer stands on north and east aspects, with 2-4 per acre retained on south and west aspects. In white fir or red fir stands, 7 snags per acre will be retained on all aspects. Snags felled for safety reasons may be retained on site to provide CWD (BA p. 32). Both logs and snags in advanced states of decay will be prioritized for retention.

6.1.3. Hazard Trees, Roads, and Landings Summary

Hazard tree mitigation, and landing and temporary road construction and use will occur in NSO habitat. See section 6.4.7 for the detailed effects analysis of these connected actions. Hazard trees will be cut to protect the safety of forest users, in areas such as campgrounds and picnic sites, special use sites, and along roads open to the public. Hazard tree mitigation (felling and leaving, or felling and removing) typically occurs within approximately 250 feet of a road on the uphill side and within approximately 150 feet on the downhill side. The USDA-FS Region 5 Hazard Tree Identification and Mitigation document will be used to identify, monitor, and mitigate hazard trees (Angwin *et al*. 2022).

There are approximately 79 miles of National Forest Transportation System roads that could be used to implement the project (BA p. 15). There is no proposal to construct new permanent roads. Existing unauthorized routes may be used as temporary roads and will be decommissioned after use. Decommissioning of non-system roads in meadows and areas of concern for resource damage will also occur. Road maintenance typically consists of grading, resurfacing, culvert cleaning, hazard tree mitigation, snow plowing, clearing roadside brush, installing rolling or critical dips, and removing debris from landslides or road cutbank slides.

Landings will be approximately ≤ 1 acre in size. There are existing landings in the project area that can be utilized. New landings will be constructed in generally open areas either inside or outside treatment units whenever possible. If new landings or temporary roads are needed, they will be created outside of NSO nesting/roosting habitat as feasible, or if they are constructed in these habitats, live trees >24" dbh will be retained as safely feasible (BA pp. 14, 53). Heavy equipment to construct landings, skid trails, or temporary roads, and to conduct road maintenance, may include bulldozers, graders, dump trucks, or excavators.

6.2. Project Effects to Northern Spotted Owls from Disturbance

Heavy equipment is required for timber removal and hauling associated with commercial or non-commercial tree thinning or chipping. It can also be used to implement other vegetation management activities. It may be used in developed recreation sites to make improvements, to replace bridges, or to construct new or expand existing recreation areas such as parking areas, campgrounds, or trailheads.

The project's vegetation treatments will be implemented using ground-based (mechanical and manual), skyline, cable, or helicopter methods. This will include the construction or reconstruction and use of skid trails, landings, and roads; mastication; piling and burning piles; underburning; and other mechanical fuels work (see section 6.1 above). Mechanical harvesters, feller-bunchers, yarders, processors, excavators, skidders, helicopters, chainsaws or other power tools, and large vehicles can introduce an increased level of sound, smoke, and human activity into the environment.

6.2.1. Noise Disturbance

Refer to Chapter 5 for our scientific basis regarding estimating the effects to NSO from noise disturbance. Harassment can occur when heavy equipment is used during the critical breeding season where it can potentially impair essential behavioral patterns related to breeding, feeding, or sheltering (see Chapter 5). Where the potential for disturbance rises to the level of harassment, the disturbance is typically mitigated using seasonal restrictions that prevent operations during the breeding season. Smoke and noise are more likely to significantly disturb and negatively affect NSOs during the critical breeding season (February 1 through July 9). This is because of the presence of unhatched eggs, young that cannot avoid the disturbance, adults that are reluctant to leave their nesting site, and the disruption of foraging activities which influences the fitness and survival of adult NSOs and their young.

Conservation measure CM-4 restricts loud and continuous noise-generating activities above ambient levels from February 1 through July 9 to avoid or minimize direct adverse impacts to breeding NSOs and their young. This seasonal restriction may be lifted if protocol surveys demonstrate nesting NSOs are not within 0.25-mile of planned activities that produce loud and continuous noise exceeding ambient levels.

For context regarding survey efforts to lift seasonal restrictions, the 2012 NSO survey protocol and methodology was designed to maximize the probability of detecting NSOs in the presence of barred owls (USDI FWS 2012a). As described in chapter 4, barred owls were recently detected in the action area in 2018, 2019, and 2022 (CNDDB 2023). Surveys or stand searches for NSO have been completed annually over the last 4-6 years for the Scott (both historic and current locations), Soapstone, and Morgan cores and home ranges. This included two years of six-visit protocol surveys in the action area (2019 and 2020), followed by spot checks (2021-2023) (USDI FWS 2012a). The long history of almost annual stand searches and other survey efforts for these three sites extends from 1986 through 2008 (BA p. 22, Table 8). Long-term occupancy is evident in both the Soapstone and Scott territories, with multiple detections occurring between the two territories and other detections of adults and young in varied locations in each home range (CNDDB 2023). The Morgan territory has not been occupied since a single NSO was detected in 2005, following a pair detection in 2004 (BA p. 22, Table 8).

Based on the BA, NSO protocol-level surveys, or other survey methods as agreed-to with the Service, will continue throughout project implementation (BA pp. 32-34). Despite the presence of barred owls in and near the action area, the probability of NSO detection is considered high to moderate given the survey information to date and the current habitat conditions that support NSO.

Given the incorporation and implementation of conservation measure CM-4 as described above, direct or adverse effects to NSOs or their young from loud and continuous noise disturbance during the critical breeding and nesting season is not expected. If protocol surveys, stand searches, or other agreed-to survey methods demonstrate NSO are not nesting, the seasonal restriction for noise-generating activities may be lifted for the year of action. While the BA does not discuss the use of autonomous recording units (ARUs), these could help provide a higher level of certainty regarding NSO occupancy in the action area over the next 30 years of project implementation (Lesmeister *et al*. 2019, 2022).

6.2.2. Smoke Disturbance

Refer to chapter 5 for our scientific basis regarding estimating the effects to NSO from smoke disturbance. Smoke-generating activities can also result in disturbance during the critical breeding and nesting season, especially when they occur within 0.25 mile of nesting, roosting, or foraging habitat areas considered large enough to support a nesting NSO pair.

The burning of machine piles or larger landing piles and underburning/broadcast burning actions primarily occur during the fall or wetter months of the year. This is typically from mid to late September through December when precipitation events are forecast. Tree-well burning in snowy conditions may also occur in early January through March. The burning of hand piles could occur at any time of the year, given their smaller size and lower risk of fire spread between the piles. Timing for all prescribed fire actions can vary however, depending on the amount and duration of precipitation in any given year.

Smoke generation from burning hand piles is commonly short in duration and small in magnitude because only a small number of piles are burned over a couple days in any one area or drainage. Burning machine piles or larger landing piles can generate larger amounts of smoke or smoke for longer periods, given the larger pile size. Smoke from broadcast burning can also have a larger probable impact due to a larger spatial extent of the burn blocks. If prescribed fire activities occur between February 1 and July 9, nesting NSOs can be impacted by moderate or heavy levels of smoke inundation.

Conservation measure CM-5 restricts smoke-generating activities within 0.25 mile of an NSO activity center or nest location, or within 0.25 mile of unsurveyed NRF habitat from February 1 through July 9. The smoke management guidance developed by the Forest and Service in 2020 can be utilized between February 1 and July 9 within 0.25 mile of unsurveyed NRF habitat in order to burn hand piles and to conduct strategic underburning in areas not likely to impact breeding NSO, as discussed and agreed to by the two agencies. See Appendix C for a map of specific areas.

As described in section 1.3 of this BO, conservation measure CM-4 also restricts underburning or broadcast burning (which also generates smoke) because it is considered a form of habitat modification. This seasonal restriction extends from February 1 through September 15 within a 0.5-mile of an active nest, or within unsurveyed NRF habitat presumed occupied by nesting NSOs.

Based on the incorporation and implementation of the two conservation measures described above, and adherence to the smoke management guidance between February 1 and July 9 in key areas, adverse effects to breeding NSOs or their young from smoke disturbance during the critical breeding and nesting season is not expected. If protocol surveys, stand searches, or other agreed-to survey methods demonstrate NSOs are not nesting, the seasonal restriction for smoke-generating activities may be lifted for the year of action.

6.3. Project Effects to Northern Spotted Owls from Direct Injury or Mortality

Conservation measure CM-4 also minimizes or avoids the likelihood of direct injury or mortality of nesting adult NSOs, their young and juvenile NSOs during the critical nesting period of February 1 through September 15. Conservation measure CM-4 prohibits any modification of NRF habitat within 0.5 mile of a known nest or in unsurveyed NRF habitat during this timeframe. This conservation measure applies to mechanical or manual thinning of vegetation, burning machine-created piles where fire can possibly spread and creep between piles and burn up smaller trees that young owls could be using, underburning in large blocks, or other broadcast burning that could modify NRF habitat in occupied cores or nest stands during this timeframe.

Given the incorporation and implementation of conservation measure CM-4 for habitat modification, we consider the potential for direct injury or mortality of nesting NSO adults, fledglings, and juveniles to be low. Adverse effects to nesting NSOs or their young from habitat modification are not expected, particularly in occupied NSO cores and unsurveyed NRF habitat, because of the seasonal restrictions. Non-nesting subadult or adult NSOs are not expected to be killed or injured because they will likely avoid active treatment areas. If protocol surveys, stand searches, or other agreed-to survey methods demonstrate NSOs are not nesting, the seasonal restriction for habitat modifying activities may be lifted for the year of action.

6.4. Project Effects to Northern Spotted Owls from Habitat Modification

We utilize and consider varied sources of information to estimate the likely degree of change in habitat quality or function from the proposed vegetation management treatments and recreation actions. Our effect determinations for impacts to NSO habitat in the action area are based on the definitions of NRF and dispersal habitat important for recovery on federal lands (Chapter 4 and Appendix B). Our conclusions are also based on information gathered during our field reviews of habitat type and quality, our reviews of stand conditions in current and historic NSO cores and home ranges, data from common stand exams, and the thinning treatments described in the BA, Draft EA, and other resource reports. We are also informed by past reviews of similar treatments and prescribed fire applications in NRF and dispersal habitat. With these tools, we can provide a quantitative and qualitative assessment of treatment effects to determine the degree of change in habitat. Refer to chapter 5 for our scientific basis regarding effects from habitat modification.

6.4.1. Summary of the Proposed Action in NSO Habitat

Several tables in the BA summarize effects to NRF and dispersal habitat. As described in section 6.1, our effects analysis is based on our independent habitat review. To determine if effects are beneficial, insignificant, discountable, or adverse, we consider the location and continuity of treatment. We also consider if the treatment is in an occupied NSO core or home range; high value habitat; an area of likely use for connectivity or dispersal; along a road with a narrow, linear configuration; a large contiguous block; or is isolated.

- Approximately 1,986 acres of nesting/roosting habitat, 6,161 acres of foraging habitat, and 4,065 acres of dispersal habitat are proposed for treatment (Table 7). Prescribed fire activities (pile or jackpot burning, underburning/broadcast burning) will either overlap with initial thinning treatments or will be implemented as a stand-alone treatment.
- Our analysis finds there will be adverse effects in 4,351 acres of NRF habitat and 1,549 acres of dispersal habitat from habitat loss and modification. This includes portions of two long-term occupied cores and home ranges, the connectivity corridors between them, and other connectivity areas in the action area. These effects in NRF and dispersal habitat will occur from FMZ treatments and in NRF habitat from the 80-120 ft^2/ac thinning treatment. We expect significant reductions in canopy cover, canopy closure, and under and midstory layering from these treatments. The accumulated impacts from follow-up fuels treatments and prescribed fire will compound the adverse effects over time.
- An additional 3,512 acres of NRF habitat will be treated and remain functional with reduced quality. We do not consider these effects adverse or long-term to habitat function. But given the treatment continuity and follow-up fuels treatments, we expect adverse effects to NSO prey species and decreased fitness of NSOs from higher energy expenditures to locate prey as they respond to the landscape disturbance. Approximately 82 acres of NRF habitat will be maintained where true fir stands are thinned to retain a higher basal area, with similar disturbance impacts to prey.
- We expect neutral and beneficial effects in approximately 202 acres of NRF habitat. The meadow restoration situated near NRF habitat, oak-conifer woodland restoration, and plantation thinning will benefit NSOs and their prey. Prescribed fire as a stand-alone

treatment in higher elevation areas and near Castle Lake are also expected to be neutral to beneficial to NSO habitat. In the remaining 2,516 acres of dispersal habitat treated, we expect neutral to beneficial effects.

The removal or reduction of habitat elements that require long timeframes to develop (e.g., large trees, canopy layering, snags, and large downed wood) can have long-term effects to the amount and quality of NSO habitat (USDI FWS 2011, 2012). The BA indicates treatments will retain the largest trees on any site, but some treatments will remove large trees in order to increase canopy spacing, or to thin and remove trees from around even larger trees (BA pp. 31, 55). Large trees are not defined, but our assumption is the dominant trees in a stand. The draft silviculture report describes larger trees will be thinned to 120-160 ft^2/ac in stands suitable for nesting and roosting and 80-120 ft^2/ac in foraging in NSO home ranges but outside cores (USDA-FS 2023c p. 15).

NSO fitness can be reduced (e.g., less successful reproduction, lower survival, or in some instances site abandonment) if extensive stand simplification occurs. This can result in altered foraging behavior and decreases in nest attendance and reproductive success (White and Thurow 1985, Andersen *et al*. 1989, McGarigal *et al*. 1991). With the project, simplification of NRF habitat will primarily occur in the FMZ treatments, and several other areas of continuous thinning treatment that reduce basal areas to a range of 80-140 ft^2/ac. This simplification is considered adverse and significant in areas of continuous thinning because of the location of some treatment blocks where a high occurrence of NSO use has been observed and documented over the last 20 years. Or where NSO use is more likely in mid to lower slope positions and in NSO cores or home ranges. Where overlapping and continuous treatments reduce the stand basal area, canopy cover and closure, layering, snags, and downed wood, negative impacts to NSOs attempting to use or cross these areas can occur from increased vulnerability to predation or from reduced prey availability of flying squirrels or woodrats (Zabel *et al*. 1992, Lehmkuhl *et al*. 2006, Meyer *et al*. 2007, Luoma *et al*. 2004, Gomez *et al*. 2005).

Table 7. Acres of vegetation treatments by NSO habitat in the action area.

Treatment	Nesting / Roosting	Foraging	Dispersal	**Total NRF**	Non-Habitat	**Total**
Thin <10" dbh on a 35' spacing and underburn	465	650	126	**1,115**	62	1,303
FMZ (60-80 ft^2/ac) and follow-up fuels treatments	685	2,578	1,549	**3,263**	1,660	6,472
80-120 ft^2/ac and follow-up fuels treatments	120	968	632	**1,088**	261	1,981
120-160 ft^2/ac and follow-up fuels treatments	0	51	23	**51**	44	118
140-200 ft^2/ac and follow-up fuels treatments	621	1,554	551	**2,175**	332	3,058
160-200 ft^2/ac and follow-up fuels treatments*	53	29	0	**82**	0	82
Fuels Unit	0	105	332	**105**	220	657
Meadow Restoration	5	13	13	**18**	133	164
Oak Conifer Woodland	0	28	52	**28**	3	83
Plantations	0	0	0	**0**	592	592
Port Orford Cedar Treatment	37	29	18	**66**	5	89
Underburn/Broadcast burn only	0	156	769	**156**	761	1,686
TOTAL	**1,986**	**6,161**	**4,065**	**8,147**	**4,073**	**16,285**

*BA p. 31 describes that outside of NSO cores and home ranges, true fir stands will be thinned to a range of 120-160 ft2 basal area (accounted for above). Within the Scott home range, there are approximately 82 acres of true fir stands that will be thinned to 160-200 ft^2/ac.

6.4.2. Effects to Nesting/Roosting Habitat

The project will treat approximately 1,986 acres of nesting/roosting habitat. The most consequential adverse effects in this habitat will occur from the reduction and removal of forest stand and habitat complexity across 805 acres. These effects will occur in 25 percent of the nesting/roosting habitat in the action area. As a result, areas that currently provide habitat conditions for nesting or roosting will no longer do so. This is because of the loss and reduction of canopy cover and closure, mid and understory layering, thermal refugia and cooler microclimate conditions, and cumulative impacts from follow-up fuels reduction treatments. The effects will occur from the 685 acres of FMZ and 120 acres of 80-120 ft^2/ac thinning treatment.

Table 8. Estimated effects in nesting/roosting habitat areas by treatment type.

Treatment	Acres	Effect to High Value Habitat with Nesting/Roosting Conditions
Thin <10" dbh on a 35' spacing and underburn	465	Degrade
FMZ (60-80 ft^2/ac)	685	Remove
80-120 ft^2/ac	120	Downgrade*
140-200 ft^2/ac	621	Degrade**
160-200 ft^2/ac true fir in cores/home ranges	53	Maintain
Meadow Restoration	5	Maintain
Port Orford Cedar Treatment	37	Degrade
Total	**1,986**	

* Refer to the discussion below for the possible range of effects

**Areas of nesting/roosting habitat situated in foraging habitat, or entire nesting/roosting stands treated with the 140-200 ft^2/ac thinning prescription will be marked, per Conservation Measure CM-1, to retain a higher basal area such that nesting/roosting habitat is not downgraded.

Existing canopy cover and closure will be reduced below 60 percent by these two treatments (see chapter 1 for the treatment prescriptions). Removing existing canopy cover, including the mid and lower canopy layering and closure which intermediate and smaller size class trees provide, will reduce the availability of roost and perch sites, and alter the microclimate conditions which support roosting habitat. The removal of mid-canopy layering will also have adverse impacts on flying squirrels, which are prey for NSO (Wilson 2010, Wilson and Forsman 2013). Where nesting/roosting (and foraging) habitat is removed, stand conditions will be hotter and drier. The significant removal of trees and overall reduction in canopy cover is expected to facilitate future growth of understory shrubs and brush. Similar shrub-growth and response after past thinning projects or fires has been observed in portions of the project area where there is abundant huckleberry oak (*Quercus vacciniifolia*), snowbush (*Ceanothus velutinous*), and bush tanoak (*Lithocarpus densiflorus* var. *echinoides*) with few overstory trees.

The FMZ treatments in nesting/roosting (and foraging) habitats are relatively continuous. Near Scott Camp Creek, the length of the FMZ treatment area is approximately three miles. It extends from the eastern portion of the Scott core to outside the home range along this creek. Along Forest Route 26 and in the central portion of the project area, the FMZ treatment area extends approximately seven miles from the northwestern portion of the Soapstone home range, then along Forest Route 26 and the South Fork Sacramento River and into the western extent of the Scott home range. The treatment area within intermixed nesting, roosting, and foraging habitats ranges approximately 0.5 mile wide to one mile wide.

The current habitat conditions with higher basal area ranges and canopy cover in nesting/roosting (and foraging) habitats will be reduced to 60-80 ft^2/ac by the FMZ treatment. Based on this basal area range, the distance between individual tree canopies is expected to be 20-35 feet, with canopy cover ranging from 20 to 30 percent. This will remove important habitat features and alter microclimate conditions from part of the currently occupied Scott core and home range, and portions of the Soapstone home range. Where the FMZ treatment occurs in nesting/roosting habitat in the eastern extent of the project area, there have been few to no NSO detections and the habitat patches are less continuous and more interspersed with foraging habitat. This includes areas northeast of Castle Lake, along and near Castle Lake Creek, and outside of the Scott home range along Scott Camp Creek.

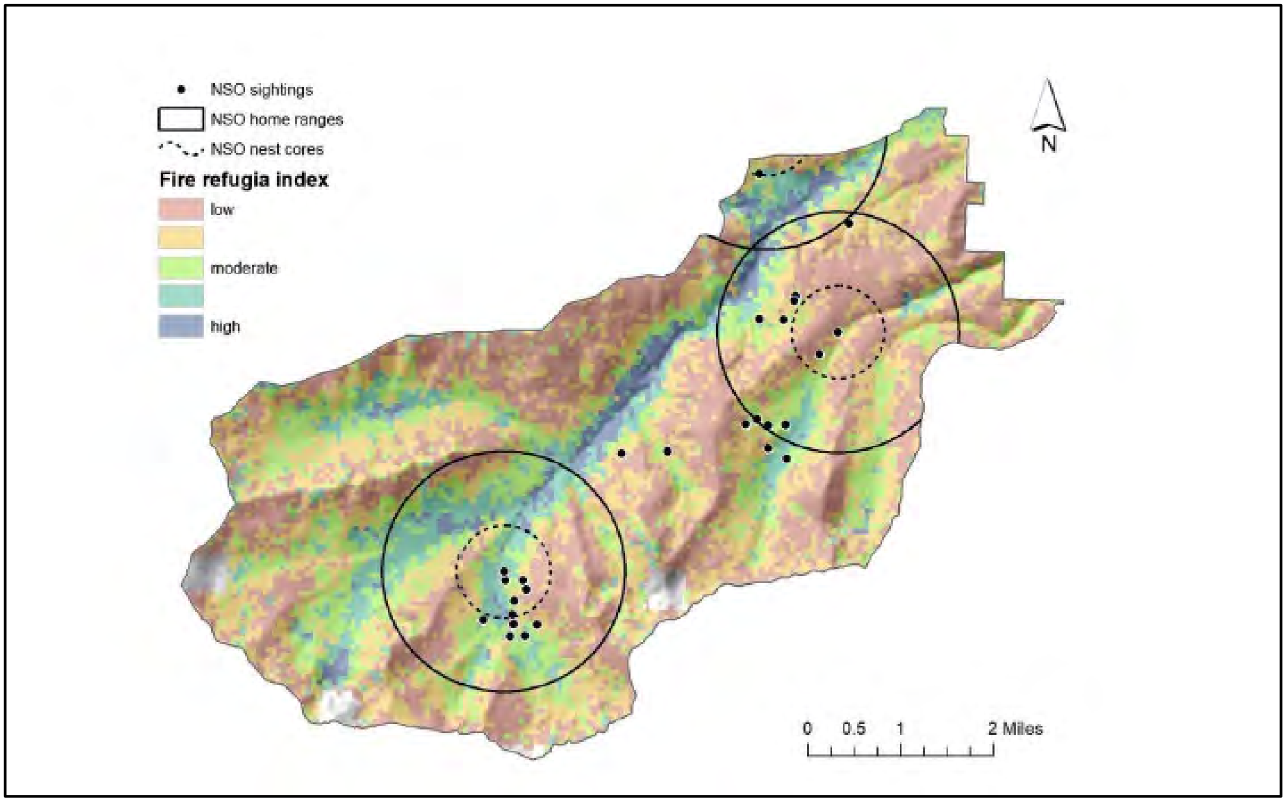

Figure 4. Map of fire refugia in the project area combined with visual observations for NSO (from Final BA Figure 4)

NRF habitat will also be removed from the mapped fire refugia between the Soapstone and Scott home ranges which, based on a review of habitat and NSO detections, provides connectivity between the two sites and to the west in mid and lower slope positions. Figure 4 in the BA (and Figure 4 below) displays the modeled fire refugia for the action area (Oregon State University 2022). Based on information from Oregon State University, fire refugia could provide vital habitat for threatened and endangered species during a time of rapid change. In addition, fire refugia areas that have been demonstrated to persist under more extreme fire conditions, or repeated burns, are a critical anchor to consider in future late-successional reserve design and management planning. The BA defines fire refugia as, "areas that burn less frequently and severely are consistent with higher tree and snag densities, downed wood, and have higher use of wildlife that select for these conditions (Underwood *et al*. 2010). Moister, denser, closed-canopy forest types and wildlife use align well with fire refugia and outside of them the forests historically tended to burn more frequently, such as mixed conifer, pine and oak woodlands with wider spaced trees, less understory cover, and more opened canopies" (BA p. 12).

The FMZ treatment of 60-80 ft^2/ac basal area, which overlaps the majority of the modeled fire refugia, appears contradictory to maintaining and protecting these areas and the habitat they can provide. The project includes follow-up fuels treatments and maintenance every 5 to 10 years to maintain the Forest's desired conditions of surface fire and flame lengths at less than four feet under 90th percentile weather conditions. As acknowledged in the BA, where nesting/roosting habitat is removed, it is not expected to recover or re-develop these conditions in the future given the follow-up treatments and continual maintenance (BA pp. 36-37). Figure 5 displays the action area NSO habitat with proposed treatments under alternative 4.

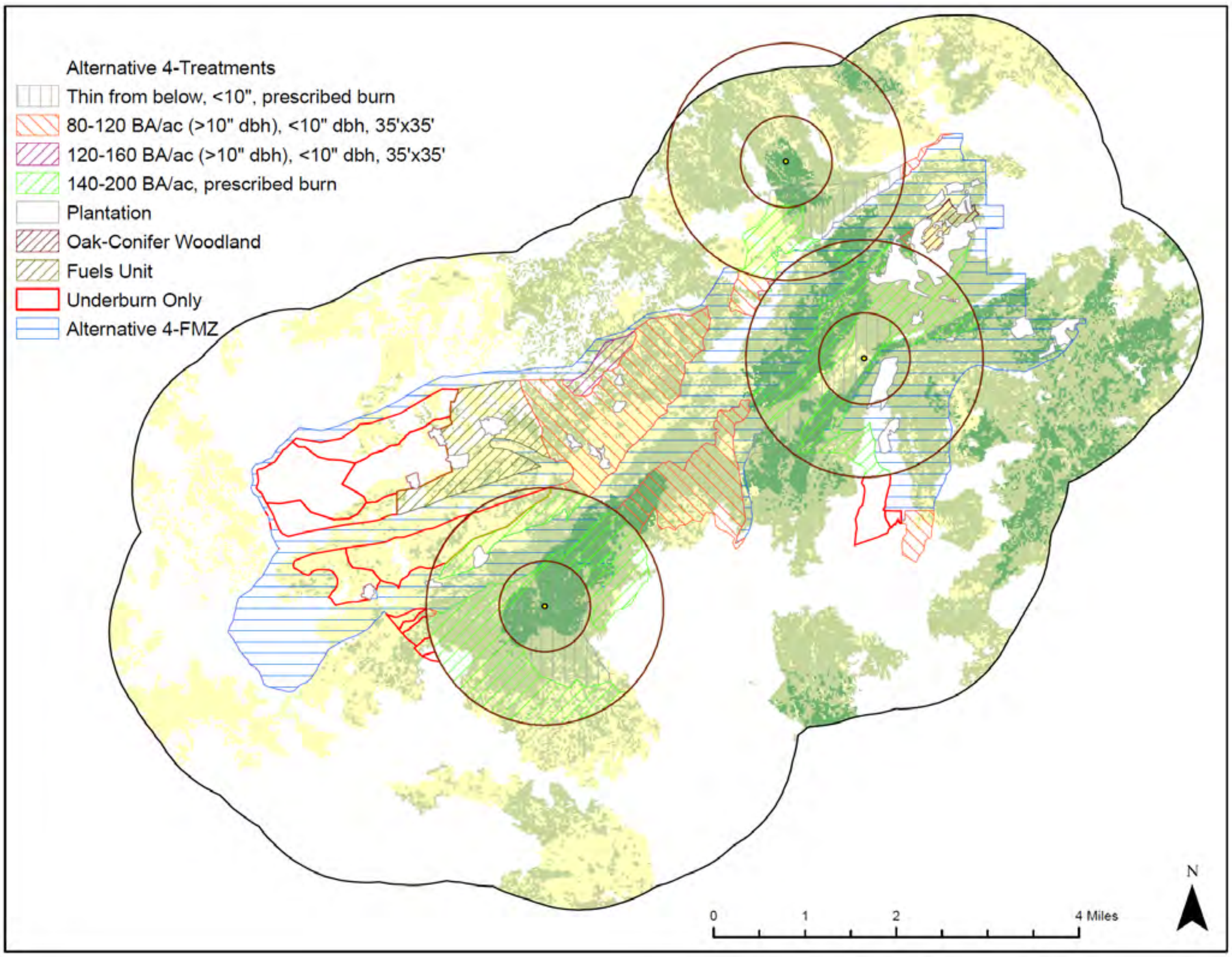

Figure 5. NSO action area habitat with Alternative 4 treatment locations.

Treatment placement relative to other continuous thinning treatment areas in nesting/roosting habitat varies and is considered in our effects analysis. The effects of the FMZ treatment and the 80-120 ft^2/ac thinning treatment are considered adverse and long-term, primarily due to their continuity, scale, placement in occupied NSO cores and home ranges, or placement in areas that provide connectivity between higher value habitats (Figure 6). The effects are considered a permanent removal of habitat, given the planned maintenance and reduction of smaller diameter surface and ladder fuels and repeat prescribed fire entries.

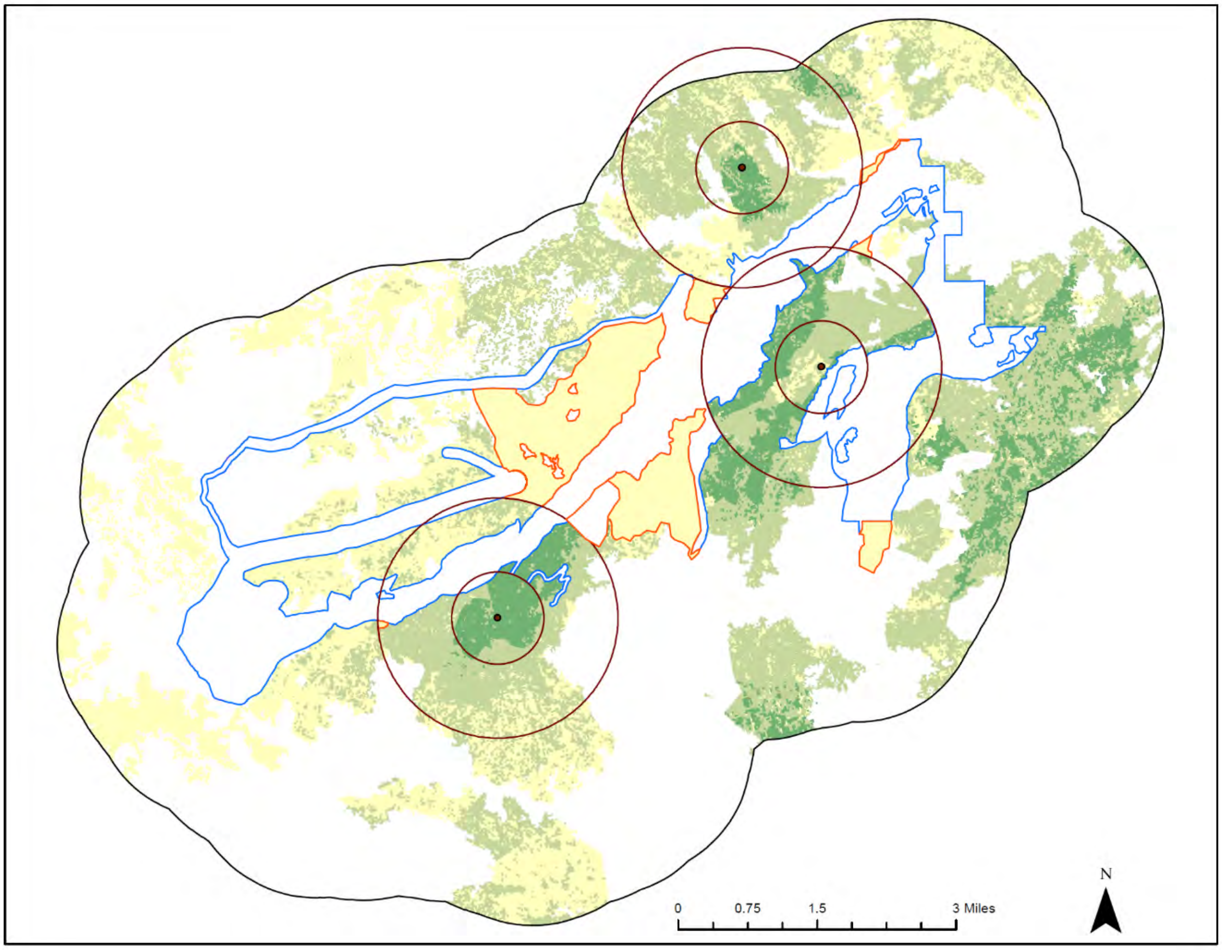

Figure 6. NSO action area habitat after FMZ and 80-120 ft^2/ac thinning treatments.

The Forest anticipates the FMZ and 80-120 ft^2/ac thinning treatments will reduce the likelihood of NSO habitat loss due to stand replacing wildfire (BA p. 6). As observed in recent fires on the Shasta-Trinity and Klamath National Forests, and other parts of the NSOs range, wind-driven fires during extreme temperature and low relative humidity conditions are not preventable or manageable due to the extreme weather conditions. Similar conditions were observed during the 2020 Slater Fire, the 2021 Antelope Fire, and the 2022 McKinney Fire which burned at high severity across the majority of each fire's area. Recent thinning and fuels reduction projects had been completed in several parts of these fire areas within the past 2-5 years (i.e., the Craggy Project, fuels reduction and prescribed fire actions near and around Happy Camp, Big Pony, and parts of the Six Shooter project). Fire effects in some of these treatment areas were severe, given the high winds. Though in portions of the 2021 Antelope Fire area, past thinning and repeat underburning treatments from over the last 20 years had a higher resilience to fire effects (Knapp 2021).

Depending on the existing vegetation conditions and fire behavior, thinning treatments may or may not be effective at reducing high severity wildfire impacts to NSO habitat. Wildfires are expected to occur with greater frequency and severity in both the California Cascades and

California Klamath recovery units, given current projections for climate change and drier, warmer winters (IPCC 2022). The effects of the long-term removal of nesting, roosting (and foraging) habitat to try to conserve or protect habitat from loss or reductions from a future wildfire is a trade-off.

The 80-120 ft^2/ac thinning treatment consists of a range of basal areas, and subsequently may result in canopy cover and open understory conditions more likely to support lower quality foraging or dispersal habitat (i.e., 40 percent or lower). We expect nesting/roosting habitat conditions to be downgraded to low-quality foraging or dispersal in the 110-120 ft^2/ac range, or removed in the 80-110 ft^2/ac range. Because there is uncertainty regarding the severity and magnitude of impacts, approximately 120 acres of nesting/roosting habitat will be downgraded to low-quality foraging or dispersal, or even removed in some areas when considering the effects of the follow-up fuels reduction and maintenance treatments. The effects will occur in a portion of the connectivity corridor between the Soapstone and Scott home range areas. See chapter 4 for the information we rely upon to predict these changes, specifically habitat conditions known to support NSO recovery and conservation on federal lands (USDI FWS 2011, 2012) and to avoid take in NSO cores and home ranges on private lands (USDI FWS 2008, 2009, 2019).

As described in chapters 4 and 5, the Service uses current and expected residual canopy cover as one factor in its evaluation of potential impacts to NSOs and their habitat. Canopy cover is believed to be important because of prey associations (Forsman *et al*. 1984), acting as a thermal mediator (Forsman *et al*. 1984, Barrows 1981, and Thomas *et al*. 1990) and providing concealment cover for predator protection (Thomas *et al*. 1990). Canopy cover alone is unlikely to provide good insight into a stand's ability to provide NSO habitat; rather, it is one factor associated with use. For example, lower quantities of one factor may be ameliorated by higher quantities of another. North and others (2017) found canopy cover of large trees a better predictor of California spotted owl nest site locations than total canopy cover. Most likely, it is the combination of several factors in variable quantities that influence the likelihood of NSO use (Zabel *et al*. 2003, Irwin *et al*. 2007, 2020). Generally, however; there is little evidence that stands with <40 percent canopy cover are substantially used by owls, and that 40 to 60 percent canopy cover may not preclude use if other features are present (e.g., perches and relatively higher prey density), while stands with denser canopy cover are most commonly used by spotted owls for nesting, roosting, and foraging (Barrows and Barrows 1978, Solis and Gutiérrez 1990, Franklin *et al*. 2000, Weathers *et al*. 2001, Forsman *et al*. 2004, USDI FWS 2011, 2012).

Approximately 621 acres will be thinned to a basal area range of 140-200 ft^2/ac (Table 8). Conservation measure CM-1 will ensure stands with nesting and roosting habitat elements are marked to retain higher basal area ranges above 150 ft^2/ac. Basal area is not the sole definition of NSO habitat but it can help inform habitat conditions. The number of large (≥26" dbh) trees per acre, high amounts of canopy closure, presence of trees with nesting structure (e.g., forked tops, mistletoe brooms, snags), and midstory and understory complexity are other factors that contribute to habitat quality.

The 140-200 ft^2/ac thinning treatment areas are relatively continuous and intermixed with some higher value foraging habitat in the currently occupied Scott and Soapstone home ranges (Figure 5). There will be impacts to nesting/roosting habitat, but with the implementation of conservation measure CM-1, we do not expect a significant reduction or loss of overstory or midstory canopy closure or larger tree structure that will modify microclimate conditions for nesting or roosting owls. While these 621 acres would continue to provide nesting or roosting conditions, the continuous treatment in the occupied sites and higher value habitat will result in cumulative adverse effects to NSOs and their prey. We expect adverse effects given the primary placement in active NSO home ranges, the continuity with other treated foraging habitat, and the location of the treatments at lower and mid slope positions in gentler, flatter terrain that NSO select for.

Thinning <10" dbh trees to a 35-foot spacing with follow-up underburning across 465 acres of nesting/roosting habitat is expected to reduce some understory and midstory complexity and habitat quality. The treated areas will continue to provide nesting and roosting opportunities as larger overstory trees and current overstory and midstory canopy cover would be retained. Not every tree in the <10" dbh size class and smaller will be removed or thinned. And understory structure for fledgling owls that cannot yet fly will remain available for individuals to climb back up into the nest tree(s), or other surrounding trees or vegetation. This treatment type is located in portions of the three territories assessed in the BA and in the historic Scott territory.

Thinning 53 acres of true fir stands in the Scott home range is expected to maintain habitat conditions for nesting or roosting behaviors, including roost sites and microclimate conditions for juvenile, subadult, or nonterritorial owls. We do not expect a change in overall canopy cover, closure, layering, or larger size class trees from the 160-200 ft^2/ac thinning treatments (USDI FWS 2011-Appendix C, 2012).

Port Orford cedar treatments along roads may remove or reduce stand elements from approximately 37 acres of nesting/roosting habitat. These trees can provide a high degree of shade and cooler microclimate conditions for roosting owls, given the tree's higher density in riparian corridors. There are currently no known occurrences of Port Orford cedar root disease (*Phytophthora lateralis)* in the project area. According to the BA, since the root disease can be introduced through the use of roads and trails, reducing the risk of spread requires removing all Port Orford cedar in potential transmission locations (BA p. 38). This includes riparian areas that typically support nesting or roosting conditions. Where roads cross streams, Port Orford cedar trees within 50 feet on either side of the stream and up to 100 feet downstream will be removed or girdled. Where the disease is detected, host trees will be removed. Where most of the treatment is planned in nesting/roosting habitat, it is intermixed with the FMZs and other thinning areas where habitat will be removed. The exception is the Soapstone core use area where conifer trees <10" dbh will be thinned and habitat will be degraded.

The Port Orford cedar treatment will reduce the quality of roosting habitat elements and conditions, but the effects are considered insignificant in terms of influencing NSO nest or roost site selection behaviors. This is because the treatments are widespread and focused to narrow, linear areas. Girdled trees will also remain available for use until they die and lose their live canopy. Where trees are girdled in proximity to roads, it is possible they will become hazard trees over time and be felled (Angwin *et al*. 2022).

Meadow restoration will occur in or near approximately five acres of nesting/roosting habitat (Table 8). Most restoration sites in or near this habitat are one acre or smaller and some are located in the currently occupied Soapstone core or Scott home range. Given the small scale of treatment, the effects are considered discountable and not likely to alter NSO nesting or roosting site selection behavior because habitat elements that will be removed are proximal to or in existing meadow openings and will not occur in large contiguous areas.

Prescribed fire as a stand-alone treatment is not proposed in nesting/roosting habitat. Our analysis of the combined effects of thinning with follow-up prescribed fire activities in nesting/roosting habitat is below in section 6.4.6.

6.4.3. Effects to Foraging Habitat

Approximately 6,161 acres of foraging habitat will be treated (Table 7 and Table 9). The areas of foraging habitat include smaller interspersed patches and stand structure that support nesting, roosting, and dispersal behaviors due to the varied and heterogeneous habitat in the action area.

Table 9. Estimated effects in foraging habitat by treatment type.

Treatment	Acres	Effect to Foraging Habitat
Thin <10" dbh on a 35' spacing and underburn	650	Degrade
FMZ (60-80 ft^2/ac)	2,578	Remove
80-120 ft^2/ac	968	Degrade*
120-160 ft^2/ac	51	Degrade
140-200 ft^2/ac	1,554	Degrade
160-200 ft^2/ac true fir in cores/home ranges	29	Maintain
Fuels Unit	105	Degrade
Meadow Restoration	13	Maintain
Oak Conifer Woodland	28	Maintain
Port Orford Cedar Treatment	29	Degrade
Underburn/Broadcast Burn Only	156	Maintain
Total	**6,161**	

* Refer to the discussion below for the possible range of effects

Adverse effects will occur from FMZ treatments in 2,578 acres of foraging habitat due to the reduction and removal of forest stands and habitat complexity. These effects are primarily from the loss of canopy cover but also losses in mid and understory layering and cumulative effects from follow-up fuels reduction treatments. As described for nesting/roosting habitat, this is considered a long-term effect and will occur across 20 percent of the foraging habitat in the action area.

Existing canopy cover and closure will be reduced below 40 percent, with reductions in basal area to levels below the minimum known to support both dispersal and low-quality foraging. Removing existing canopy cover, including the mid and lower canopy layering, will open up the stands and expose foraging or dispersing NSOs to a higher risk of predation. While prey (woodrats, deer mice) may benefit from the expected growth response of understory shrubs and natural regeneration, the removal of mid-canopy layering will also have adverse impacts on flying squirrels (Wilson 2010, Wilson and Forsman 2013). Where foraging habitat is removed, stand conditions will be hotter and drier. And as described for nesting/roosting habitat, the significant reduction in canopy cover is expected to facilitate growth of shrubs and brush, including snowbush, huckleberry oak bush tanoak, manzanita species, and other shrubs with few overstory trees.

Follow-up fuels treatments are proposed to maintain desired conditions through fuel break maintenance and repeated application of prescribed fire (USDA-FS 2023d, p. 6). Areas may also receive additional burn entries every 5-10 years. These maintenance treatments, notably if completed with mechanized equipment, may result in long-term continuous removal of foraging habitat conditions and prey impacts. As described for nesting/roosting habitat, the FMZ treatments are relatively wide and contiguous. Foraging habitat will be removed from the current Scott and Soapstone cores and home ranges, and from the modeled fire refugia between the two sites which affords connectivity between the territories and areas to the west (Figure 6).

Due to the heterogenous nature of NSO habitat across the action area, important stand elements that contribute to foraging habitat will be variously affected by the 80-120 ft^2/ac thinning treatment across 968 acres. The effects from the initial thinning treatment should result in adequate levels of canopy closure to meet low-quality foraging or dispersal standards of 40 percent. However, the additional removal of understory and midstory layering, trees, snags, and coarse woody debris from follow-up fuels reduction and underburning may not provide foraging habitat conditions or sustain prey in all areas. This thinning treatment consists of a range of basal areas and the lower end of the canopy cover range expected to support low-quality foraging or dispersal habitat. As there is uncertainty regarding the severity and magnitude of impacts to canopy cover, tree spacing, and mid and understory layering from this treatment, habitat conditions may still provide some minimal foraging opportunities because of prey habitat in more open areas. These effects will occur in a portion of the connectivity corridor between the Soapstone and Scott home range areas.

Retrospective observations and studies in managed landscapes where canopy cover (or closure) remained relatively high (>60 percent in NRF habitat and >40 percent in dispersal-only habitat) as well as retaining high basal area, large trees, canopy layering, and dead and down material were found to still provide functioning NSO habitat (Solis 1983, Forsman *et al*. 1984; King 1993, Anthony and Wagner 1998, Hicks *et al*. 1999, Thome *et al*. 1999, Irwin et al. 2000, 2007). Additionally, Jenkins and others (2019) evaluated three-dimensional stand partitioning between NSOs and barred owls, and reported NSOs preferentially selected for cover between 2 and 8 meters, whereas barred owls only selected this cover during the non-breeding season. The authors attributed this partitioning to targeted prey species distributions described by Wiens and others (2014) and potentially, protection from antagonistic encounters with barred owls.

Research suggests some types of harvest activities such as regeneration harvest and thinning or associated practices (e.g., burning slash piles) could be temporarily detrimental to dusky-footed woodrats if it reduces shrubs or downed wood. Thinning that creates substantial canopy openings could reduce habitat suitability for woodrats in the short-term but conversely can create benefits if increases in growth of shrubs follow thinning (Innes *et al*. 2007) or the creation of new ecological edges (Gallagher *et al*. 2019, Sakai and Noon 1993). A study of dusky-footed woodrats in the redwood region of California found positive relationships in the abundance of woodrats with amount of shrub cover and found lower abundances in thinned mature stands (Hamm and Diller 2009). The 80-120 ft^2/ac thinning treatment will reduce but not wholly remove important prey habitat components (e.g., snags, woody debris, shrubs). This effect will occur across eight percent of the action area's foraging habitat and the treated areas are still expected to provide minimal foraging opportunities and dispersal conditions.

The 80-120 ft^2/ac thinning treatment is located outside the current Scott and Soapstone cores and home ranges, but overlaps with mapped fire refugia and higher value connectivity habitat. Numerous NSO detections have occurred in this area over the last 20 years. This treatment is also directly adjacent to the FMZ on both sides, and the effects will further compound the habitat loss and adverse effects to prey and connectivity.

Foraging habitat will be degraded by approximately 2,389 acres of thinning treatments (Table 9) which include follow-up fuels treatments and prescribed fire. While the quality of habitat will be reduced, we expect it will continue providing foraging opportunities for NSOs. The greatest adverse impacts will be to NSO prey, given the continuous initial treatments, follow-up fuels treatments, and prescribed fire.

The 650 acres of thinning <10" dbh trees to a 35-foot spacing with follow-up underburning is expected to reduce the overall under and midstory quality and complexity of this habitat. Similar to the effects in nesting and roosting habitat, we expect these areas will continue to provide foraging opportunities as overstory trees, 40 percent or higher canopy cover, and some mid and understory layering will be retained. This treatment is considered insignificant and beneficial to NSO foraging behaviors and conditions.

Where a combined 1,605 acres of foraging habitat is thinned to basal area ranges of 120-160 ft^2/ac and 140-200 ft^2/ac (Table 9) with follow-up fuels treatments, we expect the residual stands to have at least 40 to 60 percent canopy cover or higher. Understory and midstory trees and shrubs, which provide stand complexity and prey habitat, will continue to provide foraging opportunities, but habitat quality will be reduced for approximately 5-20 years.

- The 1,554 acres of higher basal area retention (140-200 ft^2/ac) will occur in extensive portions of the Soapstone and Scott home ranges, a minor portion of the Morgan home range, and about one-third of the Scott core area. While foraging conditions would be maintained, the continuous treatment in these occupied sites within higher value habitats will result in cumulative adverse effects to NSOs and their prey. As with the downgrading of nesting/roosting habitat from this treatment, we expect adverse effects given the primary placement in occupied NSO home ranges; the continuity with other treated nesting, roosting, and foraging habitat; and the location of the treatments at lower and mid slope positions in gentler, flatter terrain that NSO select for. There are several areas of more uniform stand conditions in portions of these home ranges that will benefit from the thinning treatment. These areas are represented by conifer trees ranging from 10-18" dbh with a dense composition of smaller size class trees.
- The effects of the 51 acres of 120-160 ft^2/ac basal area treatment are considered discountable to influencing NSO foraging behaviors. This is because this treatment area is located west of the Scott home range. The effects will be discontinuous and intermixed with patches of dispersal and non-habitat and are distant from current and past NSO use areas and detections. Connectivity and dispersal conditions from the action area to areas west through this treatment area will be maintained.

The subsequent fuels reduction treatments on these combined 1,605 acres will further simplify the understory but will maintain the overstory and midstory stand structure, including larger dominant and codominant trees, intermediate trees, snags, and large logs. The largest impacts in these treatment areas, after the reduction of existing canopy and layering, will be to prey habitat and populations.

The 105 acres of fuels unit treatment will degrade or maintain foraging habitat. This treatment consists of thinning ≤10” dbh trees using manual methods (lop and scatter), or mechanical chipping or mastication. Cut material will be piled and burned prior to underburning entries. The 105 acres are located outside the Soapstone, Scott, and Morgan territories and are situated in a higher slope position. They are interspersed with dispersal and non-habitat. The effects are considered discountable in terms of influencing NSO foraging or dispersing behaviors but they are also beneficial in terms of providing some protection to nearby higher value habitats.

As in areas with nesting or roosting habitat, the Port Orford cedar treatment along roads near streams could remove or reduce stand elements from approximately 29 acres of foraging habitat. These areas likely provide higher value roosting opportunities for resident or dispersing owls. Most of the Port Orford cedar treatment is overlaps with FMZ treatment areas where foraging habitat will be removed. The exceptions are the outer portions of the Soapstone home range, and an area in the southern extent of the Scott home range along the 39N46 road. These widespread treatments, focused in narrow linear areas, are considered insignificant in terms of influencing NSO foraging behaviors. Most trees will not be removed but girdled, and will remain available for roost sites until they die. Girdled trees close to roads may become hazard trees over time and be felled (Angwin *et al*. 2022).

Meadow and oak-conifer woodland restoration is proposed in and near approximately 13 and 28 acres of foraging habitat, respectively (Table 9). For meadow restoration, most areas are one acre or smaller openings with encroaching conifers from surrounding foraging habitat. Some meadows are located in the Soapstone core or Scott home range. Restoration actions are expected to increase the abundance of meadow voles and other microtine species (Borgmann *et al*. 2007), which can benefit NSO by increasing habitat for prey and in turn, prey abundance.

The 28 acres of foraging habitat in the oak-conifer woodland restoration area is isolated to the eastern extent of this treatment area. It mainly consists of dispersal or non-habitat and is outside the Scott, Soapstone, and Morgan home ranges. We consider the effects to NSO foraging habitat complexity and function from both meadow and oak-conifer woodland restoration discountable in terms of altering foraging selection behavior by NSOs. This is because habitat elements will be removed from smaller patches of habitat rather than larger, contiguous patches. While not in close proximity to known use areas, the oak-woodland restoration would provide improved habitat for dispersing owls and is expected to increase mast (acorns) for prey.

Prescribed fire as a stand-alone treatment will maintain approximately 156 acres of foraging habitat. This treatment will occur in discontinuous patches of foraging habitat both west and northwest of the Soapstone home range. The effects of prescribed fire in these areas to NSO foraging behaviors is considered discountable because these areas are likely to continue to provide foraging opportunities and function as connectivity corridors, given they are intermixed with dispersal habitat. Our analysis of the combined effects of prescribed fire activities in thinned areas, including underburning, in foraging habitat is below in section 6.4.6.

Relatively little is known about the effects of conventional thinning on NSOs and their prey species (reviewed in Hansen 2015). Even less is known about the effects of lower-intensity or more variable forms of thinning and underburning on NSOs. However, the effects of "lighter" treatment types are generally assumed to be less impactful to NSO breeding, feeding, and sheltering behaviors and habitat quality than heavy thinning treatments. This is because the lighter thinning treatments result in less habitat alteration while retaining variability and complexity on the landscape and overall habitat function. Based on a sample of NSO site reviews after past thinning treatments in foraging habitat that used a variable density thinning approach (e.g., retained 150 ft^2/ac and higher basal area and 40-50 percent or higher canopy cover, along with intermixed "skips" (areas of no treatment) and "gaps" (areas of heavier thinning)), we found NSO sites remained consistently occupied after treatment. An important distinction is these prior treatments were not continuous across a broad area. In addition, past field reviews of nesting, roosting, or foraging habitats burned with low intensity prescribed fire (and wildfire) have also shown important habitat elements and functionality are retained even though individual stand elements of small and intermediate size class trees, downed wood, and snags were reduced (USDI FWS 2017).

6.4.4. Effects to Dispersal Habitat

Approximately 4,065 acres of dispersal habitat will be treated (Table 4 and Table 10). Effects include 1,549 acres removed, 632 acres degraded (due to reduced stand complexity and canopy cover), and 1,884 acres maintained. These effects would occur in 40 percent of the dispersal-only habitat in the action area (and 16 percent of the total dispersal habitat in the action area, which includes NRF habitat that provides for dispersal).

Table 10. Estimated effects in dispersal habitat by treatment type.

Treatment	Acres	Effect to Dispersal Habitat
Thin <10" dbh using a 35' spacing and underburn	126	Maintain
FMZ (60-80 ft^2/ac)	1,549	Remove
80-120 ft^2/ac	632	Degrade
120-160 ft^2/ac	23	Maintain
140-200 ft^2/ac	551	Maintain
Fuels Unit	332	Maintain
Meadow Restoration	13	Maintain
Oak Conifer Woodland	52	Maintain
Port Orford Cedar Treatment	18	Maintain
Underburn/Broadcast Burn Only	769	Maintain
Total	**4,065**	

Approximately 1,549 acres of dispersal habitat will be removed by FMZ treatments. The combined effects in both NRF and dispersal habitat from the FMZ treatment and the 80-120 ft^2/ac thinning treatment in NRF habitat are expected to impair or preclude a significant portion of connectivity between the Soapstone and Scott home ranges. Given the current functionally endangered status of the species and its overall lower resiliency, connectivity areas between high value habitats are more critical to conservation.

At a minimum, dispersal habitat consists of stands with adequate tree size and canopy closure to provide some protection from avian predators and at least minimal foraging opportunities. It should also contain roosting structures to allow for temporary resting and some prey base for dispersing juveniles and subadults, nonterritorial NSOs, or territorial pairs (USDI FWS 2011, 2012). The stand conditions that have long defined dispersal habitat are 11" dbh trees and 40 percent canopy cover (Thomas *et al*. 1990, USDI FWS 2011, 2012). Because under and midstory conifer vegetation will be mostly absent, and canopy cover will range from 20-35 percent after implementation, minimal foraging and roosting opportunities are not expected to exist in the FMZs after treatment and subsequently, dispersal habitat will not be maintained.

The 2,516 acres of other thinning, Port Orford Cedar, restoration, follow-up fuels treatments, and prescribed fire are expected to maintain, improve, or degrade dispersal habitat quality but connectivity and minimal foraging and roosting opportunities should remain available.

Where habitat is degraded by the 80-120 ft^2/ac thinning treatment in a larger block of dispersal, we expect residual canopy cover will range from 35-40 percent, with an average tree size of 11" dbh. The effects of these treatments are not expected to significantly impair movement of NSO throughout this portion of the project area. Most other areas of dispersal treatment are small patches intermixed with foraging or nesting/roosting habitat and habitat conditions are expected to be maintained (see Table 10). While mechanical thinning and fuels treatments will somewhat reduce the quality of dispersal habitat in patches where canopy will be more open, the overall function of dispersal habitat will be maintained and these effects are expected to be insignificant and discountable to NSO movement as key elements of affected habitat will remain available.

While important elements of roosting habitat may be removed, the effects to dispersal function in 18 acres of Port Orford Cedar treatment areas are fairly limited in scale and are widely spaced on the landscape. The effects from meadow and oak-conifer woodland restoration on 65 acres are expected to be discountable to NSO dispersing behaviors and are likely beneficial to prey at a small, localized scale. Prescribed fire as a stand-alone treatment in 769 acres of dispersal habitat in higher elevation areas is expected to maintain habitat function in the small, affected patches.

As described above, the removal of dispersal in FMZ treatment areas, combined with the long-term impacts to NRF habitat in these same areas, is expected to impair and preclude a significant area of connectivity between the Soapstone and Scott home ranges and within the action area. Connectivity areas between high value habitats are more critical to conservation.

6.4.5. Effects of Mastication or Chipping, Manual Cutting, Lop-Scatter and Pile Burn

The effects described above relative to degrading, downgrading, or removing NRF or dispersal habitat consider the additive effects of mechanical mastication or chipping, manually cutting, or lopping and scattering trees and shrubs, and piling and burning piles. These activities can have additive, cumulative effects to initial thinning treatments. Given the planned repeat entries to maintain FMZs and other treatment areas, these effects will occur over the 30-year timeframe for the project.

Mastication or chipping does not typically affect canopy closure, stand layering, tree sizes, or basal area in NRF or dispersal habitat. However, it does result in additive effects to the thinning treatments in NRF and NSO prey habitat in terms of disturbance and removal of habitat. It is primarily used to reduce surface and small ladder fuels, or thin plantations. Specific to the action area, mastication removes or reduce NSO prey food sources (truffles for flying squirrel), and hiding and thermal cover for ground-based prey (woodrats, deer mice, western red-backed voles). It will alter habitat conditions for prey, and when combined with the proposed underburning, additional prey habitat alteration is expected because of the removal of food sources, hiding cover, and thermal cover.

When manual cutting, piling, and pile burning follows a thinning treatment in NRF habitat, additional effects to NSO are not expected. However, prey habitat will be additionally impacted from the cutting and piling of material that provides hiding and thermal cover. If piles are created with machinery, compared with hand piles, soil and CWD can be re-distributed or removed. Until piles are burned, they will likely provide cover habitat for prey. Depending on how piling and pile burning is implemented, low intensity fire can move between piles ("pile creep") or be concentrated to the pile itself. For this analysis, we assume there will be some level of pile creep from machine piles which are larger than manually-constructed piles and that fire will spread out from and between the piles. Piling and burning piles reduces, but does not eliminate, small understory trees and shrubs that combine to create multi-layered stand structures found in areas used by foraging (and dispersing) NSOs (Irwin *et al*. 2007, 2011, Blakesley *et al*. 1992, LaHaye and Gutiérrez 1999, Folliard *et al*. 2000). Based on the Forest's desired conditions for pile burning (as well as underburning) such as low wind speeds, higher relative humidity, and higher fuel moisture, this treatment in NRF and dispersal habitat is not expected to further alter the function or significantly reduce the quality of the actual habitat beyond what is expected from the initial thinning treatments described above.

Lop and scatter treatments alter the arrangement of surface and ladder fuels by cutting and scattering live or dead trees typically <10" in diameter or other understory and midstory vegetation. In most instances this manual treatment will only occur on slopes greater than 65 percent. As with hand cutting or mastication, lop and scatter can alter or remove food resources for flying squirrels, or food resources and hiding and thermal cover for woodrats, mice, and voles.

As described in chapter 5, NSO fitness can be reduced (e.g., less successful reproduction, lower survival, or in some instances site abandonment) if extensive stand simplification occurs. Adverse effects occur from the reduced availability of prey which can lead to higher energy expenditure by NSOs while foraging, especially when this effect occurs at a moderate to large scale, in a continuous area (i.e., a large proportion of a core, home range, or action area), or in important habitat areas (e.g., in cores, along streams, at lower and midslope positions). Combined, these activities are expected to simplify NSO habitat with likely negative impacts to annual prey abundance and a short-term reduction in NSO fitness in the action area.

6.4.6. Prescribed Fire-Underburning

Prescribed fire and underburning will occur on approximately 14,172 acres in the project area (BA p. 33). Here we evaluate the effects of these treatments on NRF and dispersal habitat conditions. Stands will be underburned after mechanical thinning and other fuels reduction treatments (e.g., mastication, chipping, manual cutting, lopping/scattering, or pile burning) or as a stand-alone treatment. As a stand-alone treatment, broadcast burning or underburning will occur in approximately 156 acres of foraging and 769 acres of dispersal habitat (Table 7).

6.4.6.1. Underburning after Initial Thinning

Because prescribed fire can have additive effects in previously thinned NRF habitat, underburning this habitat will result in both short- and long-term negative effects to prey and downed wood levels, depending on burn timing or season and intensity. We evaluated these additive effects when considering the effects to habitat in sections 6.4.1 through 6.4.5 above. The initial mechanical or manual thinning treatments and the follow-up fuels reduction treatments reduce tree densities and canopy levels prior to underburning. Because of this, fire spread into the canopy is typically reduced, along with the risk of single tree or group tree torching. Other effects of low-intensity, mosaic burns in NRF habitat are the creation of small openings from individual tree flare-ups or a loss of small groups of trees <10” dbh.

The effects from underburning are expected to further reduce or remove residual activity and surface fuels, as well as smaller trees, brush, and downed wood that remains after the initial thinning and fuels reduction treatments. These residual ground and ladder fuels contribute to understory diversity and prey habitat, which will be altered through underburning; notably when combined with mastication, chipping, manual thinning, mechanical or manual piling, and pile burning. This includes changes in food sources, as well as hiding and thermal cover. The combined effects in NRF habitat will further reduce the habitat quality, and adverse effects are expected to prey and NSO foraging success as treatments further reduce the small trees that provide understory and midstory layering and downed wood. Studies on the fire effects to small mammals show they burrow further underground or move away as a response to fire (Walstad *et al*. 1990). This prey response could have indirect effects to NSOs fitness.

While the long-term effects can be beneficial in terms of returning low intensity fire to the landscape and increasing forest stand resilience, there will be both short- and long-term adverse effects. The combination of the preceding FMZ and additional thinning treatments with follow-up fuels reduction and underburning is expected to contribute to both long-term adverse effects to prey, and by extension, NSO fitness and survival. While creating defensible areas along ingress and egress roads, or along key ridgetop areas outside of high value NSO habitats to help reduce the risk of habitat loss to wildfire effects is an expected long-term benefit, the effects of the expansive and continuous FMZ treatments would still exert a long-term negative influence on prey resources.

Where trees <10” dbh are manually thinned in current NSO core areas with follow-up underburning, we do not expect adverse effects to habitat or prey as manual treatments are less impactive to soils, downed wood, and prey cover and forage base. Where underburning occurs after more intensive mechanical thinning in other portions of cores and higher value habitats in the NSO home ranges, the effects will be cumulatively adverse in terms of further reducing understory and midstory vegetation and stand complexity. It is not known if NSO core areas or activity centers will shift before treatment, or in response to treatment and this structure is important for owlets that cannot yet fly to be able to climb back up into the nest tree or other smaller trees to escape predation on the ground, or for fledgling or juvenile owls seeking hiding and thermal cover in the dense shade these stands provide (Forsman 1976, Forsman *et al*. 1984).

We expect the accumulated impacts from vegetation management treatments to directly injure or kill individual prey and redistribute their populations in the action area during the first 10 years of implementation. This is likely to have adverse effects and is reasonably certain to impede NSO foraging patterns, sheltering behaviors, and adult-provisioning of young. Conservation measure CM-4 will prohibit habitat modification in NRF habitat until September 15 to protect young from direct injury. By this time, juvenile owls are expected to be mature enough to forage without the aid of adults and begin dispersing before project activities begin each year (USDI FWS 2003). Despite this seasonal restriction, adult provisioning of young during the nesting season, and the feeding behaviors of juveniles after the nesting season, are expected to be impaired. This is because the continuously shifting treatments and resulting habitat modification and degradation in cores and home ranges will reduce and redistribute prey on an almost-annual basis, reducing the fitness of territorial adults, juveniles, resident singles, or any nonterritorial owls.

6.4.6.2. Underburning Only

Prescribed fire and underburning as a stand-alone treatment in a combined 925 acres of foraging and dispersal habitat is expected to have neutral to beneficial effects (Table 7). Based on our field reviews of prior stand-alone underburning treatments, midstory layering is not likely to be reduced by more than five percent and the overstory impacts are likely less than one percent (USDI FWS 2017a). Beneficial effects include increases in understory vegetation diversity (e.g., grasses and forbs) and probable increases in prey over the long-term (Beche *et al*. 2005, Innes *et al*. 2006, Knapp *et al*. 2005, 2007, Roberts *et al*. 2015).

Underburning as a stand-alone treatment in overly dense patches of forest can mimic conditions in stands adapted to frequent fire return intervals. Patchy underburning scattered within and among treatment units can also create a mosaic of forest stand structure that allows owls to move through an area and access the forest floor to capture prey. This is especially true when burned units and understory thinning patches are interspersed among unthinned or untreated areas (Carey and Peeler 1995, Franklin and Gutiérrez 2002).

As the project is implemented, we expect there will be some spatial and temporal separation of the various treatments and their effects, and beneficial effects will also occur during this timeframe. The majority of the project area is proposed for some level of treatment however, and as the project progresses and treated areas are re-entered, the adverse effects to prey habitat and local prey populations and abundance will be cumulative.

6.4.7. Effects of Connected Actions

6.4.7.1. Skid Trails, Landings and Other Operations

Forest thinning and vegetation management treatments will occur in low, mid, and upper slope positions throughout the project area. Ground-based tractor logging, skyline yarding, cable-assist tethering, or helicopter methods could be used to implement treatments.

Information was not provided for how many skid trails or log landings may be needed to implement the project for ground-based harvest, cable assist tethering, or skyline systems. Ground-based logging skid trails consist of narrow, linear openings in the understory. They are typically 14-20' wide and spread out from a landing where a skidder can move the cut and bundled trees (boles and tops) back to the landing. As described in past consultation documents, skid trail layout (and landing locations) are agreed-to during timber sale administration.

Landings typically need to be dispersed throughout treatment units if they are large in order to avoid skidding long distances. They are typically placed near existing roads or routes, or along new temporary spur roads. For the project, previous landings, natural openings, brush fields, plantation areas, dispersed camping areas, or roads will be used as feasible. As described in the BA, new landings will not be created in NRF habitat as feasible (BA p. 53). If new landings are needed in this habitat, all trees >24" dbh would be retained (BA pp. 14, 53, Table 5) as long as their retention does not impact safe use of the landing area. In addition, landings will be subsoiled and naturalized after treatment.

We do not have an estimate of existing landings in the project area. Based on reviews of past projects, one landing averaging one acre in size is needed to treat 30 acres using ground-based equipment (e.g., heavy equipment such as feller-bunchers or skidders which can operate on <35 percent slopes). Based on this and the review of treatment areas expected to require landings (e.g., thinning trees ≥10" dbh, see Table 7), we assume the project may require up to 415 landings to complete implementation. As noted above, existing landings and openings will be used as feasible. Landing construction for ground-based equipment use typically consists of clearing most of the larger trees from the landing area to allow for equipment access and safe operations. But smaller trees, snags, downed wood, and brush may be removed or reduced as well. Landing creation and use occurs at small scales and they are widely distributed across the landscape. Based on the estimated impacts in NRF and dispersal habitats from treating ≥10" dbh trees, approximately 314 acres of this combined habitat may be affected by landings.

According to the BA, any new landings will be located outside NRF habitat as feasible. While stand elements of NRF habitat may be removed, most landings are located along or near existing roads and create small openings in the overall treated landscape. We do not consider the construction and use of new landings as a downgrade or removal of NRF habitat at the stand scale due to the small, dispersed nature of the openings. As they do not result in large gaps in the canopy, both skid trails and landings generally degrade NRF habitat function.

Additional skyline corridor landings that range from 2-5 acres in size may be needed, depending on the area being treated. These landing areas are typically situated along existing roads or openings above the skyline treatment units. Skyline corridors on steep slopes consist of linear openings in the canopy where mid and overstory vegetation is removed in order to safely operate. These corridor openings can range from 20-30 feet across and are more widely spaced than skid trails. When this logging system is used, the linear openings remove or reduce NRF habitat elements and can contribute to degrading or removing the overall habitat quality in the treatment unit, depending on the thinning prescription. Cut material is landed and processed on the road or opening(s) above the treatment unit(s). The construction of skyline corridors in NRF habitat can contribute to the overall adverse effects by opening up the canopy and removing habitat elements.

Cable assist tethering requires an area along a road or other open area above the treatment unit where anchor equipment (e.g., bulldozer or other heavy machinery) can park and where decking and processing of the cut trees can occur. With this logging system, a harvester, feller buncher, or other cutting machine is cabled to an anchor above, allowing it to maneuver and cut trees on the steeper slope below. When using this logging system, the cutting equipment is able to move laterally down and across the slope, cutting the trees, and is then winched back to the landing area. It does not require the wider corridors associated with skyline logging systems.

Helicopter logging systems may be used on steeper slopes, sensitive soils, or other areas. When used, trees are typically manually limbed, cut, and felled in the unit and choker cables are attached to the boles or a grapple is used. The bundles are then flown to a central landing location by helicopter.

As described in chapter 5, prolonged activities, such as those associated with timber harvest, can increase fecal corticosteroids in NSOs (Wasser *et al*. 1997, Tempel and Gutiérrez 2004, Hayward *et al*. 2011). NSO sensitivity varies with the distance from the noise or disturbance to the nest or roost site, the duration, and the timing of disturbance relative to breeding activities and differences in individual NSO responses (Delaney *et al*. 1999, Delaney and Grubb 2001, Swarthout and Steidl 2001, 2003, Tempel and Gutiérrez 2003).

6.4.7.2. Roads and Hazard Tree Mitigation

New permanent road construction is not proposed. We do not have an estimate of new temporary roads to complete the project. Regardless, the construction and use of temporary roads is not expected to change the overall function of affected NRF or dispersal habitat at the stand scale, as these roads are typically 14-16 feet wide and consist of short segments.

Dead, dying, and weakened trees that pose a hazard to safety along National Forest Transportation System roads or at developed recreation sites will be evaluated using the USDA-FS Region 5 Hazard Tree Guidelines (Angwin *et al*. 2022). We expect roadside hazard trees will be evaluated and treated along ingress and egress routes and project haul routes using these guidelines, to ensure safe travel through these areas and safe operating conditions during timber harvest. These trees may be removed in commercial operations or left on site based on site specific prescriptions, land allocation, operational ability, and fuel reduction needs.

Hazard tree abatement can include falling a tree and either leaving or removing the log. Although generally uncommon in a stand typically distant from one another, hazard trees can contribute to canopy closure or provide NSO nest or roost sites. However, since hazard tree reduction is expected to remove only discrete, individual trees immediately along roads, near private property, or at developed recreation sites, this treatment alone is not expected to alter canopy closure or remove habitat function at the stand level. Additionally, any openings in the canopy from hazard tree reduction will likely not be discernible from the natural variation of canopy openings throughout project area. For this project, despite individual trees or groups of trees being removed, the mitigation or removal of individual hazard trees will not remove NRF habitat function.

6.4.8. Recreation (Trails, Trailheads, and Bridges)

Numerous new non-motorized trail networks will be constructed in the project area that intersect all three NSO territories (BA pp. 15, 16, Appendix I, L). Most of these proposed trails are either located within FMZ, 140-200 ft^2/ac thinning, or meadow restoration treatment areas (BA p. 57, Table 7, Appendix B, Appendix I, Appendix L). In tandem with the new trails, six new trailheads will be established or relocated (BA p. 17). Following their construction, the trails are intended to be used by non-motorized recreationalists (BA p. 6). Sustainable trail structures such as a bridge, turnpike, or boardwalk may be installed where needed to protect streams, seeps, or other resources (BA p. 16).

Throughout the project area there are 11 acres of nesting/roosting, 16 acres of foraging, and four acres of dispersal habitat where new trails will be established. Specific to the current NSO territories, 12 acres of NRF habitat will be affected in the Scott territory with approximately 1.5 acres of NRF affected in the Morgan territory. No NRF habitat will be affected in the Soapstone territory. Effects to dispersal consist of a combined three acres in the Scott and Soapstone territories.

The stand-alone construction and use of new trails, independent of other vegetation-based treatments, is not expected to change the overall function of affected NSO habitat at the stand scale. This is because the impacts of constructing these trails are expected to be less than 6 feet wide. For similar reasons, we do not anticipate negative effects to riparian areas where new trails are constructed following the initial vegetation treatment.

The six new trailheads will be placed in areas that are already disturbed and/or cleared for FMZ creation (BA pp. 17, 40). As a result, we expect the actual construction of these new trailheads to have no effect on NSO habitat. Like the new trails, bridges will be designed to accommodate non-motorized vehicles and pedestrian use (BA p. 16). The BA does not provide specific details on the construction method for these bridges, but it does provide photographic examples of similar bridges (BA. p. 17). The bridge construction, replacement, or repairs will not alter NSO habitat and, if heavy equipment is needed to implement these actions, its use will be subject to the noise seasonal restrictions.

The BA states new trails will not be located in NSO core areas (p. 39), however several maps provided by the Forest indicate small trail sections in the northwestern portion of the Scott core area (BA Appendix I, L). Following their construction, repeated use of trails in active owl territories could result in adverse effects in the form of noise disturbance, particularly in the Scott territory due to it having the largest proportion of trails (BA Appendices I and L). Additionally, we anticipate effects from the one mile of trail construction in the Gumboot meadow complex that contains substantial floral resources and potential nest sites for Franklin's bumble bee (see section 6.8).

6.4.8.1. Effects of Trail Creation

Where new trails are constructed in the FMZ treatment areas, the effects to nesting, roosting, foraging, or dispersal habitat will have already occurred (or will occur in the future if trails are constructed first). The FMZ treatments will remove habitat and after the FMZ treatments are implemented, we expect understory shrubs, brush, or natural conifer regeneration. This vegetation may be partially removed to establish new trails and trailheads through manual cutting, mastication, and/or piling and pile burning. This removal, along with any hazard tree felling and mitigation, is not expected to result in additional adverse effects within and along the new narrow, linear trail routes.

In areas where NRF habitat is degraded or downgraded following initial and follow-up vegetation management treatments, new trail construction is also expected to have an insignificant cumulative effect on understory habitat and complexity since trails will likely be constructed in a narrow, linear path. Any small-scale follow-up vegetation removal treatments that occurs when constructing new trails is not expected to change the overall function of NRF habitat due to the trails having a comparatively smaller footprint.

We expect NRF and dispersal habitat will continue to function where overstory trees, canopy closure, and mid and understory layering is retained. The effects of these treatments reduce the quality of roosting habitat elements and conditions, but they are considered insignificant in terms of influencing NSO nest or roost site selection behaviors given the narrow, linear trail area. Where new trails are constructed where dispersal habitat is degraded or maintained by initial thinning, they are not expected to impede NSO movement in or between the current NSO territories.

6.4.8.2. Effects of Trail Use

There are several anticipated sources of disturbance from new trail creation and subsequent trail use by the public. The new trails will extend into two occupied NSO territories (BA Appendix L) and as a result, will expose NSO to additional levels of noise throughout the day. Disturbance events from this action could negatively affect NSO during the daytime when owls are roosting and when most sources of disturbance are expected to occur. These disturbance events would be expected to adversely affect NSO in the Scott territory due to the overlap in trail footprint, NRF habitat, and proximal detections of NSO over recent years in the northwest section of the home range (BA Appendix I and 2023 NSO survey results). By comparison, the new trail footprint in the Soapstone territory is situated along the northern edge in dispersal habitat and does not extend into the core area or overlap with recent NSO detections.

The primary disturbance effects from both trail and trailhead construction involve noise generation from loud equipment (trail backhoes, chainsaws, mini excavators). Sections 5.2 and 6.2.1 of this BO provide a full description of noise disturbance effects to NSO, including during the critical breeding season. These activities would result in moderate (71-80 dB) to high (81-90 dB) levels of noise when compared to the ambient noise level (USDI FWS 2016, 2020). However, the standard seasonal restriction of loud noise generation within 0.25 mile of occupied or unsurveyed NRF habitat (CM-4) would make this effect discountable to breeding NSOs (BA p. 39).

There are several expected sources of continued disturbance from trail use within the occupied NSO territories. These disturbances are most applicable to the Scott territory where approximately 10 miles of new trail are proposed. Research of recreational disturbances to NSOs suggests walking and trail cycling generates low (61-70 dB) and moderate (71-80 dB) noise levels, respectively (USDI FWS 2016, 2020). Activities producing sound levels of 70 dB or less (estimated at 50 feet from the sources) would not generally rise to the level of disturbance except in certain circumstances, such as when used in very close proximity (i.e., < 82 feet) to an active nest (USDI FWS 2020).

Additionally, without specific project design features and enforcement mechanisms, there are no assurances to prevent small, motorized vehicles (dirt bikes, ATVs, etc.) from using these new trails throughout the year. These activities, should they occur, would create noise loud enough to disturb nesting or roosting owls, especially in new nest patches (Swathout and Steidl 2001). Other non-motorized recreation trails on the Forest are known to be used by illegal motorized vehicles, including small motorcycles and ATVs (MSTA and Mount Shasta Audubon Society 2023). Disturbance-induced behaviors (e.g., flushing from the nest) can preclude feeding of young or increase the risk of predation to young and thus represents a likelihood of injury (USDI FWS 2020).

Lastly, increased recreational activity can contribute to accidental or intentional fire ignitions in occupied NSO territories and surrounding habitat, generated by unextinguished cigarette butts, unauthorized campfires, or other mechanisms. The smoke disturbance to adult owls and injury to young combined with the subsequent habitat removal from fire ignitions are all expected to have adverse effects on NSO, especially in occupied territories. Section 5.2 and 6.2.2 of this BO provide a full description of smoke effects to NSO, including during the critical breeding season.

6.5. NSO Prey

Because small mammals are essential prey for NSO fitness and survival, effects to prey are critical to our evaluation of the project's impacts on NSO survival and fitness. The length of time since vegetation disturbance, the intensity of the initial disturbance and follow-up disturbances, and the patch sizes of 'untreated' areas influence small mammal populations and their distribution.

Based on our field reviews, areas of nesting/roosting and higher quality foraging habitat contain abundant, embedded large logs in the 20-30" diameter class. The more uniform stands of foraging and dispersal habitat contain smaller size classes of 6-14" diameter logs. On average, there are 2-4 snags per acre in the 15" dbh and larger size classes with more snags in small patches of concentrated mortality. Larger 27-40"+ dbh snags and trees often have cavities, forked tops, mistletoe brooms and other signs of decadence. Some treatment areas may not have this amount or size class of logs or snags (e.g., plantations, uniform stands of foraging or dispersal).

Snags, downed wood, decaying live trees, smaller CWD, hardwood masts (acorns, other fruiting events), arboreal lichens, and mycorrhizal fungi are important for NSO prey. These forest stand elements provide shelter and forage and are either lost, altered, or created during vegetation management activities. How these elements are affected depends on the location, patch size, shape, and intensity of the treatment (Waters *et al.* 1994, Lehmkuhl *et al.* 2004, Meyer *et al.* 2005, Stephens and Moghaddas 2005).

Several important prey species (e.g., dusky-footed woodrats, Douglas squirrels, deer mice, northern flying squirrels) use cavities in snags and decaying live trees for nesting, denning, and food storage (Maser *et al*. 1981, Carey 1991, McComb 2003, Martin *et al*. 2004, Innes 2007). Other "defects" in live trees can provide important resources for prey. For example, "witches' brooms" from mistletoe infections can provide nesting and resting structures for northern flying squirrels, bushy-tailed woodrats, and chipmunks (Parks *et al*. 1999).

The amount of dead and down material on the forest floor is positively correlated with the abundance of some NSO prey species. Therefore, a reduction of dead and down materials in NRF and dispersal habitat will likely result in reduced prey abundance (Thomas *et al.* 1990). Downed wood provides small mammals (e.g., woodrats, western red-backed voles, Douglas squirrels, chipmunks) with cover, under-snow and food-storage spaces, runways for moving above the forest floor, and den material (Maser *et al*. 1981, Carey 1991, McComb 2003). Downed wood is also an important resource for truffles and mushrooms, the primary food of western red-backed voles and many other small mammals. Conservation measures CM-2 and CM-3 in LSR and MLSA land allocations will retain large logs and large snags consistent with the Forest's late-successional reserve assessment's design criteria. Outside these areas, snags and CWD will be retained at lower levels (see section 6.1.2. above).

Forest management affects the abundance and availability of prey, which in turn can influence habitat selection, reproduction, and survival by NSOs (Rosenberg *et al*. 2003). Thinning treatments affect habitat elements important to small mammals and can result in direct injury or mortality of individuals. Additionally, reductions in habitat elements (e.g., understory and midstory canopy connectivity and layering) and cover (e.g., shrubs, downed wood, snags) can subsequently affect small mammal abundance and diversity over the short- or long-term (Chambers 2002, Manning *et al*. 2012). Thinning can also have short-term negative effects on understory plants from uprooting root and on below-ground fungi by killing host trees or significant ground disturbance from equipment turning (Courtney *et al*. 2004). In turn, these effects reduce or remove food sources used by small mammals.

The initial thinning treatments will likely result in a redistribution of prey and prey avoidance of treated areas, attributed to a reduction in food resources along with the increased probability of predation risk because of reduced hiding cover (Zwolak and Forsman 2008). Small understory and mid-canopy intermediate trees, overstory trees, snags, and logs will be removed or significantly reduced by treatments. Larger changes in prey abundance and distribution are expected where thinning removes or downgrades NRF habitat and follow-up fuels treatments further reduce habitat elements. We expect adverse effects to prey abundance and distribution because of these accumulated impacts. While the degree and severity of effects depend on the complex interaction of a treatment's location, size, pattern, and intensity (Waters *et al*. 1994, Lehmkuhl *et al*. 2004, Meyer *et al*. 2005, Stephens and Moghaddas 2005), we expect both short and long-term adverse effects on local prey populations and prey distribution (Lehmkuhl *et al*. 2006, Meyer *et al*. 2007, Luoma *et al*. 2004, Gomez *et al*. 2005).

In general, small mammal species have high reproductive rates and populations are able to recover from disturbance relatively quickly if habitat remains available (Smith 2000). As brush and conifers regenerate, species such as bushy-tailed woodrats (*Neotoma cinerea*) can become established (Raphael 1988, Ward 1990, Sakai and Noon 1993, 1997). A year after vegetation disturbance, species diversity can also increase as seen with woodrats, red-backed voles, and northern flying squirrels (Zwolak and Forsman 2008). Where high contrast edges occur between treated and untreated areas, habitat for small mammals may improve because of openings that allow for regeneration of brush and conifers. This leads to increased prey and NSO foraging in and near these newly created edges, as observed in post-fire landscapes (Comfort 2013).

Where variable density thinning treatments have been studied, the effects to small mammal species biomass and their diets have been shown to be insignificant or of shorter duration (Suzuki and Hayes 2003, Converse *et al*. 2006, Amacher *et al*. 2008, Dodson *et al*. 2008, Dodson and Peterson 2008, Manning and Edge 2008). Prey abundance is likely to decline during 1-10 years after thinning while vegetation regenerates. Although small mammals seem to recolonize areas soon after disturbance, diversity and species dominance differ as succession progresses. Some of the dense, uniform stand conditions of foraging or dispersal habitats are likely to benefit from the creation of openings that foster development of prey habitat elements such as shrubs or other herbaceous growth. With the expected open stand conditions and 20-30 percent or lower canopy cover in the FMZ areas, we expect a more rapid growth response in brush and shrub species than in areas where higher canopy cover is retained.

Detailed information pertaining to NSO prey and NSO foraging habits is further described in Appendix A. The effects from habitat modification are strongly influenced by impacts to the local prey species important to NSOs in the action area. For our analysis, we focus on effects to three primary prey species in the California Cascades and Klamath Provinces: the northern flying squirrel, dusky-footed woodrat, and bushy-tailed woodrat.

6.5.1. Effects to Northern Flying Squirrels

Studies of the effects of vegetation management on northern flying squirrels have found mixed results, likely due to variability in stand conditions and treatment intensity within the study areas. Depending on the prescription and initial conditions, thinning and other forms of partial harvesting can affect a flying squirrel's ability to glide or avoid predation. Thinning can destroy decaying or defective woody material, increase downed wood recruitment, or both. Flying squirrel fitness is associated with understory vegetation diversity, dead wood, defective trees, and ectomycorrhizal truffle and lichen biomass and communities (Lehmkul *et al.* 2006). The loss or reduction of downed wood can alter the production of truffles on which flying squirrels depend (Lehmkuhl *et al*. 2004). Flying squirrel abundance in thinned stands may be related to the amount of canopy cover retained during harvesting, since greater canopy cover provides protection from predators (Meyer *et al*. 2007).

Food availability influences flying squirrel abundance, and commercial thinning can temporarily (<5 years) or permanently reduce the availability of truffles and other hypogeous (underground) fungi that are key food resources for flying squirrels and other small mammals (Waters *et al*. 1994, Luoma *et al*. 2004, Gomez *et al*. 2005). Thus, reductions in any important elements of flying squirrel habitat (e.g., stand density, overstory canopy cover, midstory structure, understory vegetation diversity, dead and downed wood, defective trees, truffle and lichen biomass, canopy cover and litter) can negatively influence flying squirrel populations. Management recommendations for flying squirrel conservation include retaining existing environmental heterogeneity by not creating large openings, retaining large logs and snags, and retaining connectivity within the canopy to facilitate gliding and escape cover.

Based on our field reviews, flying squirrel abundance in the stands proposed for treatment is likely moderate in the lower and midslope positions. They are not likely to occur in higher slope positions where stand conditions are drier or more open. In addition, most habitat for this species in the action area is located in the higher value nesting/roosting and foraging habitat or riparian areas in portions of the Scott home range, portions of the Soapstone core and home range, and the high value habitat areas between the two sites. Flying squirrels may also be present in some lower slope position foraging habitat.

Significant impacts to flying squirrels and their habitat is expected from treatments in NRF habitat in lower and midslope positions. Thinning and fuels treatments that remove, downgrade, or degrade NRF habitat are expected to negatively affect the movements of flying squirrels over the short- and long-term because of the creation of canopy gaps and the simplification of the midstory and understory. This is likely to result in both short- and long-term decreases in their abundance, especially when the treatment units are adjacent to one another and impact large areas (Wilson 2010, Manning *et al*. 2012). In turn, these effects are expected to reduce foraging opportunities for NSO. While there will be some variability between stand conditions in terms of the timing of treatments and the spatial separation that can offset these impacts, the effects to flying squirrels are still considered significant given contiguous treatments across numerous NRF stands and the location of treatments in lower and mid slope areas with flatter topography and abundant springs, seeps, and streams.

6.5.2. Effects to Woodrats

Dusky-footed woodrats are a main prey species for NSO below 4,000 feet and their densities are influenced by habitat quality. They occur in a variety of conditions including old, structurally complex forests; younger seral stages; or shrubby openings. They are often associated with streams (Sakai and Noon 1993, Carey *et al.* 1999, Hamm and Diller 2009). Oaks (*Quercus* spp.), other mast producing hardwoods, and shrubs provide key food resources for dusky-footed woodrats. Shrubs also provide important sources of cover from predators.

Optimal habitat for dusky-footed woodrats is described as 15-40 year old sapling and bushy pole timber (recent clearcuts). Bushy-tailed woodrat habitat includes rock outcrops within mixed conifer and montane riparian forests, montane chaparral, and alpine dwarf-shrub habitats. An increased level of abundance beyond optimal habitat does occur in old forests as openings form in the canopy, creating patches of stable, brushy understory (Sakai and Noon 1993, Courtney *et al.* 2004). There is a gradual decline in abundance within marginal habitat of small and large saw timber stands or intermediate-aged forests.

Bushy-tailed woodrat dens are made of sticks, foliage, and debris at the entrance to crevices or caves, or in forks of trees (CDFG 1990). Vegetation management actions limit the distribution and abundance of woodrats because they constrain where woodrats can live by removing denning material and availability of shelter. Thinning that creates substantial canopy openings can reduce habitat suitability for woodrats in the short-term, but can subsequently be beneficial by increasing shrubs or hardwoods (Innes *et al*. 2007). Conversely, thinning or associated practices (e.g., burning slash piles) could be detrimental to woodrats if hardwoods, shrubs, or downed logs are significantly reduced.

Short- and long-term effects to woodrats are largely dependent on the spatial distribution of existing habitat and the proportion of habitat affected. There will be cumulative effects of treatments from initial mechanical thinning operations, mechanical and manual follow-up fuels treatments, and underburning (described in sections 6.5.4. and 6.5.5. above). We expect short-term adverse effects to woodrat abundance in treatment units. These effects are from removing live or dead trees and downed wood, which reduces the food sources and cover for concealment of woodrats. In addition, the ground disturbing actions will vary in intensity and could preclude occupancy by woodrats in the short- and long-term. The long-term maintenance of the FMZs and other treatment areas will have ongoing impacts over the years, resulting in redistribution of prey and possible precluding woodrat occupancy in some areas.

Conversely, woodrat abundance might increase because of the removal and reduction of canopy cover from heavier thinning associated with the FMZ (60-80 ft^2/ac) and 80-120 ft^2/ac thinning treatments by promoting shrub growth and regeneration of small conifers. Conservation measures CM-2 and CM-3 in LSR and MLSA land allocations retain large logs and snags consistent with the Forest's late-successional reserve assessment's design criteria. Outside these areas, snags and CWD will be retained at lower levels. These measures should help maintain and promote overall populations of woodrats in the short- and long-term.

6.6. Effects to NSO Activity Centers in the Action Area

6.6.1. Basis of Effects Determinations to NSO Activity Centers

Using habitat data, coupled with relevant research, effect determinations were made for the three activity centers assessed in the action area. The effect determination criteria relate to biologically important minimum amounts of habitat for NSO fitness and reproduction (USDI FWS 2009). The primary factors considered in this analysis include:

- the total amount of habitat available,
- the distribution of affected and untreated habitat in the core and territory or home range,
- the amount of habitat affected and intensity,
- abiotic factors (elevation, aspect, distance to water),
- barred owls, and
- the proximity of the treatment activity to the AC and core use area.

Other considerations include the conservation measures and PDFs incorporated in the project design. These conservation measures and PDFs decrease the potential effects to NSO habitat by limiting or prohibiting some activities in high value or high quality habitat areas.

We assess the potential effects at two spatial scales: the core area and the home range. The core area represents an area surrounding the nest site that is used disproportionately by territorial NSO, especially during the breeding season. Actions in the core area are presumed to have relatively stronger effects to NSOs compared with areas further from the nest (USDI FWS 2009).

For analysis purposes, we approximate the core area by evaluating habitat conditions within a 0.5 mile circle (500 acres) centered on the last known nest site or cluster of detections. The core area is surrounded by a larger area that comprises the home range of an NSO territory.

Habitat in an NSO home range (or territory) provides foraging areas and alternate nest and roosting sites that support occupancy, survival and reproduction by NSOs. We evaluate habitat conditions in a territory represented by a 1.3-mile circle (3,398 acres) centered on the most recent nest site or cluster of detections. While it is recognized actual core use areas and territories likely conform to the distribution of high-quality habitat and are therefore noncircular, the circular analysis represents a reasonable approximation of the area within which territorial NSOs obtain resources (USDI FWS 2009).

Our analysis also includes references to the Service's 'recommended' thresholds for the amount of suitable NRF habitat in a core area and territory, to provide a functional home range relative to reproductive success and survival of the NSO pair (USDI FWS 2009). These recommendations are a minimum of 250 acres nesting/roosting and 150 acres foraging habitat for a total of 400 acres of NRF in the core. The recommendation for an entire territory is a minimum of 1,336 acres of NRF habitat, or about 40 percent of the territory. A complex interaction of factors is evaluated when determining the impacts to NSO territories, as described below.

6.6.1.1. Amount of Habitat Available

Bart (1995) reported a linear reduction in NSO productivity and survivorship as the amount of NRF habitat in an NSO territory declined. Many researchers have stressed the importance of habitat availability in a core area around the nest site (Bingham and Noon 1997, Franklin *et al.* 2000, Meyer *et al.* 1998, Zabel *et al.* 2003). Table 5 in chapter 4 displays the habitat amounts in the three NSO cores and home ranges. Two are considered to be below the recommended threshold of 400 acres of NRF habitat in the core. All three are considered above the recommended threshold of 1,336 acres of NRF habitat.

6.6.1.2. Affected Habitat

NSOs depend on multi-storied, structurally complex forests dominated by large trees, and high densities of down and standing coarse wood. Habitats that contain these attributes are considered high-quality habitat, namely nesting/roosting habitat. But foraging habitat is also considered important and the NSOs in the action area are utilizing the best available habitats. A reduction in the quality and amount of NRF habitat in territories, and especially close to the nest site, can be expected to have negative effects on NSOs. Habitat changes in core areas could have disproportionate effects to individual NSOs. Survival and fitness are positively related to the proportion of older forests and the amounts of edge of other vegetation types (Dugger *et al.* 2005, Franklin *et al.* 2000). The higher the proportion of affected high-quality habitat, the more severe the potential effects may be.

In the Scott NSO territory, barely sufficient nesting, roosting, and foraging habitat will remain available in portions of the home range. An estimated 1,431 acres of NRF habitat will remain in the overall home range, as FMZ and thinning treatments will bisect both. While the NRF habitat in the current core is estimated at 271 acres after treatments, and below the Service's recommended levels, most of the habitat removal will occur in the eastern extent of the core from FMZ treatment. This area and the eastern extent of the current home range has a lower detection rate of owls and overall lower use, but it does provide important connectivity to the east along riparian corridors. The repeated treatment entries will displace prey and we therefore expect impairment of NSO breeding, feeding, and sheltering behaviors.

Within the Soapstone NSO territory, we estimate 475 and 1,770 acres of NRF habitat will remain available in the core and entire home range, respectively. We expect impairment of NSO breeding, feeding, and sheltering behaviors during the first ten years of implementation in this territory, with the most pronounced effects occurring in the first one to five years.

In the extent of the Morgan territory encompassed in the action area, we expect 353 and 1,533 acres of NRF habitat will remain in the core and home range, respectively. While long-term occupancy is not demonstrated for this territory, the habitat within it remains important for owls in the action area during natal dispersal or use, or nonterritorial owls.

6.6.1.3. Thinning Intensity

The FMZ treatments, other thinning, and understory fuels treatments are expected to remove or reduce canopy cover, dominant, codominant, intermediate and small tree size classes, snag density, and coarse woody debris; all important habitat components for northern flying squirrels (*Glaucomys sabrinus*) (Carey *et al.* 1999; Lemkuhl *et al.* 2006; Meyer *et al.* 2007) and woodrats. Heavier thinning has a higher likelihood of negatively affecting NSOs than lighter thinning since more of the structural components of NSO habitat are removed. The FMZ and 80-120 ft^2/ac and follow-up fuels treatments in nesting, roosting, and foraging habitat do not widely vary and are primarily expected to remove or significantly reduce the quality of these habitats. Other thinning treatments will degrade NRF habitat, but it will remain functional for nesting, roosting and foraging NSOs. The scale and scope of the contiguous treatments and disturbance in NRF habitat within the two occupied NSO home ranges and important areas in between pose the most concern in terms of potentially causing barred owls to move into these territories.

6.6.1.4. Abiotic Factors

Abiotic factors such as distance to streams, slope position, elevation, and aspect influence site selection by NSOs (Forsman *et al.* 1984, Irwin *et al.* 2007, USDI FWS 2009). Irwin and others (2007) found NSOs spend disproportionate amounts of time searching for prey in forest patches near or in riparian zones of small, low-order streams (i.e., down and away from ridge tops). The higher intensity treatments will have a greater impact on habitat elements and these effects will occur in important mid and lower slope positions. They will also occur along two high use roads, and near private property and the trade offs between removing habitat to improve ingress and egress conditions, and help protect habitat from fire, are considered. All of the FMZ and thinning treatments in NRF habitat in lower and mid-slope positions are intensive in terms of continuity. The treatments at lower slope positions are not distant from riparian areas and the cooler microclimates used by nesting and roosting NSOs.

6.6.1.5. Timing and Duration

To frame the context of temporal bounding, and when effects to NSO may occur, it is expected project implementation will begin in late 2023 and early 2024.

The BA estimates 30 years to complete all project activities. Silviculture activities are expected to be completed within approximately three to five years and the additional fuel treatment activities are expected to be completed within one to three years after completion of silvicultural activities. Additional maintenance treatments and underburning may occur every five to ten years, depending on site quality and vegetation type (BA pp. 6, 15, Table 5). We acknowledge that not all of the treatments will occur at the same time in the same location, but given the treatment continuity in the cores and home ranges, prey base will be impacted and may reduce NSO fitness. We expect some spatial and temporal separation of treatments may help to reduce overall effects to known NSO pairs.

As described in the BA and section 1.3 of this BO, several project design features have been developed. These include seasonal restrictions for NRF habitat modification and limiting disturbance during the breeding and nesting season. Per the BA, surveys will be done prior to and during implementation, or unsurveyed NRF habitat will be presumed occupied by nesting owls and the seasonal restrictions will be left in place. Protocol surveys are expected to provide a reasonable likelihood of detecting territorial NSOs, and a higher confidence of existing NSO locations. Because of the reasonable certainty about NSO use and occupancy in the current occupied territories in the action area, combined with the project design features, we do not expect NSOs could be harmed or harassed from noise or smoke disturbance or direct impacts associated with habitat manipulation.

6.7. Influence of Barred Owls in the Action Area

Recent detections of barred owls have occurred within and in close proximity to the action area between 2014 and 2022 (CNDDB 2023). We assume barred owls will continue to colonize portions of the action area, given the current distribution and increases in barred owl density across all portions of the NSO's range (see Chapter 5 and Appendix A). Because of this, competitive interactions between barred owls and NSOs are expected to occur, regardless of project implementation. Based on the available research and literature to date, we can reasonably conclude barred owl presence in the action area likely has similar demographic effects to NSO as described by Franklin *et al*. (2021), Dugger *et al.* (2016) and Forsman *et al.* (2011). This includes reduced NSO detectability, adult NSO survival, and NSO site occupancy, as well as increased NSO extinction rates as NSOs leave their territories.

While there are important differences in the ecology between the two species, barred owls select very similar habitat as NSOs for breeding, feeding, and sheltering. Habitat loss can intensify competition between the two species (USDI 2012 p. 71878). There are still substantial information gaps regarding ecological interactions between NSOs and barred owls (USDI FWS 2011 p. III-62) and effects of forest management on these interactions is not yet fully understood or described (Courtney *et al.* 2004, USDI 2011). Several studies describe relationships between NSO demographics and the composition of forests within NSO home ranges. Olson and others (2005) found an important positive correlation between NSO productivity and the amount of edge in the landscape, particularly between early seral and non-forest classes. Changes in patterns of NSO use have also been reported in areas shared by barred owls and NSOs (Jenkins *et al.* 2019, Wiens *et al.* 2014, 2017, 2019). Ongoing and future monitoring can provide further understanding of barred owl and NSO competitive interactions within thinned landscapes.

As described in the Recovery Plan and critical habitat rule, even without fully understanding the effects of forest management, research demonstrates the importance of maintaining high quality habitat and decreasing habitat fragmentation in order to minimize NSO interactions with barred owls (Franklin et al. 2021, Dugger *et al.* 2011, 2016, Wiens *et al.* 2014, 2017, 2019, Forsman *et al.* 2012). In those environments where the two species compete directly for resources, maintaining larger amounts of older, higher quality forest may help NSOs persist and reduce competitive interactions (Franklin *et al*. 2021, Dugger *et al.* 2011, 2015).

Our evaluation of the project's effects focuses on whether vegetation management treatments could potentially exacerbate interference competition between NSOs and barred owls by further limiting the availability of high quality habitat. Numerous treatments are proposed in NRF habitat, including higher value habitat areas. The presence of barred owls in an action area reduces the baseline NRF habitat available to NSOs (see Chapter 5). At this time, it is unknown how, or to what extent, barred owls will influence future NSO demographics in the action area and surrounding landscape. The FMZ, and other thinning treatments, combined with fuels reduction and prescribed fire treatments will remove, reduce or degrade NRF and high-quality habitat from areas known to be used by NSOs, based on past and recent detections. Based on this, and the likely presence of barred owls in and near the action area, we conclude the direct or indirect influence of barred owls is a significant factor in determining the effects of this project on NSO. The project will reduce the amount and quality of NRF habitat in occupied home ranges and the action area, and is likely to exacerbate competitive interactions between the two species.

6.8. Project Effects to Franklin's bumble bee

The species needs, importance of substantial floral resources (SFRs), and definitions of nesting and overwintering habitat are described in Chapter 3. Pollinator surveys were conducted in portions of the Fawn Meadow complex in 2022 (BA p. 63) and in 2023. To date, Franklin's bumble bee has not been detected in the action area, and the action area falls outside a high priority zone (HPZ). The action area is within the range of the species, however, and contains SFRs. The closest HPZ is approximately four miles to the northeast, within the six-mile foraging and dispersal distance for Franklin's bumble bee (Thorp, pers. comm. 2017, USDI FWS 2018, 2021a). Despite annual surveys in some past detection areas, Franklin's bumble bee has not been detected since 2006.

6.8.1. Setting

Based on our field reviews, there are approximately 145 acres of meadow restoration areas that contain SFRs. These meadows also contain abundant nesting and overwintering habitat consisting of abandoned rodent burrows, bunch grasses, rock piles, and large downed wood within 100 meters of the SFRs. Overwintering habitat is present and consists of loose, well-drained soil and other materials in shaded areas under trees.

The meadows range in elevation from 5,600-6,700 feet and consist of the larger Fawn Creek Meadow and Gumboot Meadow complexes. Table 11 displays the proposed treatments and acres or miles of treatment.

Table 11. Proposed treatment areas for Franklin's bumble bee.

Treatment Area	Treatment Area (acres)	Treatment Area (miles)
Gumboot Meadow Complex		
Proposed New Trail (in the meadow)	1	1
Meadow Restoration	47	na
Fawn Creek Meadow Complex		
Meadow Restoration	98	na

To re-establish the historic meadow footprints and reintroduce fire, all 3" dbh conifers and larger size class trees will be removed, with the exception of larger remnant trees, black oak, or other hardwood species. In these two meadow complexes, conifers primarily consist of lodgepole pine, but also include western white pine, incense cedar, Jeffrey pine, and ponderosa pine. Beaver dam analogs may also be constructed to restore riparian function and historical width in channels, some of which may intersect the higher elevation meadows (see Chapter 1).

Roads that have been established near and through meadow areas will be blocked with boulders or logs. Some of these roads may also be decommissioned by blocking the entrance, revegetating and installing water bars, removing road fill and culverts, establishing drainage and removing unstable road shoulders, or full obliteration. This includes disturbing and moving the compacted road surface soils in order to recontour and restore the natural slope (BA p. 15). Methods will be determined on a case-by-case basis. Some meadows may only require large boulders or large logs at their entrance to preclude vehicle access. Others may require breaking up the compacted wheel tracks with heavy equipment or hand tools. Where a road intercepts a wet meadow and has established overland flow paths, soil movement and recontouring would be done to restore subsurface flows. The BA indicates road decommissioning in wet meadows would be done late in the year (presumed late summer or early fall) when soils are expected to be dry. Prescribed fire actions will consist of either mechanical or manual piling of lopped or cut trees, burning pile concentrations, and underburning/broadcast burning of the meadows.

6.8.2. Project Effects

The effects of the action will consist of a temporary loss of SFRs with expected long-term benefits, disturbance or removal of overwintering or nesting habitat, disturbance or impacts to individuals if they are present, or the introduction and establishment of non-native invasive or noxious weeds that can outcompete native floral resources. Meadow restoration is expected to result in development of additional SFRs for the species by removing encroaching and established conifer.

- Implementing the project results in a moderate-to-high potential to introduce and spread non-native or invasive plant species on heavy equipment and other tools. The project conservation measures (summarized below) can help minimize spread and reduce impacts to SFRs. While non-native or invasive plants can provide resources for bumble bees, minimizing the spread of non-native, noxious weeds will help maintain native SFRs in these key meadow areas and throughout the action area. SFRs consist of high-quality forage habitat capable of supporting a colony throughout all life stages. SFRs are defined by the presence of a diverse and abundant group of insecticide-free native flowering plants that provide both pollen and nectar throughout a colony's active flight period (May 15 through September 30). The establishment and spread of invasive plants can result in competition with native flowering vegetation for light, water, and nutrients. These invasive weeds can indirectly threaten bees by outcompeting native plants that provide a superior source of nectar and pollen and reducing overall floral diversity (McKinney and Goodell 2010).

- Treatments will be completed using heavy equipment such as mechanical harvesters, skidders, dozers, graders, or excavators. Chainsaws, other hand tools, shovels, or handsaws may also be used. The primary concern to SFRs and nesting and overwintering habitats are from the impacts of heavy equipment operations in and around the meadows to remove trees, decommission roadways, and the prescribed fire actions.
    - Heavy equipment to log or remove trees, or decommission roads and areas around them, can displace or compact the soil, crush small and large downed wood, and uproot or crush shrubs and forbs. This can degrade or destroy the root systems and soil conditions for SFRs and remove or crush rodent burrows or downed wood used for nesting or overwintering. We expect most heavy equipment use to restore roads or unauthorized routes would occur on already compacted soils, but this equipment could also be used to complete restoration actions in proximal undisturbed meadow habitat.
    - Piling and burning lopped or cut trees, burning pile concentrations, and broadcast burning is expected to result in beneficial effects in terms of rejuvenating soil nutrients and helping to reduce and remove the smaller size class trees that were not cut initially, or that continue to grow in the meadows. As repeat underburning is planned every 5 to 10 years, we expect beneficial effects to the meadows and SFRs. Depending on the seasonal timing however, prescribed fire may burn hotter in certain areas depending on the fuel concentrations. It can also reduce important SFRs during critical flowering times when they are providing nectar and pollen before the bumble bee queens overwinter, or after the new queens emerge from overwintering to initiate new colonies in the spring.
    - Burning in the late fall right before rain events can ameliorate negative impacts to soil and root systems by avoiding high intensity fire. This is because burning in cool, humid conditions minimizes peak soil temperatures and reduces impacts to nests and overwintering sites below the ground's surface.
- To construct the approximate one mile of new trail in the Gumboot meadow complex, equipment could include mini excavators, small backhoes, shovels, bowsaws, loppers, or chainsaws (BA p. 17). Constructing a trail, or trail segments, in this area may consist of

clearing the vegetation, compacting soil to create the trail tread, placing rock aggregate or constructing boardwalks over wetter areas, and constructing channels in the meadow.

For the actions described above, we anticipate effects if individuals are present. Because the project does not include a seasonal restriction for removing trees, prescribed fire, or trail construction activities during the active flight period of May 15 through September 30, it is possible an active colony (nest) or hibernating female could be disturbed, crushed, or burned during project implementation.

These effects would result from the crushing or caving-in of burrows used by colonies, or other similar underground cavities or decaying logs that offer resting and sheltering. The restoration treatments will also reduce or remove large and small logs. There will be a direct loss of floral resources (crushing, uprooting) from heavy equipment use, though this loss is considered temporary and limited to one to two seasons after implementation. This short-term loss of these plants is not expected to cause a wide-spread reduction of SFRs across the two meadow complexes.

Removing the encroaching conifers will result in varied reductions of canopy cover on the periphery of the meadows as well as in the 'forested peninsula' or other meadow interior areas where conifer trees have established. The creation of small and large canopy gaps and removal of the smaller understory vegetation is expected to promote improved growing conditions for SFRs. Canopy reduction is also expected to increase solar radiation to the ground and support plant and shrub growth, considered favorable to pollinators. On the periphery, this tree removal is likely to reduce some of the shade and cover considered important for maintaining overwintering and nesting sites. Overwintering queens have been found mostly in shaded areas under trees and in banks without dense vegetation or direct sunlight (Alford 1969, Liczner and Colla 2019).

6.8.3. Summary of Conservation Measures

As described in Chapter 3, conservation measures represent actions pledged in a proposed action's description which will be implemented to further the recovery of a species (USDI FWS and USDC NMFS 1998). The project design features for Franklin's bumble bee and soil resources are considered conservation measures.

Conservation measure CM-6 is intended to minimize soil disturbance when removing the encroaching conifers from the periphery of the meadows, or trees which have grown and established within a meadow. Ground-based mechanical equipment (e.g., feller bunchers, tractors, skidders, masticators,) will only operate when meadow soils are dry, on snow pack >12" deep or over 6" of frozen ground, or away from areas containing standing water or saturated soils (BA p. 53). Conservation measure CM-7 will help avoid the spread of noxious weeds in the project area. It includes equipment cleaning before entry into the project area and when moving equipment from one treatment area to a different treatment area, avoiding staging or parking equipment in infested areas, using weed-free materials (e.g., seeds and mulch), and monitoring and treatment of noxious weed infestations throughout the project area (BA p. 54).

Under conservation measure CM-8, surveys will be conducted to determine the level and quality of floral resources in the project area. Annual bumble bee surveys are also proposed in the meadows containing these resources. These would occur prior to the use of heavy equipment operations to remove trees, or before piling and burning or underburning actions occur. It should be noted that a negative survey result for the species does not provide conclusory evidence that it is not present, given its rarity on the landscape. In addition, when underburning or broadcast burning occurs in the meadows, it will be implemented such that no more than one-third of all of the meadows in the project area are burned at one time or in a calendar year.

6.8.4. Summary of Effects

The conservation measures will help reduce some effects to SFR habitats, but will not reduce or remove the potential for direct impacts to the species during its active flight period, should it be present.

- As described earlier, inadvertent introduction of non-native, invasive plant species into the action area and treatment areas could occur. When the European honeybee (*Apis mellifera*) was intentionally introduced to California in the early 1850s (USDI FWS 2018) there was overlap in the resources used by *A. mellifera* and native bumble bees. This created the potential for increased competition for native and non-native floral resources (Thomson 2004, 2006, 2016). Where this competition occurs, the effects are local in space and time; and are most pronounced where floral resources are limited and where large numbers of commercial *A. mellifera* colonies are introduced (USDI FWS 2018).
- There is no current information to indicate any area of Franklin's bumble bee habitat in its range has limited native or non-native floral resources in combination with large numbers of *A. mellifera* (USDI FWS 2018). Based on this, we do not expect a potential localized introduction of non-native floral resources to the action area or meadows to result in competition for these resources between the two species.

Despite annual surveys conducted in some past detection areas and high-quality habitats, Franklin's bumble bee has not been detected since 2006. The species is also most likely to be detected in a HPZ. While the likelihood of direct and indirect effects to individuals is considered low, effects to individuals, colonies, and SFRs are still possible if individuals are present, as there is no seasonal restriction during the important part of the active flight period. These effects would result from heavy equipment operations, trail construction, and prescribed fire use in their foraging and overwintering habitats.

7. Northern Spotted Owl Critical Habitat

The only designated critical habitat in the action area is for the northern spotted owl.

7.1. Status of NSO Critical Habitat

The final rule designating critical habitat for the NSO was published on December 4, 2012 (USDI FWS 2012) and became effective on January 3, 2013. The 2012 final rule was revised on November 10, 2021, and resulted in the removal of approximately 204,294 acres of designated critical habitat in Oregon. It became effective December 10, 2021 (USDI FWS 2021 p. 62606;

86 FR 62606). There is now approximately 9,373,676 acres of designated critical habitat across 11 critical habitat units (CHUs) and 60 subunits in California, Oregon, and Washington (USDI FWS 2021 p. 62606; 86 FR 62641). No changes were made to the units or subunits in California or Washington under the 2021 revised rule.

Critical habitat identifies specific areas within the geographical area occupied by the species at the time of listing that contain the physical or biological features essential to the conservation of the species and may require special management or protection. It also includes areas outside of the geographical area occupied at the time of listing that are determined essential to the conservation of the species. The 2012 final rule states, "many areas of critical habitat do not require active management, and active forest management within such areas could negatively impact northern spotted owls" (USDI FWS 2012 p. 71881). Additionally, the Service does not encourage land managers to consider active management in areas of high-quality NSO habitat or occupied NSO sites. Rather, we encourage management in other areas that will maintain and restore ecological function where appropriate (USDI FWS 2012 p. 71881).

In developing the critical habitat rule, the Service relied on the recovery criteria in the Recovery Plan (USDI FWS 2011) to determine what is essential to the conservation of the species. Based on this, we identified a habitat network that meets the following criteria:

- Ensures sufficient habitat to support stable, healthy populations across the range, and also within each of the 11 recovery units;
- Ensures distribution of NSO populations across the range of habitat conditions used by the species;
- Incorporates uncertainty, including potential effects of barred owls, climate change, and wildfire disturbance risk; and
- Recognizes these protections are meant to work in concert with other recovery actions, such as barred owl management (USDI FWS 2012).

Relative to the barred owl and critical habitat, the 2021 revised rule discusses: 1) [northern] spotted owl populations are declining precipitously due to a combination of historical habitat loss and more recent competition with the barred owl; and 2) the only way to arrest this decline and have a high probability of preventing extinction (in any timeframe) is to both manage the barred owl threat and conserve adequate amounts of high quality habitat distributed across the range in a pattern that provides acceptable levels of connectivity as well as protection from stochastic events (USDI FWS 2021 p. 71881). This conclusion is supported by the most recent meta-analysis which emphasizes the importance of maintaining NSO habitat, regardless of occupancy, in light of competition from barred owls to provide areas for recolonization and connectivity for dispersing NSOs (Franklin *et al*. 2021 p. 18).

7.1.1. Physical and Biological Features of Critical Habitat

When designating critical habitat, the Service considers the physical or biological features (PBFs) essential to the conservation of the species, and which may require special management considerations or protection (50 CFR § 424.12; USDI FWS 2012). These PBFs include, but are not limited to, 1) space for individual and population growth and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, or rearing (or development) of offspring; and 5) habitats protected from disturbance or representative of the historical, geographical, and ecological distributions of a species (USDI FWS 2012).

The 2012 final rule defined the PBFs "essential to the conservation of the NSO as forested areas that are used or likely to be used for nesting, roosting, foraging, or dispersing" (USDI FWS 2012). It provides an in-depth discussion of the PBFs (USDI FWS 2012 pp. 72051-72052) and the 2021 revised rule reiterates the definitions of those critical habitat PBFs, herein incorporated by reference (USDI FWS 2021 p. 62639).

Within the areas considered essential, the 2012 final rule has defined the PBFs of NSO critical habitat as:

PBF1 – Forest types that may be in early-, mid-, or late-seral stages that occur in concert with PBF 2, 3, and 4 and that support the NSO across its geographic range. This can include plantations in concert with PBFs 2, 3 and 4;

PBF2 – Habitat that provides for nesting and roosting;

PBF3 – Habitat that provides for foraging;

PBF4 – Habitat to support the transient and colonization phases of NSO dispersal, which in all cases would optimally be composed of nesting, roosting, or foraging habitat (PCE2 or 3), but which may also be composed of other forest types that occur between larger blocks of nesting, roosting, or foraging habitat.

In general, critical habitat for the NSO is intended to protect and restore high-quality NRF habitat and good quality dispersal habitat to promote viable and persistent populations throughout the range. The exact descriptions of each PBF may vary geographically due to the diversity in vegetation types and conditions associated with NSO habitat use and site selection across its range. To contribute to conservation, the areas that contain PBFs "must provide habitat in an amount and distribution sufficient to support persistent populations, including metapopulations of reproductive pairs, and opportunities for nonbreeding and dispersing owls to move among populations" (USDI FWS 2012 p. 71900).

7.2. Current Condition of NSO Critical Habitat

See Appendix A for detailed information on the conservation role of critical habitat, PBFs, the range wide critical habitat baseline, zones of habitat associations used by NSO, and projected climate change impacts.

7.2.1. Demographic Data for NSO Critical Habitat

An estimated 85 percent of the entire critical habitat network was within the home ranges known to occur at the time of listing (USDI FWS 2012 p. 71912). Other than quantifying habitat, the current condition of the critical habitat network is difficult to assess. But, data from demographic study areas can be extrapolated to generally assess the potential demographic contributions or expectations of critical habitat. In terms of assessing population status and trends, the research primarily examines sites occupied by resident pairs that are likely breeding and contributing to future generations. These resident, territorial pairs are the most important group of NSOs for assessing the status of the species because they are producing the majority of young NSOs (and are relatively easy to detect). We acknowledge occupied sites do not comprise the entire NSO population in or outside of the critical habitat network. There may be nonterritorial and resident single NSOs that are not detected or currently breeding, but may do so in the future (see Appendix A).

Population changes have been studied and documented the past 35 years in NSO demographic study areas (DSAs) across the range and within designated critical habitat. The studies were initiated in the late 1980s and early to mid-1990s. The DSAs had been surveyed annually with mark-recapture and callback methods. The last year of surveying in this manner in the Northwestern California DSA was 2021 as the Forest Service withdrew funding support here and for other DSAs across the range. Many study areas and Federal land managers in the northern extent of the range have been transitioning to autonomous recording units (ARUs) in an attempt to better detect NSOs and assess population status, given interference competition with the northern barred owl. As of 2020, ARUs have been deployed in the in the Northwestern California study area and a portion of northern California's National Forests (Lesmeister *et al*. 2022).

The most recent metanalysis addresses the callback survey and demographic data from 2013 through 2017 (Franklin *et al*. 2021). Since DSA research began, Washington's population sizes have declined by 75 to 80 percent. In Oregon, populations on all DSAs declined by more than 60 percent, with the Central Oregon Coast and Oregon Klamath areas declining by more than 75 percent. In California, populations in the Northwestern California Study Area declined by about 50 percent, with Hoopa declining by 30 percent (by 2012) and Green Diamond declining by greater than 60 percent (Franklin *et al*. 2021). Relative to the initial populations in 1995; seven study areas had less than 35 percent of their populations remaining in 2017, with the other three study areas having less than 50 percent (Franklin *et al*. 2021).

Prior meta-analysis efforts found population declines in the DSAs were greater in the northern extent of the range (Forsman *et al*. 2011, Dugger *et al*. 2016). This comports with the higher densities of barred owls and their invasion in the NSO range from the north to the south. Per the most recent meta-analysis, declines appear similar across the range and almost all of the study areas (since 1995) have less than 35 percent of their population remaining (Franklin *et al*. 2021).

There are no DSAs in the California Cascades Province and the Northwestern California DSA is approximately 40 miles west of the action area. This regional study area includes portions of the Klamath, Six Rivers, and Shasta-Trinity National Forests; the BLM; and the Willow Creek study area. It has seen significant declines in occupied NSO sites from 1987 through 2021 (Franklin *et al*. 2022, 2021-2015). The steep decline after 2009 coincided with the increase in barred owl sites and an increase in the number of NSO sites with barred owl detections. Barred owl sites there have dramatically increased over the last decade, with barred owls currently detected on almost 75 percent of the Willow Creek study area (Franklin *et al*. 2022). The effects on NSO survival from interference competition with barred owls will likely continue impacting NSOs in all study areas, across the range, and in critical habitat.

In summary, NSO occupancy across the critical habitat network is not considered stable (Dugger *et al*. 2016, Franklin *et al*. 2021). Territories occupied by NSO are substantially declining on almost all of the DSAs as barred owl occupancy has increased. The data also shows NSOs are unlikely to colonize new territories when barred owls are present. The 2021 meta-analysis provides rangewide evidence that the negative consequences of interspecific competition with barred owls has increasingly overwhelmed dwindling NSO populations since the 2016 meta-analysis. There is substantial evidence showing interspecific interactions and competition for space, habitat, and food with rapidly expanding populations of barred owls has negatively affected NSO population viability (Anthony *et al*. 2006, Forsman *et al*. 2011, Dugger *et al*. 2016, Long and Wolfe 2019). The underlying mechanisms by which barred owls negatively impact NSOs are a combination of exploitation competition for shared habitat and prey and interference competition via interspecific exclusion from breeding territories (Hamer *et al*. 2001, Gutiérrez *et al*. 2007, Hamer *et al*. 2007, Wiens *et al*. 2014, Jenkins *et al*. 2021). The 2021 meta-analysis indicates NSO populations face extirpation if negative effects of barred owls are not ameliorated while maintaining NSO habitat across their range.

While barred owl occupancy causes NSO to leave their territories and negatively affects the colonization of new territories, other factors such as habitat and climate are important in NSO territory occupancy dynamics (Franklin *et al*. 2021). The large fires across the range in 2020 and 2021, and those in the California Cascades, California Klamath, and Oregon Klamath Provinces from 2013-2023, have also reduced the amount of NRF and dispersal habitat within and outside the critical habitat network. This reinforces the importance of conserving and maintaining NSO habitat on the landscape, even if it is unoccupied by NSOs, in the face of competitive exclusion by barred owls (Dugger *et al*. 2011, 2016, Yackulic *et al*. 2019). Maintenance of NSO habitat across the landscape can provide available areas for re-colonization by NSOs should management actions allow for a reduction in barred owls (Wiens *et al.* 2021). It also facilitates connectivity by dispersing NSO among occupied areas (Sovern *et al*. 2014).

7.2.2. Critical Habitat Unit and Subunit Information

About 4,590,300 acres of nesting/roosting habitat across the NSO range was designated as critical habitat in 2012. This includes 243,205 acres in the California Cascades physiographic province and recovery unit.

The project is located in East Cascades Critical Habitat Unit 8, which encompasses approximately 368,381 acres (USDI FWS 2012 p. 71930). The project is entirely within the East Cascades-South subunit (ECS-3).

7.2.2.1. East Cascades Critical Habitat Unit

The East Cascades Critical Habitat Unit 8 (CHU 8) incorporates the Southern Cascades Ecological Section M261D, and is based on descriptions of forest types from Ecological Subregions of the United States (USDI FWS 2012, McNab and Avers 1994). It extends from the eastern slopes of the Cascades in the Deschutes National Forest in Oregon south to the Mount Shasta area in California. Topography in CHU 8 is gentler and less dissected than the glaciated northern section of the eastern Cascades. A large expanse of recent volcanic soils (pumice region) (Franklin and Dyrness 1988 pp. 25-26), large areas of lodgepole pine (*Pinus contorta*), and an increasing presence of red fir (*Abies magnifica*) and white fir (*Abies concolor*), with decreasing grand fir, along a south-trending gradient separates this region from the northern extent of the eastern Cascades.

Forest types occur in bands that are correlated with elevation. The southern and western extent of the unit has a higher proportion of mixed conifer and true fir forest types. These are dominated by Douglas fir, sugar pine, incense cedar, Jeffrey pine, and ponderosa pine at low to moderate elevations. White and red fir; and lodgepole, western white, and whitebark pine (*Pinus albicaulis*) occur at higher elevations. The region is characterized by a continental climate of cold, snowy winters and dry summers with a moderate frequency of low to mixed severity fires. Dwarf mistletoe provides an important component of nesting habitat, enabling NSOs to nest in stands of relatively younger, smaller trees (USDI FWS 2012 p. 71930).

7.2.2.2. ECS-3 Critical Habitat Subunit

The ECS-3 subunit consists of approximately 112,179 acres in Siskiyou County, California. All of this subunit is in federal ownership and managed by the USDA Forest Service under the NWFP (USDI FWS 2012). Special management considerations or protection are required in the subunit to address threats to the essential PBFs from current and past timber harvest, losses due to wildfire, effects on vegetation from fire exclusion, and competition with barred owls. The landscape within which the ECS-3 subunit lies is a mix of federal and non-federal landownership, in a checkerboard-type pattern. Critical habitat is not designated on private lands and this ownership pattern further constrains the distribution of NRF habitat because of the higher rates of timber harvest and habitat removal on private ownership.

The function of the ECS-3 subunit is to provide demographic support in an area of sparsely distributed high-quality habitat and Federal land, and to provide population connectivity between subunits to the north and south (USDI FWS 2012 p. 71931). Therefore, maintaining connectivity and recruiting additional high-quality habitat for the NSO in the subunit is especially important.

The ECS-3 subunit is neighbored by ECS-2 to the north by approximately 11 miles. The Interior California Coast subunits ICC-7 and ICC-8 are approximately 4 miles to the west and 7 miles southeast of the action area in ECS-3, respectively. The KLW-8 subunit is approximately 8 miles west/northwest of the action area in ECS-3.

The connectivity between ECS-3 and ECS-2 is more limited by lower amounts of habitat due to the 2021 Antelope Fire and large expanses of ponderosa pine-dominated forest or open areas. Habitat conditions between these two subunits functions as dispersal at best, but is largely composed of non-habitat. The connectivity of ECS-3 to ICC-7 and KLW-8 is far better because of higher amounts of habitat across the Trinity Divide and into areas northwest, west, and south, with few private lands. Between ECS-3 and ICC-8, habitat connectivity is considered moderate, with a higher amount of checkerboard ownership and private commercial timberland management. The distance between the action area and ECS-3 and its neighboring subunits are well within the range of the known distances that support both transient and colonization dispersal movements of NSO (Hollenbeck *et al*. 2018; USDI FWS 2011, 2012; Sovern *et al*. 2012). Corridors of forest through fragmented landscapes serve primarily to support relatively rapid movement through such areas, rather than colonization or residency of non-breeding owls.

The colonization phase of dispersal is associated with nesting/roosting and foraging habitats used by breeding pairs (USDI FWS 2012 p. 72052) and these colonization rates are being impacted by interference competition with barred owls (Jenkins *et al*. 2021).

The California Cascades province and recovery unit within ECS-3 is also an important area to conserve. This is because past natural and human actions adversely affected the area more than the other provinces (Thomas *et al.* 1990). In the final rule, the ECS-3 subunit was highlighted as one of two subunits specifically identified as essential for population connectivity between subunits that would otherwise be geographically isolated (USDI FWS 2012 pp. 71917-71918). There was an estimated 11,338 acres of dispersal habitat in ECS-3 when the 2012 final rule became effective. This is an important consideration for the subunit, given its function to provide connectivity.

In the 2012 final rule, the Service's evaluation indicated approximately 69 percent of ECS-3 supported verified NSO home ranges at the time of listing (USDI FWS 2012 p. 71931). When combined with likely occupancy of NRF habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing (USDI FWS 2012 p. 71931). In addition, there are some areas of younger forest in the ECS-3 subunit that may have been unoccupied at the time of listing that have now developed into higher quality habitat. All of the unoccupied and likely occupied areas are essential for the conservation of the species and to meet the recovery criterion for the continued maintenance and recruitment of NSO habitat (USDI FWS 2011, 2012, 2021).

Because the ECS-3 subunit is located at the eastern margin of the NSO range where the climate is drier and the forests more sparsely vegetated (Mayer and Laudenslayer 1988), ecological conditions that support long-term NSO pair occupancy and reproduction are limited in distribution. The Service's relative habitat suitability modeling to support the 2012 final rule, combined with the evaluation of the distribution of current and historic NSO activity centers in the subunit,[2] indicates most NSO territories are associated with relatively high topographic relief at moderate to high elevations with mixed conifer or true fir forest composition.

The mixed conifer stands and the red fir/white fir stands provide the majority of the NSO habitat in ECS-3. As evidenced in several project areas over the last decade on the east sides of the Shasta-Trinity and Klamath National Forests and surrounding private lands, NSOs will nest in lower quality habitat areas that more closely resemble foraging habitat. This trend is also supported by a recent Recovery Action 10 analysis and review of long-term occupied sites on both Forests (USDI FWS 2020c).

While the southern and western extent of the ECS-3 subunit supports relatively larger contiguous areas of higher value mixed-conifer habitat for NSO (including the project area), the subunit also includes substantial amounts of lower elevation forest lands. These areas with lower topographic relief typically support monotypic ponderosa pine forest, or ponderosa pine/white-fir associations, and seldom support long-term NSO territories. In addition, the likelihood of use of any forest habitat by NSO is strongly influenced by the proximity to, and availability of, higher

[2] Based on an assessment of NSO territories in the subunit on the Goosenest Ranger District, Modoc National Forest to the east, and the Shasta-Trinity National Forest's South Fork Management Unit.

quality forest types that serve to 'anchor' NSO territories and core use areas. Because lower-quality habitats can support dispersal, and short-term use, by nonterritorial owls or floaters, they do serve an important function by contributing to population connectivity among existing territories, and between adjacent critical habitat subunits.

Since the 2012 designation, natural and human-caused disturbances have occurred in CHU 8 and portions of ECS-3. This includes, but is not limited to, the 2021 Antelope and Bootleg fires. These fires resulted in widespread impacts, both positive and negative, to NRF and dispersal habitat. Based on an assessment of recent fire effects, the current estimates of PBFs 2, 3, and 4, in CHU 8 and ECS-3 are displayed in Table 12 below (Davis *et al*. 2022).

Table 12. Current estimates of NSO habitat in CHU 8 and ECS-3 subunit.

Unit and Subunit	Unit and Subunit Acres	PBF (Nesting/Roosting)	PBF 3 (Foraging)	PBF 4 (Dispersal[2])	Total
8	368,381	15,115	75,648	119,570	210,333
ECS-3	112,179	2,293	20,906	49,576	72,775

[1] No changes occurred to the boundaries or designation of CHU 8 or the ECS-3 subunit under the 2021 revised rule

[2] PBF 4 acres reported here consist of stands of smaller size class trees and lower canopy cover rather than the combination of PBFs 2, 3, and 4 that all contribute to the transient and colonization phases.

In addition to wildfire effects, post-fire management projects can result in additional impacts to habitat and connectivity in the ECS-3 subunit. The most notable alteration to date was the 2021 Antelope Fire. Post-fire salvage and restoration treatments that are currently ongoing or recently completed include the Antelope-Tennant project on the Klamath National Forest, and the Pumice and Antelope Fire Restoration projects on the Shasta-Trinity National Forest (consultation codes 2023-0024447, 2023-0003178, 2023-0002086, respectively). Based on the project design, each of these post-fire actions will not remove or downgrade NRF habitat or critical habitat in ECS-3.

Several other recently implemented or ongoing projects in the ECS-3 subunit contribute to current habitat conditions. Consultations for these actions on the Shasta-Trinity National Forest include the Mudflow and Algoma projects, Porcupine, Bartle Underburning-Additional Entry, Parks Eddy Watershed Restoration, Elk Late-Successional Reserve Enhancement, and Highway 89 Safety Enhancement and Forest Ecosystem Restoration. The Harris Vegetation Management project did not affect critical habitat. On the Klamath National Forest, recent projects in ECS-3 include the Juanita Restoration, Pumice Vegetation Management (not implemented due to the 2021 Antelope Fire), High Grouse, and Big Pony. On the Modoc National Forest, projects in ECS-3 included the Highlands Roadside and Lava projects. The Lava project downgraded foraging and removed dispersal habitat from ECS-3. The majority of the other projects degraded NRF and dispersal habitat. Other projects may have been completed in the subunit that did not undergo section 7 consultation.

The effects from these projects and wildfires are incorporated into the environmental baseline for CHU 8 and the ECS-3 subunit for our analysis of the South Fork Sacramento project. Based on the Draft EA for the project, reasonably foreseeable Federal actions in ECS-3 include Phase 2 of the project (USDA-FS 2023b p. 28). Another reasonably foreseeable Federal action in the subunit includes the South End project on the Klamath National Forest.

7.3. Environmental Baseline for NSO Critical Habitat in the Action Area

We evaluated NSO habitat conditions in the action area through field review, analysis of aerial imagery, the Forest's 2022 NSO EVEG habitat layer (USDA-FS 2022a), Oregon State University fire refugia modeling, the 2022 nesting cover class habitat data developed by the Northwest Forest Plan monitoring group (USDA-FS 2022b), and our relative habitat suitability model (USDI FWS 2012). With this information, we are able to summarize the amount and condition of critical habitat PBFs in the action area.

The critical habitat analysis area for the purposes of this BO includes all of the designated critical habitat in the 47,411-acre NSO action area. Our effects analysis to critical habitat is not confined to the broadly mapped treatment areas or project area, nor the current NSO cores and home ranges. This is because all of the critical habitat in the action area may provide nesting, roosting, foraging, or dispersal habitat for territorial NSOs, and support for nonterritorial owls, dispersing subadults, or other resident single NSOs. Within the action area, there are approximately 11,920 acres of designated critical habitat (Table 13).

Table 13. Critical habitat in the NSO action area for the South Fork Sacramento Project.

Critical Habitat Action Area	PBF 2	PBF 3	PBF 4	PBF 1	Non-Habitat
11,920	1,710	5,924	2,630	155	1,501

As described above for ECS-3, the 2021 Antelope Fire diminished a portion of the subunit's ability to function for demographic support. This fire did not occur in the action area, and the nearby 2021 Lava Fire did not impact NSO habitat or critical habitat. There have been no recent large fires in the action area, which increases its importance in terms of NSO conservation and recovery. There have been numerous fire starts in the action area over the last 33 years (BA p. 36). Lightning accounted for 25 percent of these in the western higher elevations, with human-caused ignitions accounting for the remaining starts where there is a higher level of recreation use and both legal and illegal camping. As indicated in the BA, the combined acreage of these fires was less than 100 acres, with the largest event (1996 Pocket Fire) growing to 50 acres before it was suppressed.

Fire suppression response in this area is relatively rapid and effective given the proximity to the city of Mount Shasta, frequent fire patrols by the Forest Service, a higher density of roads at an average 2.6 mi/mi^2 (USDA-FS 2023e p. 5), and high levels of recreation use which increases fire patrols and responses. Average annual precipitation is between 40 and 60 inches and per the project's draft hydrology resource report, most of this precipitation falls in the form of snow between October and May (USDA-FS 2023f p. 6). Most of the watershed faces northwest and contains abundant springs, seeps, and creeks. These conditions create a more resilient landscape to both fire and fire growth. We acknowledge ongoing drought conditions and current climate change models which predict hotter temperatures and changes in precipitation regimes in terms of reduced snowpack and increased rainfall (IPCC 2022). Given this, an increase in forest stand resilience in key portions of the watershed where stands are of uniform, smaller size classes is important in order to conserve the higher value NSO habitat in the action area and the long-term source population of NSOs. Thinning in overstocked plantations, uniform stands of lower quality foraging or dispersal habitats on the periphery of NSO home ranges and other parts of the action area, and breaking up the continuity of dense brush fields, are all considered beneficial to conserving habitat in the ECS-3 subunit.

Unoccupied critical habitat and other NSO habitat in the action area can provide for dispersing subadults or nonterritorial NSOs, or relief from competitive interactions with barred owls. The habitat in the action area is considered important for NSOs that are either within, or not currently occupying or using the action area that may disperse into the action area (Dugger *et al*. 2011, 2016, Franklin *et al*. 2021).

7.4. Effects of the Project to NSO Critical Habitat

This section evaluates how the project is likely to affect the capability of critical habitat to support NSO life history requirements by considering how it affects the PBFs of critical habitat. Designated critical habitat is considered in this analysis regardless of the species' presence or absence (77 FR 233). In general, there are five possible outcomes in terms of how Federal actions may affect the PBFs of NSO critical habitat: 1) No effect, 2) wholly beneficial effects, 3) both short-term adverse effects and long-term beneficial effects, 4) insignificant or discountable effects, or 5) wholly adverse effects (USDI FWS 2012 p. 71938).

Critical habitat PBFs of nesting/roosting, foraging, dispersal will be affected across 6,752 acres (Table 14). Approximately 155 acres of plantation treatments are considered PBF 1 as they contain forest types in early- or mid-seral stages and occur in concert with PBFs 2, 3, or 4 (USDI FWS 2011 p. 71906). In addition, approximately 628 acres of non-NSO habitat designated as critical habitat will be treated by various thinning prescriptions or underburning only.

The 628 acres of non-NSO habitat consist of younger natural forest stands, shrublands, rocky areas, or openings that do not contain stand elements of PBFs 2, 3 or 4 (USDI FWS 2012 p. 71906). The effects to vegetated non-habitat areas designated as critical habitat are considered neutral to beneficial because treatments will likely reduce fire risk or help improve forest health over the long-term in the action area and near PBFs 2, 3, and 4.

Table 14. Treatments in Critical Habitat by PBFs (acres).

Treatment[1]	PBF 1	PBF 2	PBF 3	PBF 4	Total PBFs	Non-Habitat	Total
Thin <10" dbh on a 35' spacing and underburn	0	376	425	75	**876**	12	888
FMZ (60-80 ft^2/ac) and follow-up fuels treatments	0	403	1,600	537	**2,540**	369	2,909
80-120 ft^2/ac and follow-up fuels treatments	0	89	770	501	**1,360**	76	1,436
120-160 ft^2/ac and follow-up fuels treatments	0	0	0	4	**4**	0	4
140-200 ft^2/ac and follow-up fuels treatments	0	464	936	299	**1,699**	171	1,870
160-200 ft^2/ac and follow-up fuels treatments	0	53	29	0	**82**	0	82
Fuels Unit	0	0	0	5	**5**	0	5
Meadow Restoration	0	4	3	0	**7**	0	7
Plantations	155	0	0	0	**155**	0	155
Port Orford Cedar Treatment	0	34	19	4	**57**	0	57
Prescribed Fire Only (pile burn, underburn or broadcast burn)	0	0	27	95	**122**	0	122
TOTAL	**155**	**1,423**	**3,809**	**1,520**	**6,907**	**628**	**7,535**

[1] Prescribed Fire (pile burning, underburning) overlaps with numerous treatments

[2] The Oak-Conifer woodland treatment is not located in designated critical habitat

7.4.1. Analysis Framework for Critical Habitat Determinations

For actions likely to adversely affect critical habitat, both scale and context are important for evaluating the effects of forest management. The degree to which various management activities are likely to affect the capability of the critical habitat to support nesting, roosting, foraging, or dispersal will vary depending on the scope and location of the action and the quantity of the critical habitat affected (USDI FWS 2012 p. 71938).

The Service concedes it is not possible to design a "one size fits all" rule set or flowchart to determine if an action is likely to adversely affect critical habitat (USDI FWS 2012 p. 71939). This is because of differences in project and habitat types and localized vegetation where the species is found across its range (Fontaine and Kennedy 2012). Determinations should be made at a scale relevant to the NSO life-history functions that are supplied by the PBFs and affected by a project. This more localized analysis scale differs from how the Service determines if an action will destroy or adversely modify critical habitat. As described in Chapter 2 of this BO, the adverse modification analysis and determination is made at the scale of the entire designated critical habitat (USDI FWS 2012 p. 71939). Some examples of actions not likely to adversely affect critical habitat PBFs include:

- Pre-commercial or commercial thinning that does not delay development of PBFs.
- Fuel-reduction treatments with a negligible effect on NSO foraging habitat in a stand.
- Removal of hazard trees where removal has an insignificant effect on the stand's capability to provide NSO nesting or foraging opportunities.

Some forest management actions have short-term adverse effects and long-term beneficial effects on PBFs. For example, variable thinning in single-story, uniform forest stands (which likely provide lower value foraging or dispersal habitat) reduces habitat elements, but also promotes development of multistoried forest structure and nest trees. This type of thinning may result in short-term adverse impacts to the habitat's current capability to support dispersal or foraging behaviors but can have long-term benefits by creating higher quality habitat to better support territorial NSO pairs or resident singles. Activities like this will have less impact in areas where foraging and dispersal habitat is not limiting and ideally should be conducted in a manner that minimizes the short-term negative impacts. While these thinning actions can have long-term beneficial effects, if there is a short-term adverse effect, such actions may adversely affect critical habitat (USDI FWS 2012 pp. 71939-71940).

The 2021 revised rule reinforces numerous concepts from the 2012 final rule regarding active management of forests, where appropriate. The recommendations from both rules are to: 1) address currently observed downward demographic trends in NSO populations by protecting both currently and historically occupied sites, and 2) to maintain and conserve older and more structurally complex multilayered conifer forests on all lands (USDI FWS 2021 p. 62655).

In the drier, more fire-prone regions of the range, habitat conditions are more dynamic. Active management can be used to reduce the risk to essential PBFs from fire, insects, disease, and climate change impacts, but the Service does not recommend active management in areas of high-quality owl habitat or occupied owl sites (USDI FWS 2012 p. 71881). The 2021 revised rule also recommends federal agencies consider the special management considerations identified in the 2012 final rule when designing and implementing projects in critical habitat. The design, placement, and magnitude of a project's treatments should consider the demographic support role of the affected subunit(s).

7.4.2. Summary of Effects to Critical Habitat PBFs in the Action Area

As described in Chapter 6, removed, downgraded, and degraded habitat conditions can lead to adverse effects to NSO and prey. For example, project effects that occur in important habitat areas or result in reduced prey availability can lead to higher energy expenditures by NSOs to feed themselves provision and care for young and reduced fitness for several seasons. This impact is more pronounced when effects occur across a large or continuous scale (i.e., a large proportion of a core use area, home range, or the action area).

Some treatments will result in short-term adverse effects to critical habitat PBFs, with long-term beneficial effects for the owl, or insignificant, discountable, or beneficial effects to NSO PBFs in both the short- and long-term. Other effects of the action will adversely affect PBFs 2 and 3 over the long-term, as treatments will remove PBFs from broad, continuous areas, or diminish the habitat quality to the degree that further development of PBFs 2 and 3 is delayed.

The expected tradeoff and risk with some of the proposed thinning treatments are to remove or reduce NSO habitat now to conserve and protect habitat from largescale high severity wildfire effects. While several FMZ treatment areas are proposed at higher elevations and slope positions in locations less likely to be selected for use by NSOs, the majority of the FMZs are located in lower and midslope positions. They also overlap with known NSO use areas and important connectivity corridors. Other thinning treatments are also located in lower and midslope positions in current NRF habitat and within occupied or unoccupied cores and home ranges.

- Approximately 2,540 acres of PBFs 2, 3, and 4 will be removed by the FMZ (60-80 ft^2/ac). As described in chapter 6, the effects of FMZ treatments are considered a long-term permanent removal of PBFs based on the planned maintenance treatments. The removal will preclude future development of these critical habitat PBFs in these areas. The 80-120 ft^2/ac thinning treatment and follow-up fuels reduction treatments will variously affect 89 acres of PBF 2 and 770 acres of PBF 3 and may impair or preclude future development of PBFs and connectivity in the action area (Table 15; see sections 6.4.2 and 6.4.3). The adverse effects from these treatments will occur in 37 percent of the nesting, roosting, and foraging PBFs in the action area, and 20 percent of the dispersal PBF.
- Approximately 2,254 acres of PBFs 2 and 3 will be degraded to a degree where some habitat remains functional, but the quality will be reduced over the short- and long-term while individual large, intermediate, and small sized trees continue to grow and the canopy recovers. Where thinning degrades PBFs 2 and 3, individual tree health, growth, and resilience are expected to increase. There is a tradeoff, however, between reducing the current quality and availability of these PBFs and delaying further development of PBFs 2 and 3 with the expectation that treated areas will be more resilient to moderate or severe fire effects. In the face of both climate change and increasing barred owl competition, balancing the benefit of reducing the potential for high and moderate severity fires with the immediate adverse effects from NSO habitat simplification and removal requires careful consideration of the scope, location, and intensity of the treatments.
- Approximately 116 acres of PBFs 2 and 3 will be maintained, or neutrally affected, from meadow restoration, thinning in true fir stands, and underburning as a stand-alone treatment.
- The effects in an additional 983 acres of PBF 4 consist of either degrading, maintaining, or benefitting habitat conditions (Table 15). These effects are considered insignificant due to their location and scale and they are inconsequential to NSO use, dispersal, and connectivity at the action area scale. The thinning treatments to promote or maintain late seral conditions and reduce fire risk to NSO by thinning in PBF 4 will maintain and improve its current function. We expect both short- and long-term benefits in PBF 4,

including the protection these treated areas can provide to adjacent PBFs 2 and 3. These types of thinning treatments in dispersal habitat are considered consistent with the active management recommendations from the Recovery Plan and 2012 final rule since they promote the development or improve the functionality of critical habitat for NSO without causing adverse effects to PBFs (USDI FWS 2012 p. 71939).

- Effects will be wholly beneficial where 155 acres of PBF 1 are treated in plantations.

7.4.3. Effects to Physical and Biological Features by Treatment Type

The FMZ treatments will remove PBFs 2, 3, and 4 across 2,540 acres (Table 15). We consider these effects adverse over the long-term for the following reasons:

- The continuity of the FMZ treatment, large scale, magnitude of habitat effects, and juxtaposition with other continuous treatment areas where additional adverse effects to NRF habitat will occur.
- The removal of these PBFs is expected to impair connectivity and movement between the Soapstone and Scott home ranges and into areas to the west and east. These effects at this scale are expected to impair the intended connectivity function of designated critical habitat in the action area. Because mid and understory will be largely absent after implementation of the FMZ and maintenance treatments, the Service does not believe minimal foraging opportunities will exist after treatment and subsequently does not believe dispersal habitat will be maintained.
- These effects will occur on approximately 26 percent of the nesting, roosting, and foraging PBFs in the action area and will preclude the future development of these PBFs. While the intent of the treatment is to better protect communities and other resources from high severity wildfire, the treatment effects will remove and reduce critical habitat structure and simplify stands from the reduction and removal of stand complexity (canopy cover, large and small trees, within-stand layering, snags, and downed wood).

The 80-120 ft^2/ac thinning treatment will affect 89 acres of PBF 2, 770 acres of PBF 3, and 501 acres of PBF 4 (Table 15).

- We expect nesting/roosting habitat conditions will be changed or downgraded to low-quality foraging or dispersal or removed on 89 acres of PBF 2. This is because of the uncertainty regarding the intensity of impacts when considering the additional effects of the follow-up fuels reduction and maintenance treatments. Similarly, there is uncertainty regarding the intensity and extent of impacts to canopy cover, tree spacing, and mid and understory layering in 770 acres of PBF 3. Foraging conditions may be degraded or downgraded and still provide some minimal foraging opportunities because of prey habitat in more open areas, or it may be removed.
- There will be adverse effects to the future development of critical habitat, given the degree of change and juxtaposition with the FMZ treatment areas. While this treatment is not situated in a current NSO core or home range, portions of it do provide important connectivity between the Soapstone and Scott home ranges. These effects will occur in approximately 11 percent of these PBFs in the action area, but will not permanently

impair the future development of PBFs 2 and 3. The effects to habitat and NSO prey are fully described in Chapter 6.

- The 80-120 ft^2/ac thinning treatment in 501 acres of PBF 4 will degrade habitat function by reducing some quality of the low-quality foraging and roosting habitat conditions in this dispersal habitat (e.g., prey base, reduced canopy cover). We expect long-term benefits from reduced stand density and the thinning of smaller size class trees and increased individual tree health. We do not expect a delay in the development of PBF 4 (or further development into PBF 3) from this treatment. This is because basal areas will range from 80-120 ft^2/ac with approximately 30 percent or higher canopy cover for dispersing owls.

Table 15. Effects to critical habitat PBFs by treatment type.

Treatment*	PBF 2 (Nesting/Roosting)			PBF 3 (Foraging)				PBF 4 (Dispersal)		
	Maintain	Degrade	Remove	Maintain	Degrade	Degrade, Downgrade or Remove	Remove	Maintain	Degrade	Remove
Thin <10” dbh	0	376	0	0	425	0	0	75	0	0
FMZ (60-80 ft^2/ac)	0	0	403	0	0	0	1,600	0	0	537
80-120 ft^2/ac	0	0	89**	0	0	770	0	0	501	0
120-160 ft^2/ac	0	0	0	0	0	0	0	4	0	0
140-200 ft^2/ac	0	464***	0	0	936	0	0	299	0	0
160-200 ft^2/ac	53	0	0	29	0	0	0	0	0	0
Meadow Restoration	4	0	0	3	0	0	0	0	0	0
Port Orford Cedar	0	34	0	0	19	0	0	4	0	0
Fuels Unit	0	0	0	0	0	0	0	5	0	0
Underburn only	0	0	0	27	0	0	0	95	0	0
Total	**57**	**874**	**492**	**59**	**1,380**	**770**	**1,600**	**482**	**501**	**537**

*Approximately 155 acres of PBF 1 will be wholly benefitted through plantation thinning.

**PBF 2 may be downgraded or removed by the 80-120 ft^2/ac thinning treatment, depending on the magnitude of impacts from the thinning initial and follow-up treatments. See chapter 6 for more detail.

***Areas of PBF 2 habitat situated in PBF 3, or entire nesting/roosting stands treated with the 140-200 ft^2/ac thinning prescription will be marked, per Conservation Measure CM-1, to retain a higher basal area such that PBF 2 habitat is not downgraded.

The 160-200 ft^2/ac thinning treatment will maintain a combined 82 acres of PBFs 2 and 3 in areas of true fir stands. The 140-200 ft^2/ac thinning treatment may change small portions of 464 acres of PBF 2 to PBF 3 and will degrade 936 acres of PBF 3. The 120-160 ft^2/ac and 140-200 ft^2/ac thinning treatments will maintain 303 acres of PBF 4 (Table 15).

- In PBF 2, the 140-200 ft^2/ac thinning treatment in 464 acres of higher value habitat will have minor impacts to some areas of nesting and roosting habitat. These treatments are situated in the Scott NSO core and both the Scott and Soapstone home ranges. This thinning treatment will reduce the existing higher basal area and canopy cover, followed by mechanical and manual fuels reduction treatments and prescribed burning. When thinning treatments simplify a stand and reduce the cooler microclimate conditions by removing portions of the mid and understory canopy and layering, dominant and codominant trees, logs, snags, and overall forest structure, it may no longer function as nesting or roosting habitat. Conservation Measure CM-1 consists of pre-marking stands with nesting/roosting conditions to retain a higher basal area range. This should ensure retention of 150-200 ft^2/ac in these areas and associated higher canopy cover levels with mid and understory layering. Despite the conservation measure, we consider this treatment's location inside occupied cores and home ranges to not be in alignment with the 2011 Recovery Plan and 2012 Critical Habitat Rule (USDI FWS p. 71881), which do not encourage active management in areas of high-quality owl habitat or occupied owl sites.
- In 936 acres of PBF 3 in the Scott and Soapstone home ranges, the 140-200 ft^2/ac thinning treatment and follow-up fuels and prescribed fire treatments will reduce foraging habitat quality because some stand elements and complexity will be reduced or removed. We expect canopy cover to remain at 50 to 100 percent and some retention of the under and midstory trees, logs, snags, and shrubs. The effects of this treatment to habitat and NSO prey are fully described in Chapter 6. The effects from the continuous treatments and subsequent follow-up treatments in foraging habitat are considered adverse to NSO prey and are expected to alter or impair NSO foraging patterns and behaviors.
- In 303 acres of PBF 4, the combined 120-200 ft^2/ac thinning treatments and follow-up fuels and prescribed fire treatments are expected to maintain and improve dispersal habitat conditions.
- As described in chapter 6, many areas of dispersal are intermixed with foraging habitat in the action area and treatment areas. We do not expect a delay in the development of PBFs 3 or 4 (or further development into PBFs 2 and 3) from the combined 1,239 acres of these thinning treatments in foraging and dispersal habitat.

The Port Orford cedar treatments will affect a combined 57 acres of PBFs 2, 3, and 4 (Table 15). These trees can provide a high degree of quality shade and cooler microclimate conditions for roosting owls, given the tree's higher density in riparian corridors. Approximately 37 acres in NRF or dispersal habitat is intermixed with the FMZ or other thinning areas where PBFs will be removed. The exception is in the Soapstone NSO core area where surrounding habitat will be degraded. The effect of the 20 acres of Port Orford cedar treatment in the Soapstone home range is considered adverse in terms of reducing and possibly removing roosting habitat elements of PBF 2 in important areas along Soapstone Creek. However, we do not expect these effects will impair or influence roost site selection behavior or use, given effects will occur in narrow, linear areas and not all Port Orford cedar trees will be removed. The reduction or removal will not preclude or significantly delay the future development of the affected PBFs.

The effects from thinning a combined 82 acres of PBFs 2 and 3 with the true fir thinning prescription in the Scott home range, and a combined seven acres of PBFs 2 and 3 of meadow restoration treatments, will maintain NRF habitat conditions (Table 15). Most meadow restoration sites in the Scott and Soapstone home ranges are one acre or smaller. We consider the effects of removing any stand elements of PBFs 2 and 3 insignificant in terms of altering nesting, roosting, or foraging behaviors of NSO. This is because habitat elements will be removed from smaller patches of habitat rather than larger, contiguous areas and meadow restoration is expected to increase prey numbers and availability in these small openings.

The understory thin and fuels reduction treatment (thinning <10” dbh trees to a 35-foot spacing and underburning) will degrade and maintain a combined 876 acres of PBF 2, 3, and 4.

- Understory complexity will be reduced where thinning and burning occurs in the Soapstone, Scott, and Morgan core areas. We expect habitat will be maintained however, as overstory trees and canopy closure, and most mid and understory layering, will be retained. Not every tree in the <10” dbh size class will be removed or thinned, and the understory structure that is vital for fledgling owls that cannot yet fly will remain available for individuals to climb back up into the nest tree, or other surrounding trees or vegetation (Forsman 1976, Forsman *et al*. 1984). Thinning smaller diameter trees to a 35-foot spacing may enhance growing conditions of residual trees and reduce fire risk, further contributing to the ongoing development and maintenance of PBFs 2 and 3.
- While any treatment in long-term occupied cores is not considered consistent with Recovery Action 10 or the 2012 final rule, this lower-intensity treatment attempts to strike a balance by helping to protect and facilitate further growth of NSO habitat in these locations without causing adverse effects to PBFs 2 and 3 (USDI FWS 2012 p. 71939).

Treatments in the fuels unit (thinning ≤10” dbh trees, piling/burning, and underburning) will maintain five acres of PBF 4 and will not affect PBFs 2 or 3.

- Habitat function will be maintained and dispersal habitat conditions will be improved by reducing stand density and increasing individual tree health. The effects are considered wholly beneficial to PBF 4. They are discountable in terms of impeding NSO movement through the area, as this treatment is located in a higher slope position, mostly in non-habitat. Treatments in the entire fuels unit across 657 acres will provide some protection to higher value habitats, including PBFs 2 and 3.

Thinning plantations will improve the function of 155 acres of PBF 1.

- The Service considers effects here wholly beneficial in terms of increasing stand resilience and promoting growing conditions toward development of PBFs 4 and 3.
- These beneficial effects are both short- and long-term. They are expected to reduce the risk of habitat loss proximal NSO habitat in the current Scott core and home range and other important areas throughout the action area from insects, disease, or wildfire.
- If prioritized for implementation, this type of treatment is considered highly consistent with active management recommendations from the Recovery Plan and the 2012 final rule. It promotes the development or improves the functionality of critical habitat for NSO without causing adverse effects to PBFs (USDI FWS 2012 p. 71939).

Approximately 122 acres of PBFs 2, 3, and 4 will be underburned as a stand-alone treatment. We consider the effects neutral, since stand elements of affected PBFs will be maintained, and discountable in terms of altering NSO nesting, roosting, foraging, or dispersing behaviors. This is because of the small treatment areas, the expected post-treatment stand conditions, and treatment placement in higher slope positions and elevation ranges with a lower likelihood of NSO use.

7.5. Effects to Critical Habitat in the ECS-3 Subunit

When evaluating proportional impacts to critical habitat subunits and units, we focus on NRF habitats (PBFs 2 and 3) because these represent the highest quality habitat and are most critical to NSO survival, fitness, and reproduction. The effects to dispersal habitat (PBF 4) habitat are also important however, as it supports the transience and colonization phases. PBF 4 does provide a life-history need at the landscape-level scale and effects to it should be assessed at a larger scale than PBFs 2 and 3 (USDI FWS 2012 p. 71939). Potential scales of analysis for PBF 4 include the local watershed or sub-watershed, a dispersal corridor, or other relevant landforms (USDI FWS 2012 p. 71939). Effects to PBFs 2 and 3 should also be considered as effects to dispersal habitat to the extent they provide important areas during the colonization phase of natal and territorial pair dispersal.

Approximately 5,232 acres of habitat contributing to PBFs 2 and 3 will be treated (Table 16). There will be long-term adverse effects to PBFs 2 and 3 across 2,862 acres. We expect 116 acres of PBFs 2 and 3 to be maintained and benefitted. Additional benefits are expected over the long-term in 2,254 acres where habitat is treated but degraded. It will remain available and functional for breeding, feeding, and sheltering behaviors, but at a reduced quality over the short-term.

Table 16. Effects to PBF 2 and PBF 3 in the ECS-3 Subunit.

Critical Habitat	Estimated acres in Subunit	Wholly Beneficial Effects	Neutral to Beneficial Effects	Adverse Effects
PBF 2	2,293	57	874	492
PBF 3	20,906	59	1,380	2,370
Total	**23,199**	**116**	**2,254**	**2,862**

The recovery and conservation function of ECS-3 is to provide demographic support in an area of sparsely distributed high-quality habitat on Federal land, and to provide population connectivity between subunits to the north and south (USDI FWS 2012 p. 71931). Because there will be adverse effects to PBFs, it is necessary to evaluate these effects in relation to the designated conservation functions of the subunit.

- At the action area scale of PBFs 2 and 3, approximately 37 percent of the effects in these PBFs are considered adverse. This is due to precluding and delaying the future development of nesting, roosting, and foraging habitat in important areas of known owl use in the western extent of the Scott home range and connectivity in an important part of the action area. These effects will occur on 2,862 acres.

- The effects to PBFs 2 and 3 will mostly occur in the long-term, currently occupied cores and home ranges with resident or reproducing NSOs, and in areas that provide important connectivity. While habitat conditions in parts of the watershed may be considered of lower value in comparison to other areas in the NSO range, the action area is considered to hold some of the highest value habitat for NSO in the California Cascades recovery unit and ECS-3, in combination with habitat areas to the east and north of the McCloud River. The watershed has been continuously occupied and used since before the species listing. The effects and continuous habitat manipulation across the project area in an action area where barred owls have also been detected could also increase competitive interactions because of significant habitat modification, removal, or disturbance.
- At the subunit scale, the adverse effects to PBFs 2 and 3 will influence approximately 12 percent of these PBFs in ECS-3 (Table 17). The remaining 2,370 acres of impacts to PBFs 2 and 3 at the action area scale are considered insignificant to altering the functions of the subunit.

Table 17. Effects to critical habitat PBFs at the action area, Subunit, and Unit Scales.

Effects to PBFs (acres)		**Percent of PBFs affected in action area**	**Percent of PBFs affected in ECS-3**	**Percent of PBFs affected in Unit 8**
PBFs 2 and 3				
Beneficial or Neutral Effects	2,370	31	10	3
Adverse Effects	2,862	37	12	3
PBFs 2, 3, and 4				
Beneficial or Neutral Effects	3,353	32	5	2
Adverse Effects	3,399	33	5	2

At the action area scale, the scope, magnitude, and location of adverse effects to the PBFs of critical habitat are expected to impair the intended function of the entire subunit, which is to provide demographic support (i.e., successfully reproducing pairs, continued occupancy of territorial owls, and support for subadults and young). This impairment is expected to be most impactful during the first 10 years of project implementation. The continuous effects will occur in long-term occupied sites that contribute to the local NSO population in the ECS-3 subunit, and both the California Cascades and California Klamath recovery units. While average annual reproduction has not been consistent in the action area, it has remained continuously occupied by NSOs and remains important for contributing to the survival and recovery of the species in both recovery units and the ECS-3 subunit.

Where PBFs are removed or reduced, the effects will occur in areas known and likely to be occupied by territorial pairs and their young, dispersing subadults, and possibly nonterritorial owls. Where PBFs are treated but habitat remains functional for nesting, roosting, or foraging, these areas will remain available for use by NSOs, but with short-term reductions in habitat quality. The continual impacts to prey in the treatment areas and occupied sites throughout implementation may further impair NSO foraging behaviors, exerting a negative influence on their fitness.

7.5.1. Demographic Support

As described in the 2012 final rule, subunits that are expected to provide demographic support should be assessed for their ability to continue to support NSO nesting territories in conditions suitable for occupancy by pairs of owls (e.g., amount and location of nesting habitat, proximity of foraging habitat) (USDI FWS 2012 p. 71940). The adverse effects of the action to critical habitat are primarily from effects to PBFs 2 and 3 that will be removed. This removal will primarily occur in areas that support connectivity, but also in the eastern and western portions of the Scott home range. Chapter 6 describes the effects of the action in NSO territories.

- Within the Scott NSO territory, barely sufficient nesting, roosting, and foraging habitat will remain available in portions of the home range. An estimated 1,431 acres of NRF habitat will remain in the overall home range, as FMZ and thinning treatments will bisect both. It is important to note that part of the current Scott core area near the nest tree in 2021 and 2022 are more open. While the NRF habitat in the current core is estimated at 271 acres after treatments, and below the Service's recommended levels to avoid take, most of the habitat removal will occur in the eastern extent of the core from FMZ treatment. This area and the eastern extent of the current home range has a lower detection rate of owls and overall lower use, but it does provide important connectivity to the east along riparian corridors. We are uncertain if demographic support will continue in this territory. This is because of the continuous area of treatment across the territory and effects from habitat removal and degradation. The repeated treatment entries will displace prey and we therefore expect impairment of breeding, feeding, and sheltering behaviors.
- Within the Soapstone NSO territory, we estimate 475 and 1,770 acres of NRF habitat will remain available in the core and entire home range, respectively. We expect demographic support will continue in this territory, but given the continuous areas of treatment and repeated treatment entries that will displace prey, we also expect impairment of breeding, feeding, and sheltering behaviors during the first ten years of implementation in this territory, with the most pronounced effects occurring in the first one to five years.
- In the extent of the Morgan territory encompassed in the action area, we expect 353 and 1,533 acres of NRF habitat will remain in the core and home range, respectively. While long-term occupancy is not demonstrated for this territory, the habitat within it remains important for owls in the action area during natal dispersal or use. At the northwestern extent of the action area, it can provide for connectivity to the northwest to another area of ECS-3, as well as the ICC-7 and KLW-8 subunits to the west.

The action area contains 15,811 acres of NRF habitat and 7,634 acres of PBFs 2 and 3. Based on habitat as a surrogate alone, it could provide for four territorial pairs. Habitat conditions in the higher elevations are patchy and less anchored to higher value habitat areas in lower or midslope positions however. Over the last 20 years, many detections outside the two long-term occupied sites and connectivity corridors have occurred. The action area likely provides important areas for natal dispersal by subadult owls until they prospect or colonize outside of the action area. It may also be important for nonterritorial owls that prospect for territorial vacancies created when residents die or leave their territories (USDI FWS p. 71885). These nonterritorial owls contribute to stable or increasing populations of northern spotted owls by quickly filling territorial vacancies.

We acknowledge the PBFs will be affected for 1-30 years over the course of implementing the project. Because NRF habitat is expected to remain available across the action area, be more resilient, and will mostly remain available in the known NSO territories, overall demographic support is not expected to be compromised at the subunit scale. Table 17 provides information on the percentage of nesting, roosting, foraging, and dispersal habitat that will be affected at various scales, which also represents the relative change and effects to PBFs in treated areas.

7.5.2. Connectivity

The 2012 final rule states, "If a particular subunit was designated to support connectivity between subunits, then the loss or impact to connectivity must be assessed" (USDI FWS 2012 p. 71940). ECS-3 is neighbored by ECS 2 to the north, ICC-7 and KLW-8 to the northwest, west, and south, and ICC-8 to the southeast. The effects of the action will adversely affect 2,862 acres of nesting, roosting, and foraging PBFs and an overall 3,399 acres of habitat that can be used for dispersal from ECS-3 (Table 17).

Within the action area, owls are most likely to disperse to subunits ICC-7, KLW-8, or ICC-8 because habitat between ECS-3 and ECS-2 is largely absent. As described in section 7.2 above, the distances between ECS-3 and its neighboring subunits are considered within the known distances for both the transient and colonization phases of NSO dispersal. We expect some diminished connectivity to the west into ICC-7 and KLW-8 from the FMZ treatments. ICC-8 is expected to remain well connected to ECS-3.

While the proportion of overall connectivity support in the ECS-3 subunit that will be removed is small (five percent), we conclude the effects of the action will negatively influence the abundance, distribution, and demographic performance of two long-term NSO territories in the action area, influencing these same population factors across the ECS-3 subunit.

7.6. Effects to Critical Habitat in the East Cascades Unit

At the scale of Critical Habitat Unit 8, the amount of PBFs 2 and 3 that will be affected is six percent relative to the size and amount of available NRF habitat in the unit (90,763 acres). The unit will continue to provide demographic support because of the current overall amount of existing NRF habitat and PBFs 2 and 3. We expect adequate habitat will remain available to support reproduction, foraging, and dispersal outside the action area in the subunit and unit. This habitat will not be significantly altered by the effects of the action, despite the localized adverse effects to PBFs 2 and 3 and occupied NSO sites. Because the connectivity between subunits will not be significantly altered, it will not be affected at the larger scale of critical habitat Unit 8.

The critical habitat in Unit 8 will continue to serve its intended support role for NSO recovery by providing habitat necessary to support essential life history functions such as reproduction and connectivity. The proportion of critical habitat removed or otherwise reduced in quality by the project's effects will not appreciably reduce the ability of the designated critical habitat at the unit scale to provide the recovery support functions for which it was designated.

7.7. Effects to Provincial and Rangewide Critical Habitat

The effects from habitat removal and thinning treatments that will preclude or delay development of PBFs 2, 3, and 4 on approximately 3,399 acres of nesting, roosting, foraging, and dispersal habitat equate to a small amount relative to the habitat available in both the California Cascades and California Klamath provinces and recovery units, Critical Habitat Unit 8, and at the rangewide scale of designated critical habitat.

Overall, we expect some long-term beneficial effects in the action area from increasing habitat resilience to moderate or severe wildfire despite the short- and long-term adverse effects to critical habitat. We have determined the project actions will impair the intended recovery function of the ECS-3 subunit and preclude or delay development of essential PBFs in the action area. These effects will influence five percent of these essential PBFs in the ECS-3 subunit, with two percent in Unit 8. While not biologically relevant, the proportion of effects in the subunit and unit compared to what remains available complements our conclusion that the recovery and conservation role of critical habitat will not be appreciably reduced at the scale of the rangewide critical habitat network. While we expect both short- and long-term adverse effects to nesting, roosting, foraging, and dispersal PBFs in the action area, with similar impacts to NSO from reduced fitness and survival, the project is not expected to impair overall NSO recovery within critical habitat at the province or rangewide scales.

7.8. Cumulative Effects to NSO Critical Habitat

Critical habitat for the NSO is not designated on state, private, or Tribal lands (USDI USFWS 2012 p.71877); therefore, there are no cumulative effects to NSO critical habitat from implementation of the proposed action. Future federal actions in critical habitat will be subject to the consultation requirements established under section 7 of the ESA and, therefore, are not considered cumulative to the proposed action.

8. CUMULATIVE EFFECTS

Cumulative effects are those effects of future state, tribal, and private actions that are reasonably certain to occur within the action area. Future Federal actions will be subject to the consultation requirements established in section 7 of the ESA and, therefore, are not considered cumulative to the proposed action but instead will be incorporated into the baseline of future projects. The ESA cumulative effects for the project are those changes to the existing condition caused by reasonably certain non-federal activities when added to the effects and consequences of the project.

There are 5,819 acres of non-federal ownership in the action area that include approximately 2,820 acres of private commercial timberland. The remaining 2,999 acres consist of 13 acres of CDFW managed lands, and 2,986 acres of rural residential zones and homes, County-managed lands around Lake Siskiyou developed and managed for recreation, and the Lake Siskiyou Camp Resort. Based on our independent review of GIS data and knowledge of the area, there are no tribal lands in the action area.

For purposes of this analysis, we only address cumulative effects to the NSO as the private and state lands in the action area do not contain habitat for Franklin's bumble bee. The private property and state land does not overlap with the current Scott, Soapstone, or Morgan NSO core areas or home ranges in the action area. There is a small amount of private land in the Boulder NSO home range at the southern extent of the action area, which contains a mix of foraging and dispersal habitat south of Castle Creek. No project treatments are proposed in this location.

8.1. Cumulative Effects Assessment

To evaluate the cumulative effects from actions on private lands in the action area to NSO, we reviewed the CalTREES THP database to determine if forest management actions are planned in the action area under timber harvest plans (THPs), NTMPs, and/or Exemption and Emergency Notices.[3] Additionally, we used GIS information from CALFIRE's database.[4] As of November 14, 2023, there is one proposed THP (2-22-00180-TRI) that overlaps the southwestern portion of the action area on private land. The West Mt. Shasta Forest Resiliency Project also proposes vegetation treatments on private lands to reduce the risk of wildfire through vegetation management in the northern extent of the action area. There are no NTMPs, Exemption Notices, or Emergency Notices planned in the action area.

8.1.1. Timber Harvest Plans

As described above, to evaluate cumulative effects from THPs, the Service reviewed the CalTREES Timber Harvest Plan database. As of November 14, 2023, six acres of a proposed THP (2-22-00180-TRI) overlaps the southwestern portion of the action area near Cliff Lake. This THP was submitted to CAL FIRE in 2022 and proposes an alternative/clearcut prescription. The landowners have no foreseeable plans for land actions and use their property for recreation only. Over the last thirty years there have been no NSO observations in the vicinity of that inholding (BA p. 50). There are three approved but incomplete THPs that overlap the action area, for a total of 403 acres. These THPs are considered ongoing private actions as described in chapter 4, yet the effects have yet to occur as they are not completed to date.

8.1.2. Other Private Lands

The Shasta Valley Resource Conservation District plans to implement the West Mt. Shasta Forest Resiliency Project through the California Vegetation Treatment Program (CalVTP) Program. The project area is 12,966 acres and extends from just north of Lake Siskiyou to Black Butte. About six percent of this project area falls within the NSO action area. It is expected to reduce the risk of wildfire through vegetation treatments on private lands. The project consists of ecological restoration (including meadow restoration), fuels reduction in wildland-urban interface (WUI), and constructing fuelbreaks. Proposed treatment activities include mechanical and manual thinning treatments, prescribed fire and underburning, and herbicide application.

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[3] CalTREES website: https://caltreesplans.resources.ca.gov/caltrees/Default.aspx

[4] CALFIRE Forest Practice GIS website: https://forest-practice-calfire-forestry.hub.arcgis.com/

8.2. Cumulative Effects Analysis

The CalTREES THP database provides information on proposed, approved, and completed THPs on private lands. A spatial layer of emergency and exemption notices is also available on the website. Accordingly, this information was analyzed for our cumulative effects analysis.

The proposed THP on six acres of private land which has been submitted but is not yet approved is expected to remove small amounts lower quality dispersal habitat and non-habitat. We consider these effects to NSO habitat discountable because of the small size and impacts to habitat. This area also has a low likelihood of use by territorial NSOs given its elevation of approximately 6,200 feet. The 403 acres of approved THPs, which are reasonably certain to occur but where the effects have yet to occur, will mostly remove foraging and dispersal habitat, and a small amount of nesting/roosting habitat. We consider these cumulative effects insignificant in terms of affecting breeding, feeding, or sheltering behaviors of NSO. This is because the THPs are small in size, will not occur in important dispersal and connectivity corridors for the NSO, and do not overlap with current NSO home ranges.

The cumulative effects from the West Mt. Shasta Forest Resiliency Project are considered both insignificant in terms of affecting breeding, feeding, or sheltering behaviors of NSO and their ability to disperse on the landscape. This is because the project will mostly treat foraging and dispersal habitats by thinning <12" dbh trees and may include prescribed burning. We expect these treatments to degrade and maintain NSO habitat function. They will be beneficial in terms of reducing fire risk around private properties and surrounding NSO habitat that provides for connectivity and dispersal to the north and west. While there are no proposed (or approved) THPs to implement this project to date, we expect most of them to be small in size. At this time, there are no current or historic NSO home ranges in this portion of the action area, though past detections have occurred (CNDDB 2023).

Our review of the § 1038 Exemptions and Emergency Notices for the action area did not identify areas where emergency actions are planned to occur. There are also no NTMPs planned in the action area at this time.

In conclusion, the identified cumulative effects will impact NSO habitat in the action area, but none of the effects will occur in NRF or dispersal habitat in the current NSO cores or home ranges. Considering the placement of these vegetation management activities on private lands, the small scale, and low magnitude of effects we have determined they are insignificant and discountable. These effects are not expected to contribute to the project's adverse effects or additional incidental take. While cumulative to the effects of the action, they will not contribute to a significant impairment of NSO breeding, feeding, or sheltering behaviors.

9. Summary and Synthesis of the Proposed Action-Northern Spotted Owl

This chapter is the final step for assessing the risk posed to the threatened northern spotted owl as a result of implementing the proposed action. As described in chapter 3, the Service considers the northern spotted owl functionally endangered (USDI FWS 2020a, Appendix A). Here, we evaluate the effects of the action, environmental baseline, and cumulative effects with respect to the owl's status to inform our conclusion in this Biological Opinion. Chapter 10 provides our conclusions regarding jeopardy and adverse modification of critical habitat for the northern spotted owl, based on this synthesis. It also includes our conclusion regarding jeopardy for Franklin's bumble bee.

The Service understands and acknowledges the critical safety concerns within portions of the project area and action area, notably given the one way in-one way out access along the high-use Castle Lake Road. We understand the purpose and need to create safer routes for forest visitors to exit the project area in the event of a wildfire (egress), and safer access for suppression resources while visitors are evacuating (ingress). As described in the BA, these safer travel routes also allow suppression resources to engage the fire instead of managing evacuations. We also acknowledge the risk to NSO habitat loss, but conversely the proposed action and alternative 4 are not considered consistent with the recovery goals and actions, or the 2012 final critical habitat rule regarding active management in occupied sites (Recovery Action 10) nor conserving high quality habitat (Recovery Action 32). See Appendix B for a discussion of these recovery actions.

We reviewed the current status of the northern spotted owl and its critical habitat at the rangewide scale, the environmental baseline, the effects of the proposed action, and the cumulative effects. The following summary and synthesis supports our conclusions in Chapter 10. It is based on the information presented and factors analyzed in chapters 1 through 8.

9.1. Jeopardy Analysis for Northern Spotted Owl

The status of the species for the northern spotted owl (NSO) includes information on the listing status, life history, threats, conservation needs, rangewide habitat and population trends, and recovery units (Appendix A).

- NSOs are habitat and prey specialists, utilizing mid- to late-seral mixed conifer forests for nesting, roosting, or foraging. They prey primarily on flying squirrels and woodrats, and may use pockets of early-seral forest stands for foraging where woodrat abundance is generally higher.
- The main threats are habitat loss and competition from barred owls. The conservation needs center around a network of habitat that is spatially and functionally able to support multiple NSO pairs and provide for movement between areas of nesting, roosting, and foraging (NRF) habitat.
- Recent studies on habitat and population trends indicate NSOs and their habitats continue to decline (Franklin *et al*. 2021). While the rates of habitat loss remain relatively consistent with those predicted by the NWFP, the rates of population decline have been increasing, with evidence of barred owls affecting population trends.
- Physiographic Provinces were used as the basis for 12 recovery units in the Recovery Plan. The action area is mostly located in the California Cascades province and recovery unit, but also includes a portion of the California Klamath province and recovery unit (Appendix B).

The environmental baseline describes the current distribution, quality, and amount of NSO habitat in the action area. It mostly consists of Federal Forest Service lands, with approximately 12 percent in non-federal ownership or management.

- The southern extent of the action area consists of a checkerboard pattern of private commercial timberlands at higher elevations. Where habitat is present, these lands mostly provide for dispersal and connectivity. The private ownership and management pattern does not constrain the distribution of higher value habitats in the mid-and lower-slope portions of the action area, nor does it preclude connectivity out of the action area to the south or southeast into the Sacramento River canyon, or east toward the McCloud River watershed and McCloud Flats area. Habitat connectivity is limited to the north out of the action area by areas of private rural residential lands.
- Despite past vegetation management on Federal lands, the resulting mix of habitats in the action area have been continuously occupied and used by territorial owls. Midslope and lower slope forest stands contain large amounts of within- and between-stand forest heterogeneity because of past management.
- There is a long history of NSO occupancy in the action area and individuals and territorial pairs continue to use the best available habitat, even if it is categorized as foraging habitat, based on stand conditions. Higher value habitat areas mostly consist of larger conifer trees (>22" dbh) and a range of 50-100 percent canopy cover with varied amounts of midstory and understory layering. They are in closer proximity to water or contain more abundant springs, seeps, and streams, with connectivity areas between these habitats. Distributed throughout the higher value habitat areas are smaller pockets of conifer mortality, dense shrublands, or smaller size class trees.
- Other stands provide mostly low-quality foraging or dispersal conditions characterized by uniform and dense smaller diameter (12-15" dbh) trees with varying levels of canopy cover, depending on the stand density.
- Most non-habitat is situated above 6,000 feet elevation on both Forest Service and private commercial timberlands, and in the northern extent of the action area on private rural residential lands. Five current or historic NSO territories overlap the action area: Morgan, Scott, historic Scott, and Soapstone. Barred owls were detected in the action area in 2018, 2019, and 2022.

The effects of the action are described in Chapter 6. The risk of adverse effects from noise or smoke disturbance, or from direct injury or mortality, during implementation is low. This is because of the conservation measures for implementing seasonal restrictions both within and near NRF habitat during the critical breeding and nesting season. The implementation of these seasonal restrictions will minimize, if not wholly avoid, direct injury or mortality of nesting NSOs or their young. This includes managing smoke creation and dispersion when burning hand piles or underburning in specific areas.

Adverse effects are anticipated from habitat loss, reduction, and continuous areas of effects in currently occupied sites and important connectivity areas.

- Approximately 52 percent of the NRF habitat in the action area will be treated and variously maintained, degraded, downgraded, or removed. Of this, approximately 28 percent will be adversely affected. There will be mostly beneficial to neutral effects to habitat function in 24 percent of the NRF habitat in the action area.
- The adverse effects will result from: 1) the long-term, permanent removal of NSO habitat in fuel management zones, 2) the simplification of NRF habitat stand structure in important connectivity areas, and 3) the continuous treatments in lower and midslope areas of NSO habitat, primarily in occupied NSO territories, which will reduce NSO habitat quality and distribution. The effects of the various thinning treatments and the simplification that can occur by reducing or removing stand complexity (large and small trees, canopy cover and closure, within-stand layering, snags, and downed wood) are described in Chapter 6. Other treatments will have insignificant effects, or will maintain or benefit NSO habitat conditions over the short- and long-term.
- Changes to the distribution, amount, and quality of NRF habitats will adversely impact NSO prey. Effects can include direct injury or mortality, and displacement caused by repeated, cumulative habitat disturbance throughout implementation of the various forest thinning and vegetation management treatments. These effects to prey will thereby negatively influence NSO fitness in the action area due to higher energy expenditures to locate prey, and will increase predation risk to NSOs because of more open canopy conditions.
- The treatments summarized above will be implemented in the currently occupied Soapstone and Scott territories and adverse effects to individuals and habitat are expected including take. Impacts will also occur to subadults or possibly nonterritorial owls in the action area throughout implementation. Competitive interactions with barred owls could also be exacerbated by habitat loss and degradation in these sites, or other portions of the action area used by NSOs. We expect discountable effects in the currently unoccupied Morgan territory. The treatment effects in this habitat are unlikely to preclude occupancy and use in the future, as habitat will mostly be maintained or degraded. The treatments in the Morgan territory span approximately 25 percent of the home range, in contrast to vegetation management throughout the Soapstone and Scott home ranges. The current habitat conditions in the Morgan territory are also unlikely to support long-term occupancy, but this area can provide for dispersing subadults or nonterritorial NSOs, including young owls generated in the Scott or Soapstone territories.

The effects of the action are expected to impair NSO breeding, feeding, and sheltering behaviors in two occupied core use areas and home ranges, and connectivity areas between the two sites. The effects in the Scott and Soapstone home range are predicted to result in reduced productivity and fitness of NSOs during the first 1-10 years of management actions in these locations.

- The majority of the Soapstone core will have a lighter thinning treatment, and this is expected to maintain and promote more resilient habitat conditions. Similar effects are expected in about 50 percent of the Scott core, with more intensive impacts to habitat and prey from the fuel management zone and thinning treatments in the remaining 50 percent of this core.

- NSOs are expected to continue to occupy the Soapstone territory over the short- and long-term. Continued occupancy of the Scott territory is not predictable, given the scale and magnitude of effects, including an estimated 10 miles of new trail construction and increased recreation use and disturbance in the home range.

The project's conservation measures for snag and log retention, and retaining higher basal area in treated stands of nesting or roosting habitats, are expected to retain some key structural components for NSOs and their prey.

Approximately 41 percent of the dispersal habitat in the action area will be treated and variously maintained, degraded, or removed. Of this, approximately 15 percent will be removed. This analysis represents effects to dispersal as a stand-alone habitat element. When combined with the effects to nesting, roosting, and foraging habitat that also provide for dispersal, approximately 23 percent of the dispersal-capable habitat in the action area will be removed or significantly altered to lower habitat quality. This removal will primarily occur in the fuel management zones, likely creating a connectivity barrier throughout portions of the action area and to the west into the California Klamath province and neighboring critical habitat subunits. Because of more open stand conditions, NSOs would be more vulnerable to predation, as well as drier and hotter microclimatic conditions. Outside the fuel management zones we do not expect the impacts to dispersal habitat to alter territorial, resident, or nonterritorial NSOs use of the landscape.

Chapter 8 addresses the cumulative effects from activities on private and state lands in the action area. We determined the effects of vegetation management associated with the West Mt. Shasta Forest Resiliency project and several timber harvest plans to be insignificant and discountable in terms of contributing to the adverse effects of the action or additional take.

Reproduction, numbers, and distribution of NSO in the action area will be reduced over the first ten years of implementation. We estimate two pairs (four adults) and eight young or subadult NSOs will be harmed and taken by the effects of the proposed action, with the majority of the adverse effects occurring throughout the first one to five years of implementation in the occupied territories. As described in chapter 7, we are uncertain if demographic support will continue in the current Scott territory because of the continuous area of treatment and effects from habitat removal and degradation.

We anticipate some treatments will increase forest stand resilience to moderate and severe fire effects and help protect and promote development of better quality NSO habitat without significantly reducing or impairing its quality. These effects will occur in the plantation stands, oak conifer woodlands, and other natural stands where habitat quality is degraded but the function is maintained. We also expect short- and long-term beneficial effects from returning low-intensity prescribed fire to the landscape because of the increased resilience this treatment can provide in terms of reducing NSO habitat loss from severe wildfire.

9.1.1. Effects at the Province Level and Recovery Unit Scale

The effects of the action will impair individual NSO fitness, and possibly continued use and occupancy of the action area over the first ten years of implementation. This is because of the scale and magnitude of effects in occupied core use areas and home ranges. While impactful, these localized impacts are not expected to preclude the survival or recovery of the species at the scale of the California Cascades or California Klamath provinces and recovery units.

- The action area's contribution to the NSO population in the two recovery units is likely to be reduced during this time period. At the scale of the California Cascades and California Klamath recovery units, the affected NRF habitat in the action area represents approximately 1 and 0.3 percent of the available NRF habitat in each recovery unit, respectively.
- Despite the small amount of habitat affected at the scale of these recovery units, the watershed and action area contain two of the longest occupied NSO territories in the California Cascades recovery unit since the 1990 listing. They contribute to the local population and populations in both recovery units. The NSO pair associated with the current Scott territory had two young in 2021 and 2022; and in years when the Soapstone NSO pair has reproduced, they average three young per year. Reproduction was not confirmed for the Scott NSO pair in 2023, though the adults were detected several times west of their current activity center in an area of higher quality habitat. Active management which results in adverse effects to individual owls and high-quality habitat in occupied sites is not considered consistent with the goals of the Recovery Plan or the 2012 final rule (USDI FWS 2011 p. III-42, USDI FWS 2012 p. 71881). While the Scott and Soapstone NSO territories do not represent the sole source population to either recovery unit, their breeding, feeding, and sheltering behaviors will be impaired by the effects of the action. This will result in a likely reduced contribution of future owls (numbers) and subsequent reduced distribution in the two recovery units for one to five years.
- While the proposed action will affect important habitats that contribute to the successful reproduction and survival of NSOs and their long-term recovery in the action area, these effects are not expected to measurably influence the provincial baseline or constitute an appreciable reduction in the "recovery support" function of each recovery unit, as defined in the Recovery Plan.

In terms of species reproduction, numbers, or distribution, the impacts to and take of individuals that contribute to the California Cascades and California Klamath recovery units will not appreciably impair or preclude the conservation role provided by these recovery units to the survival and recovery of the species as a whole.

- We do not have current population estimates for the two affected recovery units. When we consider the long-term monitoring and population trend data from the Northwestern California Demographic study area (Franklin *et al*. 2022) in the California Klamath recovery unit and other known, occupied sites in the California Cascades recovery unit (CNDDB 2023), the adverse impacts from the action may influence approximately 21 percent of the estimated population.

9.1.2. Effects at the Rangewide Scale

The reduction in quantity and quality of nesting, roosting, foraging, and dispersal habitat for NSO in the action area represents less than one percent of the habitat available for the species across its range.

- The adverse effects to individual owls, NRF habitat, and dispersal habitat in the action area are not expected to appreciably reduce the likelihood of both the survival and recovery of the species at the rangewide scale. At this scale, and the provincial scale, the action affects an insignificant proportion of habitat.
- The negative effects to the two occupied territories in the action area are not expected to appreciably diminish the survival of the species across its range. Further long-term benefits, including areas of improved forest health and a reduced risk and severity of wildfire can help contribute to the maintenance and promotion of well-distributed habitat across the range of the species.

In terms of species reproduction, numbers, or distribution, while the impacts to and take of individuals is considered significant at the action area scale, it represents less than one percent of the current estimated population at the rangewide scale where the Service has estimated there are likely 3,000 or fewer individuals present (Appendix A).

9.2. Adverse Modification Analysis for Northern Spotted Owl Critical Habitat

The status of NSO critical habitat includes information on the designation of critical habitat, its conservation role, the physical and biological features (PBFs) essential to the conservation of the species, special management considerations, and the rangewide baseline. The role of NSO critical habitat is to support the life-history needs of the species to the extent populations of nesting owls are well-distributed and interconnected, allowing for their persistence within properly functioning ecosystems.

The PBFs are forest types that support NSO nesting, roosting, foraging, and dispersal. Special management considerations are described in the 2012 final rule to document instances where passive or active management may be necessary to address species recovery. Finally, the rangewide baseline provides information on the amounts of critical habitat available at the rangewide scale and at the scale of the East Cascades Unit (CHU 8) where the project is located (see Appendix A).

Chapter 7 describes the environmental baseline for the current distribution, quality, and amount of critical habitat in the action area. It also includes information on habitat levels in CHU 8 and the affected East Cascades South subunit (ECS-3).

- The effects of the action will be adverse to PBFs 2, 3, and 4 from forest thinning treatments that remove or variously downgrade or significantly degrade NRF and dispersal habitat on 3,399 acres. Post-harvest, these effects are expected to increase fragmentation and predation risk, with incremental adverse impacts to NSO prey distribution and numbers. Woodrat abundance may be increased in areas where canopy cover is removed or reduced and early seral conifer or shrub regeneration occurs. The adverse effects to PBFs 2 and 3 will occur across 37 percent of these two critical habitat PBFs in the action area.

- PBF 4 consists of habitat that supports the transience and colonization phases of dispersal. Effects to PBF 4 should be assessed at a larger scale than effects to PBFs 2 and 3 (USDI FWS 2012 p. 71939). At the sub-watershed scale, habitat which provides for successful dispersal will be removed from 25 percent of the available critical habitat (PBFs 2, 3, and 4) that supports this behavior and life-history function in the action area.
- Approximately 30 percent, or 2,254 acres, of PBFs 2 and 3 in the action area will be degraded in quality but remain available for important life-history functions of foraging, nesting, roosting, and dispersal. Because prey numbers and distribution in these areas will be adversely impacted by cumulative repeated treatments, we expect reduced NSO fitness and survival in the action area during the first ten years of implementation. We expect 116 acres or two percent of these PBFs will be maintained and wholly benefitted from meadow restoration, areas of true fir thinning, or underburning as a stand alone treatment.
- Approximately 155 acres of PBF 1 will be wholly benefitted from plantation thinning where stand resilience will be increased. This treatment will also promote development of PBFs 4 and 3. The thinning treatments in these plantations will help reduce the risk of habitat loss to proximal NSO habitat in the Scott core and home range, and other important areas in the action area.

Because NSO critical habitat is not designated on state, private, or Tribal lands (USDI FWS 2012 p. 71877), there are no cumulative effects to critical habitat.

The proposed action is entirely located in the East Cascades South subunit (ECS-3). The amount of affected PBFs 2 and 3 represent 23 percent of this critical habitat available in the subunit and six percent of it in CHU 8.

- We expect short- and long-term impacts to NSO breeding, feeding, and sheltering behaviors and reduced fitness where habitat quality is changed by removing or reducing PBFs 2 and 3. As described above, these impacts will occur over the first ten years of project implementation with incremental cumulative impacts to prey numbers and distribution from repeated vegetation and ground disturbance.
- The amount of critical habitat removed that contributes to the life-history functions of PBF 4 represents four and one percent of these available habitats in the ECS-3 subunit and CHU 8, respectively. As described in chapter 7, we focus our evaluation of effects at the subunit scale on PBFs 2 and 3 because these represent the highest quality habitat and are most critical to NSO survival, fitness, and reproduction. But given the role of dispersal-only habitat to help support connectivity, gene flow, and population support, the effects to areas of critical habitat in the subunit that only provide dispersal conditions (e.g., smaller 11” dbh trees with canopy cover of 40 percent) are an important consideration. There is a larger proportion of forest stands that provide only for dispersal in the ECS-3 subunit, estimated at 49,576 acres. This habitat comprises 44 percent of the overall subunit. NSOs in the ECS-3 subunit are also known to use lower quality habitats for nesting, roosting, foraging, and dispersal. The effects of the action will influence approximately three percent of this critical habitat. We therefore conclude the

connectivity role within the subunit will not be impaired.

- The project will adversely affect all PBFs, but there will also be short- and long-term beneficial effects across 19 percent of the critical habitat PBFs in the action area. The long-term reduction in the contribution of PBFs 2 and 3 to demographic support is localized to the action area and its connectivity corridors and does not have the same impacts at the scale of either the subunit or CHU 8. These demographic effects are likely to be balanced by the increased resilience of critical habitat in the action area where habitat conditions are degraded but remain available to support NSOs.
- The effects of the action will not influence connectivity between the other subunits that comprise CHU 8, the connectivity between ECS-3 and the ICC-8 subunit to the east and southeast; nor the ECS-2 subunit to the north. The connectivity between ECS-3 and the ICC-7 and KLW-8 subunits to the west and southwest will be impaired.

The proposed action’s design is not aligned with the recommendations to avoid active management in occupied NSO sites or in areas of high-quality owl habitat (USDI FWS 2012 p. 71881). Some treatments are aligned with the recommendations for resiliency and restoration goals described in the 2012 final rule, including those in PBF 1 and those that do not result in long-term adverse effects to the development of PBFs. There will be negative impacts to the demographic contributions from the two occupied NSO sites in the action area over the first ten years of project implementation, with the most pronounced effects in the first five years. While we expect impaired connectivity to the ICC-7 and KLW-8 subunits to the west, the project’s removal and degradation of PBFs 2, 3, and 4 is limited to the ECS-3 subunit.

We have determined the effects of the action will impair the intended recovery function of the ECS-3 subunit and preclude or delay development of essential PBFs in the action area; but these effects will not preclude the subunit from meeting its designated conservation and recovery role. The effects will influence five percent of the essential PBFs in the ECS-3 subunit, with two percent in Unit 8. While not biologically relevant, the proportion of effects in the subunit and unit compared to what remains available complements our conclusion that the recovery and conservation role of critical habitat will not be appreciably reduced at the scale of the rangewide critical habitat network. While we expect both short- and long-term adverse effects to nesting, roosting, foraging, and dispersal PBFs in the action area, with similar impacts to NSO from reduced fitness and survival, the project is not expected to impair overall NSO recovery within the critical habitat network at the province or rangewide scales.

The project affects less than one percent of PBFs 2 and 3 at the rangewide scale of the critical habitat network. At this scale, the species is expected to continue to have enough untreated critical habitat where it can reproduce. While the reproductive behaviors and production of young from the territorial NSO pairs in the action area will be reduced or delayed because of habitat degradation or removal, or from an increased potential of competitive interactions with barred owls because of the project, the reproductive output at the rangewide scale will not be appreciably harmed by implementing the proposed action.

The effects of the action are not expected to result in an appreciable reduction of the conservation role of the rangewide designation of NSO critical habitat. Therefore, it is our determination that implementation of the action will not result in the destruction or adverse modification of critical habitat designated for the northern spotted owl.

10. Conclusion

Under section 7(a)(2) of the ESA, federal agencies must ensure the activities they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. Regulations implementing this section of the ESA define the phrase, "jeopardize the continued existence of" as "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).

A final rule revising the regulatory definition of "destruction or adverse modification of critical habitat" was published on February 11, 2016 (81 FR 7214) and revised August 27, 2019 (84 FR 45016). The revised definition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species." Because we concur with the action agency that critical habitat for any listed species will not be adversely affected by the proposed action, an adverse modification analysis is not required here.

As described in Chapter 2, the jeopardy analysis considers the effects of the proposed Federal action and any cumulative effects on the rangewide survival and recovery of the listed species. It relies on four components:

1. The Status of the Species, which evaluates the species' current rangewide condition relative to its reproduction, numbers, and distribution; the factors responsible for that condition; the species survival and recovery needs; and explains if the species' current rangewide population is likely to persist and if recovery of the species will remain viable.
2. The Environmental Baseline, which evaluates the current condition of the species in the action area relative to its reproduction, numbers, and distribution absent the consequences of the proposed action; the factors responsible for that condition; and the relationship of the action area to the survival and recovery of the species.
3. The Effects of the Action, which evaluates all future consequences to the species that are reasonably certain to be caused by the proposed action, including the consequences of other activities that are caused by the proposed action, and how those impacts are likely to influence the survival and recovery of the species.
4. The Cumulative Effects, which evaluates the consequences of future, non-Federal activities reasonably certain to occur in the action area on the species, and how those impacts are likely to influence the survival and recovery of the species.

10.1. Northern Spotted Owl

Despite the short- and long-term adverse effects to individual NSOs, their prey, and their habitat, after reviewing the current status of the species, the environmental baseline, the effects of the action, and the cumulative effects, it is Service's biological opinion that implementation of the project, as discussed herein, is *not likely to jeopardize the continued existence of the northern spotted owl* by reducing their reproduction, numbers, or distribution. We reached this conclusion based on the information and analysis in chapters 1-6, chapter 8, and the summary and synthesis in chapter 9.

Despite the adverse effects to NSO critical habitat, after reviewing the current status of critical habitat, the environmental baseline and the conservation role the critical habitat plays in the action area, the effects of the action on critical habitat PBFs, and the cumulative effects, it is Service's biological opinion that implementation of the project, as discussed herein, is *not likely to result in the destruction or adverse modification of designated critical habitat for the northern spotted owl*. We reached this conclusion based on the information and analysis in chapters 1-7, and the summary and synthesis in chapter 9.

10.2. Franklin's bumble bee

After reviewing the current rangewide condition relative to Franklin's bumble bee reproduction, numbers, and distribution and the factors responsible for that condition, the environmental baseline, the effects of the action, and the cumulative effects, it is the Service's biological opinion that implementation of the project, as discussed herein *is not likely to jeopardize the continued existence of Franklin's bumble bee* by reducing their reproduction, numbers, or distribution. We reached this conclusion based on the information and analysis in chapters 1, 3, 6, and 8.

The Service reached this conclusion based on the following findings:

- There are no recorded historic or recent observations of the species in the action area. However, the closest high priority zone is approximately four miles northeast of the action area, which is within the known foraging distance of the species. Since widespread surveys of habitat have not been completed, the Service cannot rule out the possibility a colony inhabits the action area.
- Individuals or colonies that may be present could be crushed or displaced by ground-disturbing and prescribed fire activities during the active flight period, which would result in adverse effects. These effects could reduce numbers, reproduction, and distribution in the action area.
- The project's effects will not permanently remove substantial floral resources from the action area. Other adverse impacts, such as the loss of or crushing of plants, the loss or filling in of underground burrows or other cavities, or the loss of habitat that provides nesting and overwintering sites are expected to be of short duration, lasting one season to five years. We expect the substantial floral resources will remain available to fulfill the species needs, should individuals be present, thereby supporting its numbers, reproduction, and distribution.
- The beneficial effects from meadow restoration treatments are expected to contribute to a higher abundance of substantial floral resources for foraging bees.

In addition, no significant loss or degradation of Franklin's bumble bee habitat has been attributed to the effects from timber harvest and removing encroaching conifer or other trees in meadow restoration areas. Because habitat for the species is not limiting, and because the bee is flexible with regards to its habitat, habitat availability does not limit the conservation of Franklin's bumble bee (USDI FWS 2021a).

Incidental Take Statement

Introduction

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened animal species, respectively, without special exemption. Take is defined by the ESA as actions that harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct (ESA section 3(18)). Harm is further defined as an act that actually kills or injures fish or wildlife (50 CFR § 17.3). Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §17.3). Incidental take is defined as takings that result from, but are not the purpose of, carrying out of an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR § 402.02).

The Service's regulatory definition of harass is constrained to "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" and therefore is not considered incidental take (50 CFR § 17.3). If intentional acts are determined to be a form of take (trap, capture, harass, etc.), when the Service analyzes those activities as part of the proposed action and includes them in an Incidental Take Statement, that is considered adequate to serve as the exemption for that take. Under the terms of Sections 7(b)(4) and 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking, provided that such taking is compliant with the terms and conditions of this Incidental Take Statement.

The reasonable and prudent measures, and terms and conditions, described below are non-discretionary, and must be undertaken by the Forest Service so that they become binding conditions of any grant or permit issued by the action agency, as appropriate, for the exemption in section 7(o)(2) to apply. The Forest Service has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the action agency (1) fails to assume and implement the terms and conditions, or (2) fails to require any contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, contract, or grant document, the protective coverage and exemption provided in section 7(o)(2) may not apply. In order to monitor the effect of incidental take, the Forest Service must report the progress of the proposed action and its effects on the species to the Service as specified in the Incidental Take Statement [50 CFR § 402.14(i)(3)].

Amount or Extent of Take Anticipated

As described in the final Biological Assessment, the proposed action is intended to be implemented over 30 years, with silviculture activities taking three to five years once contracts are awarded (p. 6). It estimates all silviculture activities would likely be completed within 10 years, with fuels treatment activities occurring one to three years afterward (p. 6). We reviewed the proposed action as described in the final Biological Assessment and its accompanying maps (Appendices B, C, I, and L). We also reviewed the northern spotted owl detection locations, which span the past 35 years, and areas modeled as high relative habitat suitability for the owl (USDA-FS 2022b, USDI FWS 2012). Our analysis is supplemented by field reviews in the Scott, Soapstone, and Morgan northern spotted owl territories. Based on our field reviews, there is more nesting, roosting, and higher quality foraging habitat in the action area than what is described and delineated in the final Biological Assessment (see chapter 4).

As described in chapter 6 of the Biological Opinion, there will be adverse effects to the northern spotted owl from implementing the proposed action. The effects of the action are expected to remove at least 403 acres, downgrade or remove 89 acres, and degrade 874 acres of nesting/roosting habitat. It will also remove at least 1,600 acres; downgrade, degrade, or remove 770 acres, and degrade 1,380 acres of foraging habitat. The majority of these impacts are expected to occur during the first ten years of implementation from creating fuel management zones, additional thinning treatments, and follow-up mechanical fuels treatments and prescribed fire within and between the occupied Scott (SIS-0268) and Soapstone (SIS-0231) core use areas and home ranges. Effects will occur directly in nesting, roosting, and foraging habitats, with lighter thinning treatments in the current core use areas. We expect the most pronounced effects during one season to five years after treatments begin. Thinning and other vegetation management will occur on the same acres over a short period of time, with additional follow-up thinning and mechanical and manual fuels treatments on those same acres. These activities are likely to adversely affect and are reasonably certain to impede northern spotted owl feeding and foraging patterns, sheltering behaviors, and adult-provisioning of young associated with the two core use areas and home ranges. We used the best available survey data from the Forest Service and the California Natural Diversity Database, and the best available science regarding habitat use by northern spotted owls and vegetation management impacts to their prey, to determine if take was reasonably certain to occur and to what extent.

Based on our review of the proposed action described in the final Biological Assessment, and clarification with the Forest Service, we have determined that the incidental take of twelve northern spotted owls is reasonably certain to occur from implementing the proposed action. This consists of the take of four adults (two territorial pairs), and eight young, juveniles, or subadults in the form of harm caused by the removal, significant modification, and degradation of NRF habitat, and continuous disturbance. These two territories have continuously contributed to the long-term persistence of northern spotted owls in the action area, and to the northern spotted owl populations in both the California Cascades and California Klamath recovery units and range-wide scale over the last 35 years. This estimate is based on the average annual nesting behaviors for reproduction in the Northwestern California Demographic Study Area (Franklin *et al*. 2012-2021). The proposed action may affect 100 percent of the NRF and dispersal habitat in the Scott (SIS-0268) and Soapstone (SIS-0231) core use areas and home ranges. The degradation, removal, and modification of habitat and continuous spatial extent of the effects of the proposed action is expected to significantly impair the breeding, feeding, and sheltering behavior of the adult owls and their young. This is because of altered behavior patterns and reduced fitness associated with shifting or expanding their core use area and home range to adapt to the treated areas. For example, owls may shift their foraging or roosting patterns or nest patch location to avoid treated areas.

The seasonal restriction that prohibits habitat manipulation in NRF habitat until September 15 will protect young from direct injury. By this time, they are expected to be mature enough to forage without the aid of adults and begin dispersing before project activities begin each year (USDI FWS 2003). Despite this seasonal restriction, adult provisioning of young during the nesting season and the feeding behaviors of juveniles after the nesting season are expected to be significantly impaired. This is because the continuously shifting treatments and resulting habitat removal, modification, and degradation in the core use and home range areas will reduce and redistribute prey on an almost-annual basis, reducing the fitness of adults and juvenile owls.

Take of reproducing northern spotted owls from noise or smoke disturbance during the critical breeding season is not anticipated to occur because of the seasonal restrictions described in the Conservation Measures section of this Biological Opinion (see chapter 1).

The Service is not reasonably certain the effects of the action will incidentally take Franklin's bumble bee. Surveys and other measures to help reduce potential impacts to the species and its habitat are included in our Conservation Recommendations below. Because there have been no confirmed detections since 2006, we do not have sufficient information to make a reasonably certain determination of incidental take for this species.

Effect of the Take

In chapters 9 and 10 of the Biological Opinion, the Service concluded the effects of the South Fork Sacramento Public Safety and Forest Restoration Project, including the anticipated take, are not likely to jeopardize the continued existence of the northern spotted owl. As described in chapter 2, the jeopardy determination is made by adding the effects of the action and cumulative effects to the environmental baseline and evaluating it in light of the status of the species. This formulates our opinion as to whether the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species. is required across the rangewide scale of the species. We also consider the role of the action area and the affected recovery units for both the survival and recovery of the species (see chapter 2).

Reasonable and Prudent Measures

Pursuant to 50 CFR § 402.14(i)(1)(ii) and (iv), the incidental take statement specifies those reasonable and prudent measures that are considered necessary or appropriate to minimize the impact of such incidental taking on the species, and the terms and conditions (including reporting requirements) that must be complied with by the action agency or applicant to implement the reasonable and prudent measures. These must be carried out for the exemption in section 7(o)(2) to apply. For the established reasonable and prudent measures and terms and conditions below, the USDA Forest Service – Shasta-Trinity National Forest is considered the responsible party.

The Shasta-Trinity National Forest has taken steps to avoid or minimize impacts to the northern spotted owl through the incorporation of seasonal restrictions during the nesting season. They also include project design features to retain larger amounts of down wood and large snags in late-successional reserve allocation, specifically in nesting, roosting, foraging, and dispersal habitat; and to retain higher basal area levels in their mapped nesting/roosting habitat areas proposed for thinning and burning treatments. The Service's evaluation of jeopardy and incidental take is premised upon the implementation of these conservation measures, as defined under the Endangered Species Act (ESA), which can help reduce the adverse effects to northern spotted owls, their habitat, and their prey (see chapter 1). Despite the conservation measures, the effects of the proposed action are reasonably certain to result in the taking of two pairs (4 adult) and 8 young or subadult northern spotted owls through harm over the first one to five years of project implementation in areas associated with the Scott and Soapstone territories.

Despite the continuous habitat impacts across the project area, the reasonable and prudent measures are strategically focused in core use areas, surrounding home ranges, and areas of high value habitat where pair detections or young have been observed between 2015 and 2023, and in areas of high value habitat. The effects to habitat in these occupied core use areas and home ranges from the proposed action are described in chapter 6 of the Biological Opinion.

The following reasonable and prudent measures and their implementing terms and conditions are necessary or appropriate actions to minimize the incidental take of northern spotted owl. To be exempt from the prohibitions of section 9 of the ESA, the Shasta-Trinity National Forest is required to comply with all of the reasonable and prudent measures and corresponding terms and conditions described below. During the development of these reasonable and prudent measures and terms and conditions, we kept our recommendations narrowly focused to select areas with a high probability of use by northern spotted owls and remained within the scope of the minor change rule by restricting the measures and terms to proposed activities which:

- Occur in nesting, roosting, or foraging habitats, and high value areas identified through our field validation and a review of additional habitat data. Data sources include aerial imagery, the Forest's 2022 NSO EVEG habitat layer (USDA-FS 2022a), Oregon State University fire refugia maps for the action area, and the 2022 nesting cover class habitat data developed by the Northwest Forest Plan monitoring group (USDA-FS 2022b).
- Occur in close proximity to known or likely nest or roost sites or important connectivity areas, determined by habitat value and detection locations in two long-term occupied territories between 2000 and 2023.
- Intersect with areas identified as "selected-for" by northern spotted owls based on the Service's relative habitat suitability model for critical habitat (USDI FWS 2012c).

Most of the adverse impacts are expected to occur during the first one to ten years of implementation in two long-term occupied territories; Scott and Soapstone. These effects will be from the fuel management zone and thinning treatments, which both include mechanical and manual follow-up fuel reduction treatments, followed by underburning. Based on the final Biological Assessment, the underburning treatments in these cores and home ranges span 4,753 acres. Underburning or broadcast burning is expected to occur immediately after all of the mechanical or manual thinning and fuels reduction, but may not occur for one to three years after the initial fuel management zone and thinning treatments.

The effects from these actions represent both short- and long-term adverse impacts, as described in chapter 6. While effects from prescribed fire associated with the two territories are expected to occur later in time, they are considered cumulative impacts to northern spotted owl prey, and reduced fitness and survival. All of these activities will adversely affect the northern spotted owls and their prey in these occupied cores and home ranges, and are reasonably certain to impede foraging patterns, sheltering behaviors, and provisioning and caring of young.

The following reasonable and prudent measures and their implementing terms and conditions are non-discretionary. They are considered necessary or appropriate actions to minimize the impact of the incidental taking.

RPM-1. Minimize harm by temporally and spatially separating treatments in nesting, roosting, and foraging habitat, and prey-base habitat, in a currently occupied core and in areas with a high probability of use by northern spotted owls.

RPM-2. Minimize harm from the removal, downgrading, or degradation of nesting or roosting habitat by modifying treatments in long-term occupied core use areas and home range areas with a high probability of continued occupancy and use. Harm will be minimized by retaining the current nesting and roosting habitat complexity and quality for northern spotted owls and their prey. Retention is intended to minimize the ecological impacts to habitat which provides important demographic support to this local northern spotted owl population.

RPM-3. Minimize harm from the removal, downgrading, or degradation of foraging habitat with a high probability of continued occupancy and use. Harm will be minimized by modifying the proposed treatments in these areas to retain high value habitat patches. The retention is intended to provide and contribute to maintaining some foraging habitat complexity and quality for northern spotted owls and their prey where surrounding habitat will be removed or degraded. Habitat patch retention will reduce harm by continuing to support foraging opportunities, maintaining important habitat components for prey, and minimizing the ecological impacts to habitat which provides important demographic support to this local northern spotted owl population.

Terms and Conditions

To be exempt from the prohibitions of Section 9 of the ESA, the action agency must fully comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary with respect to species listed under the ESA. To assure this compliance, the Shasta-Trinity National Forest will include in any contract or other implementing documents, the following terms and conditions:

1. To meet RPM-1, delay the 140-200 ft^2/ac thinning treatment in the Scott and Soapstone home ranges by two years after completion of all of the mechanical portion of the fuel management zone treatments (60-80 ft^2/ac; FMZ) in these two home ranges, (with the exception of subunit 3a described below), thereby minimizing the effect of the taking. For clarity, the term and condition does not delay the <10" dbh tree thinning treatment in the two cores and portions of their home ranges, with the exception of subunits 2c and 2d, which should be delayed by 2 years after completion of initial treatments in the Scott home range. To meet RPM-1 in the Scott and Soapstone home ranges, delay the underburning or broadcast burning associated with all other treatments (i.e., 140-200 ft^2/ac and <10" dbh thinning treatments) besides the FMZ treatment by two or more years after completion to minimize the effect of the taking, depending on regrowth conditions.

   This term and condition minimizes harm as the temporal separation of treatments will afford recovery time for displaced prey and will minimize harm to northern spotted owl breeding, feeding, and sheltering behaviors. The conservation gain from the temporal spacing of treatments can help assure these two territories remain occupied by territorial northern spotted owls, which contribute additional individuals to the local and rangewide population.
2. To meet RPM-2 and RPM-3, in areas in higher value nesting, roosting, and foraging habitats in the Scott core and home range, Soapstone home range, and an important connectivity area between the two territories (subunits 2a-2d in Figure 1 below), thin only ≤10" dbh conifer trees, as feasible, to an approximate 35 foot spacing between the trees, thereby minimizing the effect of the taking. The underburning or broadcast burning in these subunits will not

occur until two years after the tree thinning is completed. Additionally, in subunit 2a for the portion outside the Soapstone home range, thin to 180-200 ft^2/ac and retain ≥26" dbh trees, consistent with the marking guidelines as discussed. And additionally, in subunit 2d implement the 140-200 ft^2/ac treatment within a 200-foot buffer of the infrastructure associated with the Methodist Camp (see Figure 1 below).

This Term and Condition minimizes harm to northern spotted owl breeding, sheltering, and feeding behaviors as owls are also known to forage in nesting or roosting habitat. These subunits currently consist of higher value nesting, roosting, and foraging habitat conditions and the majority of territorial owl pair and single detections have occurred in these areas. They consist of mapped fire refugia, connectivity areas, riparian areas with many seeps, springs, or streams, or are considered "highly selected for" by northern spotted owls based on relative habitat suitability modeling (USDI FWS 2012c).

3. To meet RPM-2 and RPM-3, in the Scott home range retain ≥26" dbh trees in subunit 3a, consistent with the marking guidelines as discussed. Also, in subunit 3a, incorporate treatment skips in the highest value habitat within the 140-200 ft^2/ac treatment area to minimize the effect of the taking (see Figure 1 below). Also, where feasible retain similar skips in the Soapstone home range throughout the thin treatment (140-200 ft^2/ac) areas (see Figure 1 below depicting these areas). They should range from 0.25 to 2 acres in size, based on analyses of northern spotted owl territory use and field observations regarding minimum patch size (Lesmeister *et al*. 2021, pp. 3, 5). Skips should be placed in and around the best available roosting and foraging habitat structure for northern spotted owls and their prey. High value skip areas are typified by Douglas fir, incense cedar, and sugar pine trees ≥26" dbh with large lateral branches, mistletoe broom structure, broken tops, and large down wood.

   This term and condition minimizes harm to northern spotted owl sheltering and feeding behaviors as these skips can provide cooler microclimate conditions for roosting owls and hiding cover for prey. They will provide and maintain foraging habitat complexity and roosting opportunities for northern spotted owls in higher value habitat areas where the surrounding habitat function will be removed, downgraded, or degraded.

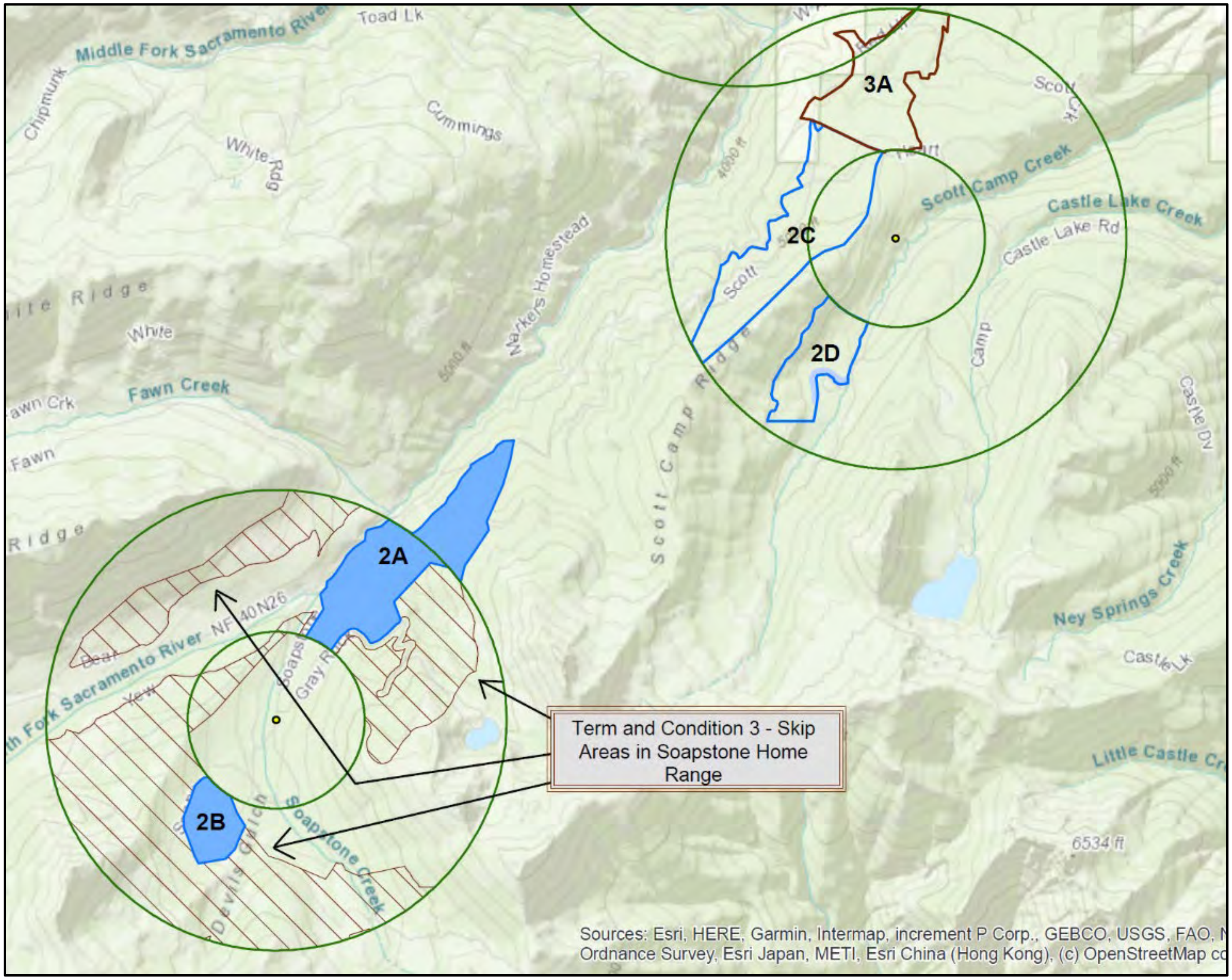

Figure 1. RPM Map for South Fork Sacramento Public Safety and Forest Restoration Project.

Monitoring and Reporting Requirements

When incidental take is anticipated, the Terms and Conditions must include provisions for monitoring to report the progress of the proposed action and its impact on the listed species as specified in the Incidental Take Statement (50 CFR §402.14(i)(3)).

The amount of incidental take of northern spotted owls is based on the best available information the Service has regarding the project implementation timeframe, occupancy and reproductive status in the action area, the presence of barred owls, and the last 10 years of reproduction rates by northern spotted owls, as reported in the Northwestern California Demographic Study Area (Franklin *et al*. 2012-2021).

Although we can quantify the take in terms of the likely number of affected individuals, it is not practical to monitor to verify take has occurred and determine if the take limit has been reached or exceeded for two reasons. First, there is a low likelihood of finding an injured or dead northern spotted owl because their home ranges are large and injured or dead individuals are quickly consumed or removed by predators and scavengers. Second, the anticipated take from habitat changes in a core or home range are primarily in the form of reduced fitness of the affected adult and juvenile and subadult owls, caused by the removed or degraded habitat conditions and associated impacts on prey populations from the proposed action. This reduced fitness is likely to decrease survival and reproduction of the affected owls as discussed in chapter 6. Documenting this reduction in fitness is difficult and doing so may take months or years at considerable expense.

To obtain information on the project's effects, the interagency Level One Team will conduct field reviews of the project area in northern spotted owl nesting, roosting, and foraging habitat that has been mechanically thinned or underburned. This will help both agencies validate or modify our assumptions regarding post-treatment habitat effects and take for the project, and will help inform future project planning and consultation.

Prior to January 31st of each year for the duration of project implementation, the Shasta-Trinity National Forest will provide an annual monitoring report of the estimated take that may have occurred in relation to the amount of take identified in this Incidental Take Statement during the prior calendar year. The report must specify whether pre-project surveys or surveys concurrent with implementation were conducted, as well as the survey results. The report must also include a detailed accounting of when the implementation and coordination activities associated with the Terms and Conditions to meet RPM-1, RPM-2, and RPM-3 occurred. The Service will subtract from the rangewide baseline all acres of nesting, roosting, and foraging habitat assessed in the Biological Opinion as removed, downgraded, degraded, or added. Adjustments may be made by the Shasta-Trinity National Forest in conjunction with the Service in the event portions of the project are not implemented.

The annual monitoring report should contain, at a minimum, the following information:

1. Progress and status of the selected alternative and the status of northern spotted owls, such as occupancy and reproductive status, in the action area.
2. The amount and type of northern spotted owl habitat removed or modified, including the acres of critical habitat in the ECS-3 subunit by habitat type (PBF 2, PBF 3, PBF 4).

3. The timing of treatment implementation in the northern spotted owl core use areas and home ranges where take was reasonably certain to occur.
4. Any changes to project implementation not discussed in the project decision document or final NEPA document.
5. Portions, including mapped areas, of the project that will not be implemented.
6. A joint (Forest and Service representatives) assessment that monitors and reports the estimated effects from thinning and fuels treatments. This assessment will be used to validate assumptions regarding the degree of change to habitat and to assess the take associated with project implementation.

DISPOSITION OF SICK, INJURED, OR DEAD SPECIMENS

Any dead or injured northern spotted owls must be reported to Service's Law Enforcement Division (916-414-6660) or the Yreka Fish and Wildlife Office as soon as possible. The specimen will be turned over to the Law Enforcement Division or to a game warden or biologist of the California Department of Fish and Wildlife for care or analysis. The Service is to be notified in writing within three working days of the accidental death of, or injury to, an owl or of the finding of any dead or injured northern spotted owls during implementation of the proposed action. Notification must include the date, time, and location (including GPS location information in UTM, NAD 83) of the incident or discovery of a dead or injured northern spotted owl, as well as any pertinent information on circumstances surrounding the incident or discovery. The Service contact for this written information is the Field Supervisor for the Yreka Fish and Wildlife Office at 1829 South Oregon Street, Yreka, California, 96097 or by telephone at (530) 842-5763.

CONSERVATION RECOMMENDATIONS

Sections 2(c) and 7(a)(1) of the ESA direct Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species and the ecosystems upon which they depend. Regulations in 50 CFR § 402.02 define conservation recommendations as discretionary measures suggested by the Service to minimize or avoid adverse effects of a proposed action on a listed species or critical habitat, to help implement recovery plans, or to develop information.

We propose the following conservation recommendations:

1. Between the Castle Lake Road and Scott Camp Creek in the Scott core use area, modify the fuel management zone treatment (60-80 ft^2/ac) in this approximate 40-acre area, thin to a basal area range of 125 ft^2/ac or higher to better conserve connectivity conditions in this riparian corridor in the core.

2. Reduce the width of wide fuel management zone (FMZ) treatment areas in northern spotted owl nesting, roosting, and foraging habitats to within 300 feet each side of the road. This Conservation Recommendation refers to roads where wide FMZs are proposed and is not intended to modify the treatment widths for narrower-width FMZ areas.

3. To assist with implementation of RPM-3, collaborate with the Service on skip retention

identification and placement in reference stands prior to treatment layout and implementation in the Soapstone home range. This conservation recommendation could help both agencies discuss and meet the resource objectives stipulated in term and condition.

4. The Service appreciates the Forest's efforts to survey for bumble bees and other pollinators and recommends continuing these surveys as feasible.

We request notification when any conservation recommendation is implemented in order to remain informed of additional actions that minimize or avoid adverse effects to, or that conserve or benefit the northern spotted owl, its habitat, and prey; and the Franklin's bumble bee and its habitat.

REINITIATION – CLOSING STATEMENT

This concludes formal consultation on the South Fork Sacramento Public Safety and Forest Restoration Project. As provided in 50 CFR § 402.16, reinitiation of consultation is required and shall be requested by the Action Agency, or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) If the amount or extent of taking specified in the incidental statement is exceeded.

(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered – this includes notifying the Service immediately if northern spotted owl detections occur that indicate the establishment of a new activity center location (Service 2012 pp. 24-28) or barred owl detections in core use areas or home ranges.

(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this Biological Opinion and written concurrence; or

(4) If a new species is listed or critical habitat is designated that may be affected by the proposed action or selected alternative.

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Appendix A. Status of the Species and Critical Habitat for the Northern Spotted Owl

PRODUCED BY THE U.S. FISH AND WILDLIFE SERVICE, PORTLAND, OREGON - DECEMBER 2022

A.1. Executive Summary

The northern spotted owl (NSO; *Strix occidentalis caurina*) has declined across large portions of its range since the time of listing in 1990. The biggest threats are 1) loss of habitat due to timber harvest or severe wildfire 2) and competition with non-native barred owls (*Strix varia*). The most severe population declines are occurring in the northern portion of the species range where barred owls have been established for the longest period of time. The current rate of decline raises concerns about the long-term persistence of the NSO throughout the Pacific Northwest.

Northern spotted owls rely on older forested habitats because such forests contain the structures and characteristics required for nesting/roosting, and foraging (NRF). The NSO was listed as threatened throughout its range "due to loss and adverse modification of NSO habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USDI FWS 1990a). Loss of NSO habitat on Federal lands since the 1990s due to timber harvest has been reduced on Federal lands over the past two decades under the Northwest Forest Plan (NWFP or the Plan).

Wildfire is currently the primary cause of habitat loss on Federal lands, and the rate and severity of wildfire in portions of the range of the NSO are expected to increase in the future under projected climate change scenarios. NSO habitat on private lands has continued to decline since the time of listing and has declined at a higher rate than on Federal lands; thus, Federal and State lands will continue to provide the majority of habitat for NSO for the foreseeable future. With the exception of some areas in northern California, NSO are unlikely to persist in areas without Federal lands.

The most recent observed 5.3 percent annual rate of decline of the NSO (Franklin *et al.* 2021) indicates that this species is in severe decline and the extinction risk for this species has increased since the time of listing. NSO populations in long-term study areas have declined 32 to over 80 percent since the early 1990s. If this rate continues into the future, the species will likely decline to extirpation in the northern portion of its range in the near future where population declines have been greatest (over 60 percent). Additionally, NSO population simulations indicated that without a reduction in barred owl impacts on NSO, NSO populations had a greater than 50 percent probability of extirpation in Washington and the Oregon Coast Ranges. The most recent rangewide NSO demographic study indicated that barred owls are currently the factor with the largest negative impact on NSO (Franklin *et al.* 2021).

Critical habitat for the NSO includes approximately 9,373,676 acres in 11 units and 60 subunits in California, Oregon, and Washington (USDI FWS 2021b). This acreage resulted from the November 10, 2021, final rule's exclusion of approximately 204,294 acres within the Harvest

Land Base for BLM and some tribal lands in Oregon (USDI FWS 2021b) from the 2012 critical habitat designation (USDI FWS 2012a).

A.2. Legal Status

The NSO was listed as threatened on June 26, 1990, due to widespread loss and adverse modification of suitable habitat across the species' entire range and the inadequacy of existing regulatory mechanisms to conserve the owl (USDI FWS 1990a). Recovery priority numbers are assigned on a scale of 1C (highest) to 18 (lowest). The number reflects the severity of threats and the potential for recovery, and "C" reflects conflict with development, construction, or other economic activity (USDI FWS 1983). The NSO was originally listed with a recovery priority number of 3C, but that number has been changed several times over the years and is now 6C.

This number reflects a high degree of threat, a low potential for recovery, and conflicts with economic activity (USDI FWS 1983). In 2012, the U.S. Fish and Wildlife Service (Service) was petitioned to uplist the NSO from threatened to endangered status under the Endangered Species Act (Act). In April 2015, the Service determined that petition presented substantial information indicating that the listing may be warranted due to a number of listing factors (USDI FWS 2015). An assessment of the species status in the most recent 5-year review documented the declining status of the NSO (USDI FWS 2019). After this review, the Service concluded on December 15, 2020, that changing the status of the NSO from threatened to endangered was warranted but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants (USDI FWS 2020b).

A.3. Life History

A.3.1. Taxonomy

The NSO is one of three subspecies of spotted owls currently recognized by the American Ornithologists' Society. The taxonomic separation of these three subspecies is supported by genetic (Barrowclough and Gutiérrez 1990, Barrowclough *et al.* 1999, Haig *et al.* 2004, Funk *et al.* 2008) morphological (Gutiérrez *et al.* 1995), and biogeographic information (Barrowclough and Gutiérrez 1990). Studies analyzing mitochondrial DNA sequences (Haig *et al.* 2004, Chi *et al.* 2004, Barrowclough *et al.* 2005) and microsatellites (Henke *et al.* unpubl. data) confirmed the validity of the current subspecies designations for northern and California spotted owls (*Strix occidentalis occidentalis*).

The narrow hybrid zone between these two subspecies, which is located in the southern Cascades and northern Sierra Nevada, appears to be stable (Barrowclough *et al.* 2005), although bi-directional hybridization and dispersal between the subspecies occurs (Funk *et al.* 2008). The distribution of the Mexican subspecies (*S. o. lucida*) is separate from those of the northern and California subspecies (Gutiérrez *et al.* 1995). However, Funk *et al.* (2008) discovered intro-regression of Mexican spotted owls into the northernmost parts of the NSO populations in Washington, indicating some long-distance dispersal of Mexican spotted owls into the NSO range. Hybridization of NSO with barred owls (*Strix varia*) has been recorded (Hamer *et al.* 1994, Dark *et al.* 1998, Kelly 2001, Kelly and Forsman 2004, Funk *et al.* 2008, Wiens 2012).

A.3.2. Physical Description

The NSO is a medium-sized owl and is the largest of the three subspecies of spotted owls (Gutiérrez *et al.* 1995). It is approximately 46 to 48 centimeters (18 inches to 19 inches) long and the sexes are dimorphic, with males averaging about 13 percent smaller than females. The mean mass of 971 males taken during 1,108 captures was 580.4 grams (1.28 pounds) (out of a range 430.0 to 690.0 grams) (0.95 pound to 1.52 pounds), and the mean mass of 874 females taken during 1,016 captures was 664.5 grams (1.46 pounds) (out of a range 490.0 to 885.0 grams) (1.1 pounds to 1.95 pounds) (Loschl, P. and E. Forsman pers. comm. 2006 cited in Service 2011b). The NSO is dark brown with a barred tail and white spots on its head and breast, and it has dark brown eyes surrounded by prominent facial disks. Four age classes can be distinguished on the basis of plumage characteristics (Forsman 1981; Moen *et al.* 1991). The NSO superficially resembles the barred owl, a species with which it occasionally hybridizes (Kelly and Forsman 2004). Hybrids exhibit physical and vocal characteristics of both species (Hamer *et al.* 1994).

A.3.3. Behavior

Northern spotted owls are primarily nocturnal (Forsman *et al.* 1984) and spend virtually their entire lives beneath the forest canopy (Courtney *et al.* 2004). They are adapted to maneuverability beneath the forest canopy rather than strong, sustained flight (Gutiérrez *et al.* 1995). They forage between dusk and dawn and sleep during the day with peak activity occurring during the two hours after sunset and the two hours prior to sunrise (Gutiérrez *et al.* 1995, Delaney *et al.* 1999). They will sometimes take advantage of vulnerable prey near their roosts during the day (Layman 1991, Sovern *et al.* 1994).

A.3.4. Current and Historical Range

The current range of the NSO extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (USDI FWS 1990a). The range of the NSO is partitioned into 12 physiographic provinces (see Figure A-1) based on recognized landscape subdivisions exhibiting different physical and environmental features (Thomas *et al.* 1993, USDI FWS 2011b). These provinces are distributed across the species' range as follows:

Four provinces in Washington: Eastern Washington Cascades, Olympic Peninsula, Western Washington Cascades, Western Washington Lowlands

Five provinces in Oregon: Oregon Coast Range, Willamette Valley, Western Oregon Cascades, Eastern Oregon Cascades, Oregon Klamath

Three provinces in California: California Coast, California Klamath, California Cascades

The NSO is extirpated or uncommon in certain areas such as southwestern Washington and British Columbia. Timber harvest activities have eliminated, reduced or fragmented NSO habitat sufficiently to decrease overall population densities across its range, particularly within the coastal provinces where habitat reduction has been concentrated (Thomas and Raphael 1993, USDI FWS 2011b).

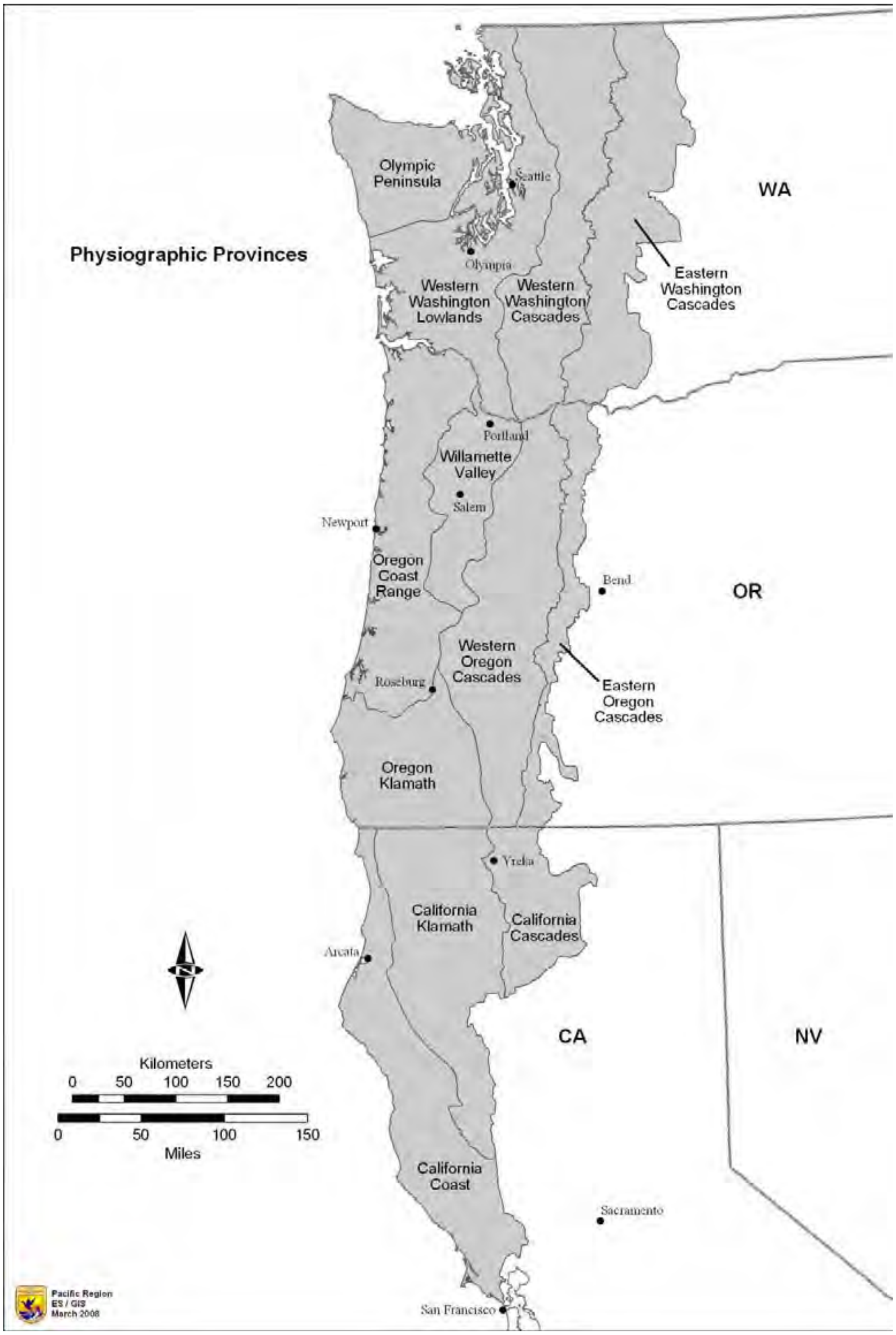

Figure A-1. Physiographic Provinces within the range of the northern spotted owl in the United States (from Service 2011b, A-3).

Northern spotted owls seek sheltered roosts to avoid inclement weather, summer heat, and predation (Forsman 1975, Barrows and Barrows 1978, Barrows 1981, Forsman *et al.* 1984).

NSO become stressed at temperatures above 28°C, but there is no evidence to indicate that they have been directly killed by temperature because of their ability to thermoregulate by seeking out shady roosts in the forest understory on hot days (Barrows and Barrows 1978, Forsman *et al.* 1984, Weathers *et al.* 2001). During warm weather, NSO seek roosts in shady recesses of understory trees and occasionally will even roost on the ground (Barrows and Barrows 1978, Barrows 1981, Forsman *et al.* 1984, Gutiérrez *et al.* 1995). Glenn *et al.* (2010) found that population growth was negatively associated with hot summer temperatures at their southernmost study area in the southern Oregon Cascades, indicating that warm temperatures may still have an effect on NSO. Both adults and juveniles have been observed drinking water, primarily during the summer, which is thought to be associated with thermoregulation (Gutiérrez *et al.* 1995).

Northern spotted owls are territorial; however, home ranges of adjacent pairs overlap (Forsman *et al.* 1984, Solis and Gutiérrez 1990) suggesting that the area defended is smaller than the area used for foraging. They will actively defend their nests and young from predators (Forsman 1975, Gutiérrez *et al.* 1995). Territorial defense is primarily carried out by hooting, barking and whistle type calls. Some NSO are not territorial but either remain as residents within the territory of a pair or move among territories (Gutiérrez 1996). These birds are referred to as "floaters." Floaters have special significance in NSO populations because they may buffer the territorial population from decline (Franklin 1992). Little is known about floaters other than that they exist and typically do not respond to calls as vigorously as territorial birds (Gutiérrez 1996).

Northern spotted owls are monogamous and usually form long-term pair bonds. "Divorces" occur but are relatively uncommon. There are no known examples of polygyny in NSO, although associations of three or more birds have been reported (Gutiérrez *et al.* 1995).

A.3.5. Habitat Relationships

A.3.5.1. Home Range and Core Areas

Northern spotted owls are territorial raptors that range widely in search of prey but are 'anchored' during the breeding season to a nest site (central-place forager). Evaluations of NSO habitat are usually conducted at two spatial scales; the home range and core areas. The home range is the "area traversed by the individual in its normal activities of food gathering, mating, and caring for young" (Burt 1943 as cited in USDI FWS 2009).

Home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality (USDI FWS 1990a). Estimates of median size of their annual home range (i.e., the area traversed by an individual or pair during their normal activities) (Thomas and Raphael 1993) vary by province and range from 2,955 acres in the Oregon Cascades (Thomas *et al.* 1990) to 14,211 acres on the Olympic Peninsula (USDI FWS 1994). Zabel *et al.* (1995) showed that these provincial home ranges are larger where flying squirrels are the predominant prey and smaller where wood rats are the predominant prey. Home ranges of adjacent pairs overlap (Forsman *et al.* 1984, Solis and Gutiérrez 1990), suggesting that the defended area is smaller than the area used for foraging.

Within home ranges, areas receiving concentrated use, typically surrounding the nest site and favored foraging areas, are called core areas. Results from Bingham and Noon (1997) showed that NSO typically used 20-21 percent of their home range as core use area habitat, which generally included 60-70 percent of the sites within their home range used during the breeding season. As central place foragers, nesting NSO are likely very sensitive to activities that occur within their core areas and especially their nest patches (Miller 1989, Swindle *et al.* 1997, Meyer *et al.* 1998). Zabel *et al.* (2003) found the best-fitting model for NSO occupancy predictions in northwest California was at the 200-ha (500 acre) scale.

Some studies have found that NSO use smaller home ranges during the breeding season and often dramatically increase their home range size during fall and winter (Forsman *et al.* 1984, Sisco 1990). In Southern Oregon, one study found that home range and core areas remained essentially the same between seasons, concluding that perhaps this was due to the quality of available habitat (Schilling *et al.* 2013).

The habitat composition, specifically sufficient amounts of nesting, roosting and foraging habitat, within cores and annual home ranges has been found to be directly correlated with demographic responses such as occupancy, reproductive success, survival, and fitness. For example, Franklin *et al.* (2000) found that the proportion of good habitat was around 60 percent to lesser quality habitat for owl core areas in northwest California. Bart (1995) found that core areas should contain 30-50 percent mature and old growth forest. When NSO home ranges have less than 40 to 60 percent NRF, they were more likely to have lower occupancy and fitness (Thomas *et al.*1990, Bart and Forsman 1992, Bart 1995, Dugger *et al.* 2005, Olson *et al.* 2005). NSO survival has been found to be negatively correlated with forest fragmentation (Schilling *et al.* 2013).

The probability of occupancy is increased when core areas contain a range of habitat conditions suitable for use by NSO, and the survival and fitness of NSO is positively correlated with larger patch sizes or proportion of older forests (Franklin *et al.* 2000, Dugger *et al.* 2005, USDI FWS 2009). The Service notes that "the strongest type of information relevant to the evaluation of take relates the fitness of [NSO] to characteristics of their habitat" (USDI FWS 2009). Although differences exist in natural stand characteristics that influence home range size, habitat loss and forest fragmentation effectively reduce habitat quality in the home range. A reduction in the amount of suitable habitat reduces spotted owl abundance and nesting success (Bart and Forsman 1992, Bart 1995).

A.3.5.2. Habitat Use and Selection

Forsman *et al.* (1984) reported that NSO have been observed in the following forest types: Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica shastensis*), mixed evergreen, mixed conifer hardwood (Klamath montane), and redwood (*Sequoia sempervirens*). The upper elevation limit at which NSO occur corresponds to the transition to subalpine forest, which is characterized by relatively simple structure and severe winter weather (Forsman 1975, Forsman *et al.* 1984).

Northern spotted owls generally rely on older forested habitats because such forests contain the structures and characteristics required for nesting, roosting, and foraging. Features that support nesting and roosting typically include a moderate to high canopy closure (60 to 80 percent); a multi-layered, multi-species canopy with large overstory trees (with diameter at breast height [dbh] of greater than 30 inches); a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for NSO to fly (Thomas *et al.* 1990). Weathers *et al.* (2001) found the NSO association with structurally complex habitats containing high canopy closure was in part due to their intolerance of high temperatures. Complex vertically structured habitat such as mature and old-growth forests habitats contain sufficient cover to provides protection from predators (Franklin *et al.* 2000).

Northern spotted owls nest almost exclusively in trees. Nest sites are found in forests having complex structure dominated by large diameter trees and high canopy closure (Forsman *et al.* 1984, Hershey *et al.* 1998, LaHaye *et al.* 1997). Even in forests that have been previously logged, spotted owls select forests having a structure (i.e., larger trees, greater canopy closure) different than forests generally available to them (Folliard 1993, Buchanan *et al.* 1995, Hershey *et al.* 1998). Similarly, roost sites selected by NSO have more complex vegetation structure than forests generally available to them (Barrows and Barrows 1978, Forsman *et al.* 1984, Solis and Gutiérrez 1990).

Foraging habitat, which provides a food supply for NSO survival and reproduction, is the most variable of all habitats used by territorial NSO (Thomas *et al.* 1990; USDI FWS 2011b). NSO select old forests for foraging in greater proportion than their availability at the landscape scale (Carey *et al.* 1992, Carey and Peeler 1995, Forsman *et al.* 2004), but will forage in younger stands with high prey densities and access to prey (Carey *et al.* 1992, Rosenberg and Anthony 1992, Thome *et al.* 1999). Glenn *et al.* (2004) found that NSO had larger home ranges in areas with less old-growth and mature forest, although the population was not self-sustaining during the study period (Franklin *et al.* 1999 in Glenn *et al.* 2004).

Foraging activity is positively associated with tree height diversity (North *et al.* 1999), canopy closure and woody debris (Irwin *et al.* 2000, Courtney *et al.* 2004), snag volume, density of snags greater than 20 in (50 cm) dbh (North *et al.* 1999, p. 524; Irwin *et al.* 2000, pp. 179-180; Courtney *et al.* 2004, pp. 5-15), density of trees greater than or equal to 31 in (80 cm) dbh (North *et al.* 1999), volume of woody debris (Irwin *et al.* 2000), and young forests with some structural characteristics of old forests (Carey *et al.*1992, Irwin *et al.* 2000). Habitat use is influenced by prey availability. Ward (1990) found that NSO foraged in areas where the occurrence of prey was more predictable within older forests and near ecotones of old forest and brush seral stages. The availability or abundance of prey can in turn influence reproductive success (Rosenburg *et al.* 2003).

Dispersal habitat is essential to maintaining stable populations by filling territorial vacancies when resident NSO die or leave their territories, and to providing adequate gene flow across the range of the species. While dispersal habitat may include younger and less diverse forest stands than foraging habitat, such as even-aged, pole-sized stands, at a minimum it consists of stands with adequate tree size and canopy closure to provide protection from avian predators and at least minimal roosting and foraging opportunities (USDI FWS 2011b). NSO have been found to disperse through highly fragmented forest landscapes (Forsman *et al.*, 2002; p. 22). However, in a study of the natal dispersal of NSO, Sovern (2015) found the majority of roosts were in forested habitats with at least some large (>50 cm or about 19 inches dbh) trees and they selected stands with high canopy cover (>70 percent) at the landscape scale. These authors suggested the concept of 'dispersal' habitat as a lower quality type of habitat may be inappropriate.

A.3.6. Geographic Variability

In redwood forests and mixed conifer-hardwood forests along the coast of northwestern California, NSO occur in both old growth forests and younger forest stands, particularly in areas where hardwoods provide a multi-layered structure at an early age (Thomas *et al.* 1990, Diller and Thome 1999). In the southern portion of their range, where woodrats are a major component of their diet, NSO are more likely to use a variety of stands, including younger stands, brushy openings in older stands, and edges between forest types in response to higher prey density in some of these areas (Forsman *et al.* 1984).

In the Coast Ranges, Western Oregon and Washington Cascades, and the Olympic Peninsula, radio-marked NSO selected for old-growth and mature forests for foraging and roosting and used young forests less than predicted based on availability (Forsman *et al.* 1984, Carey *et al.* 1990, Thomas *et al.* 1990, Irwin *et al.* 2000, Herter *et al.* 2002, Forsman *et al.* 2005).

In mixed conifer forests in the eastern Cascades in Washington, 27 percent of nest sites were in old-growth forests, 57 percent were in the understory reinitiation phase of stand development, and 17 percent were in the stem exclusion phase (Buchanan *et al.* 1995). In eastern Washington, NSO nest sites were found to have canopies of dominant and/or codominant and intermediate trees that were farther aboveground, more 35-60-cm (14-24 in)-dbh Douglas-fir, greater basal area of Douglas-fir trees, more 61-84-cm (24-33.5 in) dbh ponderosa pine trees, more live tree basal and more basal area of Class IV snags (i.e., broken snags with no branches and little bark).

The availability and distribution of habitats are important considerations. Landscape-level analyses in portions of Oregon Coast and California Klamath provinces suggest that a mosaic of late-successional habitat interspersed with other seral conditions may benefit NSO more than large, homogeneous expanses of older forests (Zabel *et al.* 2003, Franklin *et al.* 2000, Meyer *et al.* 1998). Olson *et al.* (2004) infer that while mid-seral and late-seral forests are important to NSO, in the central Oregon Coast Range a mixture of these forest types with younger forest and non-forest may be best for NSO survival and reproduction in their study area.

In a large-scale demography modeling study, Forsman *et al.* (2011) found a positive correlation between the amount of suitable habitat and recruitment of young. The most recent rangewide population meta-analysis (Franklin *et al.* 2021) found that increased amounts of NSO habitat decreased site extirpation, and in most areas increased site colonization, even when barred owls were present. Yackulic and others (2019) found that the influence of habitat availability on population extirpation was similar in magnitude to the influence of barred owls.

A.3.7. Reproductive Biology

The NSO is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman *et al.* 1984, Gutiérrez *et al.* 1995). NSO are sexually mature at 1 year of age, but rarely breed until they are 2 to 5 years of age (Miller *et al.* 1985, Franklin 1992, Forsman *et al.* 2002). Breeding females lay one to four eggs per clutch, with the average clutch size being two eggs; however, most NSO pairs do not nest every year, nor are nesting pairs successful every year (USDI FWS 1990b; Forsman *et al.* 1984, Anthony *et al.* 2006), and re-nesting after a failed nesting attempt is rare (Gutiérrez 1996). The small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of NSO (Gutiérrez 1996).

Courtship behavior usually begins in February or March, and females typically lay eggs in late March or April. The timing of nesting and fledging varies with latitude and elevation (Forsman *et al.* 1984). After they leave the nest in late May or June, juvenile NSO depend on their parents until they are able to fly and hunt on their own. Parental care continues after fledging into September (USDI FWS 1990a; Forsman *et al.* 1984). During the first few weeks after the young leave the nest, the adults often roost with them during the day. By late summer, the adults are rarely found roosting with their young and usually only visit the juveniles to feed them at night (Forsman *et al.* 1984). Telemetry and genetic studies indicate that close inbreeding between siblings or parents and their offspring is rare (Haig *et al.* 2001, Forsman *et al.* 2002). Hybridization of NSO with California spotted owls and barred owls has been confirmed through genetic research (Hamer *et al.* 1994, Gutiérrez *et al.* 1995, Dark *et al.* 1998, Kelly 2001, Funk *et al.* 2008).

A.3.8. Dispersal Biology

Natal dispersal of NSO typically occurs in September and October with a few individuals dispersing in November and December (Miller *et al.* 1997, Forsman *et al.* 2002). Natal dispersal occurs in stages, with juveniles settling in temporary home ranges between bouts of dispersal (Forsman *et al.* 2002, Miller *et al.* 1997). The median natal dispersal distance is about 10 miles for males and 15.5 miles for females (Forsman *et al.* 2002). Dispersing juvenile NSO experience high mortality rates, exceeding 70 percent in some studies (USDI FWS 1990a, Miller 1989). Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (Miller 1989, USDI FWS 1990a, Forsman *et al.* 2002). Parasitic infection may contribute to these causes of mortality, but the relationship between parasite loads and survival is poorly understood (Hoberg *et al.* 1989, Gutiérrez 1989, Forsman *et al.* 2002). Successful dispersal of juvenile NSO may depend on their ability to locate unoccupied suitable habitat in close proximity to other occupied sites (LaHaye *et al.* 2001).

There is little evidence that small openings in forest habitat influence the dispersal of NSO, but large, non-forested valleys such as the Willamette Valley apparently are barriers to both natal and breeding dispersal (Forsman *et al.* 2002). The degree to which water bodies, such as the Columbia River and Puget Sound, function as barriers to dispersal is unclear, although radio telemetry data indicate that NSO move around large water bodies rather than cross them (Forsman *et al.* 2002). Analysis of the genetic structure of NSO populations suggests that gene flow may have been adequate between the Olympic Mountains and the Washington Cascades, and between the Olympic Mountains and the Oregon Coast Range in the late 1990s (Haig *et al.* 2001).

Breeding dispersal occurs among a small proportion of adult NSO; these movements were more frequent among females and unmated individuals (Forsman *et al.* 2002). Breeding dispersal distances were shorter than natal dispersal distances and also are apparently random in direction (Forsman *et al.* 2002). In California spotted owls, a similar subspecies, the probability for dispersal was higher in younger owls, single owls, paired owls that lost mates, owls at low quality sites, and owls that failed to reproduce in the preceding year (Blakesley *et al.* 2006). Both males and females dispersed at near equal distances (Blakesley *et al.* 2006). In 72 percent of observed cases of dispersal, dispersal resulted in increased habitat quality (Blakesley *et al.* 2006).

Dispersal can also be described as having two phases: transience and colonization (Courtney *et al.* 2004). Dispersal success is likely highest in mature and old growth forest stands where there is more likely to be adequate cover and food supply (USDI FWS 2012a). Transient dispersers use a wider variety of forest conditions for movements than colonizing dispersers, who require habitats resembling NRF habitats used by breeding birds (Miller *et al.* 1997, Courtney *et al.* 2004, USDI FWS 2012a).

A.3.9. Food Habits

Northern spotted owls are mostly nocturnal, although they also forage opportunistically during the day (Forsman *et al.* 1984, 2004, Sovern *et al.* 1994). The composition of the NSO diet varies geographically and by forest type. Generally, flying squirrels (*Glaucomys sabrinus*) are the most prominent prey for NSO in Douglas-fir and western hemlock (*Tsuga heterophylla*) forests (Forsman *et al.* 1984) in Washington and Oregon, while dusky-footed wood rats (*Neotoma fuscipes*) are a major part of the diet in the Oregon Klamath, California Klamath, and California Coast Range provinces (Forsman *et al.* 1984, 2004, Ward *et al.* 1998, Hamer *et al.* 2001). Depending on location, other important prey include deer mice (*Peromyscus maniculatus*), tree voles (*Arborimus longicaudus, A. pomo*), red-backed voles (*Clethrionomys* spp.), gophers (*Thomomys* spp.), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*Neotoma cinerea*), birds, and insects, although these species comprise a small portion of the NSO diet (Forsman *et al.* 1984, 2004, Ward *et al.* 1998, Hamer *et al.* 2001).

Other prey species such as the red tree vole (*Arborimus longicaudus),* red-backed voles (*Clethrionomys gapperi),* mice, rabbits and hares, birds, and insects) may be seasonally or locally important (reviewed by Courtney *et al.* 2004). For example, Rosenberg *et al.* (2003) showed a strong correlation between annual reproductive success of NSO (number of young per territory) and abundance of deer mice (*Peromyscus maniculatus*) ($r^2 = 0.68$), despite the fact they only made up 1.6±0.5 percent of the biomass consumed. However, it is unclear if the causative factor behind this correlation was prey abundance or a synergistic response to weather (Rosenberg *et al.* 2003). Ward (1990) also noted that mice were more abundant in areas selected for foraging by owls. Nonetheless, NSO deliver larger prey to the nest and eat smaller food items to reduce foraging energy costs; therefore, the importance of smaller prey items, like *Peromyscus*, in the NSO diet should not be underestimated (Forsman *et al.* 2001, 2004).

A.3.10. Population Dynamics

The NSO is relatively long-lived, has a long reproductive life span, invests significantly in parental care, and exhibits high adult survivorship relative to other North American owls (Forsman *et al.* 1984, Gutiérrez *et al.* 1995). The NSO long reproductive life span allows for some eventual recruitment of offspring, even if recruitment does not occur each year (Franklin *et al.* 2000).

Annual variation in population parameters for NSO has been linked to environmental influences at various life history stages (Franklin *et al.* 2000). In coniferous forests, mean fledgling production of the California spotted owl, a closely related subspecies, was higher when minimum spring temperatures were higher (North *et al.* 2000), a relationship that may be a function of increased prey availability. Across their range, spotted owls have previously shown an unexplained pattern of alternating years of high and low reproduction, with highest reproduction occurring during even-numbered years (e.g., Franklin *et al.* 1999). Annual variation in breeding may be related to weather (i.e., temperature and precipitation) (Wagner *et al.* 1996, Zabel *et al.* 1996 *In*: Forsman *et al.* 1996) and fluctuation in prey abundance (Zabel *et al.* 1996).

A variety of factors may regulate NSO population levels. These factors may be density-dependent (e.g., habitat quality, habitat abundance) or density-independent (e.g., climate). Interactions may occur among factors. For example, as habitat quality decreases, density-independent factors may have more influence on survival and reproduction, which tends to increase variation in the rate of growth (Franklin *et al.* 2000). Specifically, weather could have increased negative effects on NSO fitness for those owls occurring in relatively lower quality habitat (Franklin *et al.* 2000). A consequence of this pattern is that at some point, lower habitat quality may cause the population to be unregulated (have negative growth) and decline to extinction (Franklin *et al.* 2000, Yackulic *et al.* 2019).

Competition with barred owls is an important stressor of NSO populations. The presence of barred owls decreases NSO fecundity, survival, and recruitment, as well as occupancy, colonization, and extirpation of territories (Franklin *et al.* 2021). Older research also established barred owl influences on site occupancy, site extirpation, and colonization (Olson *et al.* 2005). In the older research, NSO site occupancy was mostly stable through time, but in more recent research, site occupancy has declined at all study areas (Franklin *et al.* 2021, Olson *et al.* 2005). The older research also found that per-visit detection probabilities were lower than expected and were highly variable among years and study areas (Olson *et al.* 2005). The most recent analysis of occupancy, colonization, and extirpation of NSO territories also accounts for varying detection probabilities (Franklin *et al.* 2021).

Even while accounting for the effects of competition with barred owls, habitat availability and climatic patterns also appear to influence survival, occupancy, recruitment, and, to a lesser extent, fecundity (Dugger *et al.* 2016). Occupancy, colonization, and extirpation of NSO territories are all influenced by the amount of habitat present, and territory extinction is also related to climate factors (Franklin *et al.* 2021). Habitat availability also influences the likelihood of NSO population persistence, and this effect is similar in magnitude to the effect of competition with barred owls (Yackulic *et al.* 2019).

Northern spotted owl populations are declining across the range. Between 1995 and 2016, the Northwest California study area showed the lowest rate of decline, around two percent per year; the Hoopa study area, also in northwestern California, showed a similar rate of decline from 1995 through 2012, prior to the implementation of barred owl control there (Franklin *et al.* 2021). The highest rates of decline, around 9 percent per year from 1995 through 2016, have been observed in Washington at the Cle Elum and Olympic study areas (Franklin *et al.* 2021). Considering only study areas without barred owl removal, the rangewide mean rate of population change was -5.3 percent per year from 1995 through 2016 (Franklin *et al.* 2021). By 2016, NSO populations in study areas without barred owl removal were, at best, 50 percent of their size in 1995 (for the Northwest California study area), and at worse, more than 80 percent smaller than in 1995, for the Cle Elum and Olympic study areas (Franklin *et al.* 2021). For more details on current status, see section on Population Trends below.

A.4. Threats

The NSO was listed as threatened throughout its range "due to loss and adverse modification of suitable habitat as a result of timber harvesting and exacerbated by catastrophic events such as fire, volcanic eruption, and wind storms" (USDI FWS 1990a). More specifically, threats to the NSO included low populations, declining populations, limited habitat, declining habitat, inadequate distribution of habitat or populations, isolation of provinces, predation and competition, lack of coordinated conservation actions, and vulnerability to natural disturbance (USDI FWS 1992). Of these threats, declining habitat was recognized as a severe or moderate threat to the NSO throughout its range, isolation of populations was identified as a severe or moderate threat in 11 provinces, and a decline in population was a severe or moderate threat in 10 provinces (USDI FWS 1992). Together, these three factors represented the greatest concerns about rangewide conservation of the NSO. Limited habitat was considered a severe or moderate threat in nine provinces, and low populations were a severe or moderate concern in eight provinces, suggesting that these factors were also a concern throughout the majority of the NSO range. At the time of listing, vulnerability to natural disturbances was rated as low in five provinces.

The degree to which predation and competition might pose a threat to the NSO was unknown in more provinces than any of the other threats, indicating a need for additional information. Few empirical studies exist to confirm that habitat fragmentation contributes to increased levels of predation on NSO (Courtney *et al.* 2004). However, great horned owls (*Bubo virginianus*), an effective predator on NSO, are closely associated with fragmented forests, openings, and clearcuts (Johnson 1992, Laidig and Dobkin 1995). As mature forests are harvested, great horned owls may colonize fragmented forests, thereby increasing NSO vulnerability to predation.

The Service conducted a 5-year review of the NSO in 2004 (USDI FWS 2004), for which the Service prepared a scientific evaluation of the status of the NSO (Courtney *et al.* 2004). Some of the key threats identified in 2004 were catastrophic wildfire, barred owls, and the legacy of past harvest (Courtney and Gutiérrez 2004). The 2011 Revised Recovery Plan for the Northern Spotted Owl emphasizes that habitat loss and barred owls the main threats to NSO recovery (USDI FWS 2011b), and that effects of high severity wildfires pose concern for habitat conservation in some portions of the range (Davis *et al.* 2016).

The most recent 5-year review, completed in 2019, concludes that competition with barred owls is likely now driving population declines across the range, that habitat loss has slowed but remains a threat, and that climate change is expected to drive increases in habitat loss due to fire (USDI FWS 2019). Even more recent scientific information, published since 2019, continues to confirm the severity of the threats from barred owls, lack of habitat, and the effects of increasingly severe fire (e.g., Franklin *et al.* 2021, Jones *et al.* 2021).

A.4.1. Barred Owls

Barred owls currently appear to be the primary threat to NSO. Having expanded along the coast as far south as Marin County, California and in the Sierra Nevada, as far south as the Greenhorn Mountains in northern Kern County, California (Gutiérrez *et al.* 2004, Steger *et al.* 2006, Long and Wolf 2019), the barred owl's range now completely overlaps that of the NSO. Evidence that barred owls are occurring in higher densities than NSO in many parts of the range (e.g., 3 to 8 barred owl territories per NSO; Hamer *et al.* 2007, Singleton *et al.* 2010, Wiens *et al.* 2011, 2014), now including the portion of the NSO range within California (Diller *et al.* 2016, Dugger *et al.* 2016). In a recent study, the highest densities found were in the Oregon Coast Range, with up to 20 barred owls per NSO territory reported (Wiens *et al.* 2017).

The two species of owls share similar habitats and are likely competing for food resources (Hamer *et al.* 2001, Gutiérrez *et al.* 2007, Livezey and Fleming 2007, Wiens *et al.* 2014, Holm *et al.* 2016, Long and Wolf 2019, Irwin *et al.* 2020). Hamer *et al.* (2001) found a strong diet overlap (76 percent) between NSO and barred owl diets. Barred owl diets are more diverse than NSO diets and include species associated with riparian and other moist habitats (e.g., fish, invertebrates, frogs, and crayfish), along with more terrestrial and diurnal species (Smith *et al.* 1983, Hamer *et al.* 2001, Gronau 2005, Wiens *et al.* 2014). Even though barred owls may be taking NSO primary prey only as a generalist, NSO may be affected by a sufficient reduction in the density of these prey items due to barred owls, leading to a depletion of prey to the extent that the NSO cannot find an adequate amount of food to sustain maintenance or reproduction (Gutiérrez *et al.* 2007, Livezey and Fleming 2007). These impacts are likely to have direct and indirect effects on ecosystem processes (Holm *et al.* 2016).

In addition to competition for prey, barred owls are competing for habitats (Hamer *et al.* 1989, Dunbar *et al.* 1991, Herter and Hicks 2000, Pearson and Livezey 2003, Wiens *et al.* 2014). Barred owls were initially thought to be more closely associated with early successional forests than NSO, based on studies conducted on the west slope of the Cascades in Washington (Hamer *et al.* 1989, Iverson 1993). However, more recent studies conducted in the Pacific Northwest show that barred owls frequently use mature and old-growth forests (Pearson and Livezey 2003, Gremel 2005, Schmidt 2006, Singleton *et al.* 2010).

In the fire prone forests of eastern Washington, a telemetry study conducted on barred and NSO showed that barred owl home ranges were located on lower slopes or valley bottoms, in closed canopy, mature, Douglas-fir forest, while NSO sites were located on mid-elevation areas with southern or western exposure, characterized by closed canopy, mature, ponderosa pine or Douglas-fir forest (Singleton *et al.* 2005). Several other studies in western Washington have similarly shown that when barred owls are present, NSO habitat use shifts upslope and into areas with steeper slopes and more marginal habitat (Pearson and Livezey 2003, Gremel *et al.* 2005, Mangan *et al.* 2019, Irwin *et al.* 2020). The most recent rangewide meta-analysis indicated that barred owl colonization of NSO territories was more likely in lower-elevation territories in most study areas (Franklin *et al.* 2021).

In addition to resource competition, barred owls have been documented to physically attack NSO (Pearson and Livezey 2003), and circumstantial evidence strongly indicated that a barred owl killed a NSO (Leskiw and Gutiérrez 1998).

A consensus in the literature documents the negative influence barred owls are having on NSO site occupancy, fecundity, reproduction, apparent survival, and detectability, and that data indicates that over the last 26 years, they are contributing to declines in NSO populations (Olson *et al.* 2005, Forsman *et al.* 2011, Dugger *et al.* 2011, Dugger *et al.* 2016, Franklin *et al.* 2021). As barred owls have expanded, the occupancy of historical NSO territories is declining (Franklin *et al.* 2021). Even 20 years ago, site occupancy of NSO in Washington and Oregon was significantly lower ($p < 0.001$) after barred owls were detected within 0.8 kilometer (0.5 miles) of the territory center but was "only marginally lower" ($p = 0.06$) if barred owls were located more than 0.8 kilometer (0.5 miles) from the NSO territory center (Kelly *et al.* 2003). Pearson and Livezey (2003) found that there were significantly more barred owl site-centers in unoccupied NSO circles than occupied NSO circles (centered on historical NSO site-centers) with radii of 0.8 kilometer (0.5 miles) ($p = 0.001$), 1.6 kilometer (1 mile) ($p = 0.049$), and 2.9 kilometer (1.8 miles) ($p = 0.005$) in Gifford Pinchot National Forest. In Olympic National Park, Gremel (2005) found a significant decline ($p = 0.01$) in NSO pair occupancy at sites where barred owls had been detected, while pair occupancy remained stable at NSO sites without barred owls. Olson *et al.* (2005) found that the annual probability that a NSO territory would be occupied by a pair of NSO after barred owls were detected at the site declined by 5 percent in the HJ Andrews study area, 12 percent in the Coast Range study area, and 15 percent in the Tyee study area.

In contrast, Bailey *et al.* (2009), when using a two-species occupancy model, showed no evidence that barred owls excluded NSO from territories in Oregon. More recently, results from a barred owl and NSO radio-telemetry study in Washington reported two NSO fleeing their territories and traveling six and 15 miles, believed to be as a result of frequent direct encounters with barred owls; both NSO were subsequently found dead (Irwin *et al.* 2010). In study areas for a recently completed experimental barred owl removal study, NSO pair occupancy was low, and continued to decline in control sites; while the occupancy by barred owls generally increased (Wiens *et al.* 2017). The probability of use by barred owls within 500-acre hexagons (1,235 acres) in the Oregon Coast Ranges study area was high in the first two years of the study in the control area (>0.920) (p. 16).

Numerous studies suggest that barred owls are negatively affecting NSO survival and reproduction. Anthony *et al.* (2006) found significant evidence for negative effects of barred owls on apparent survival of NSO in two of 14 study areas (Olympic and Wenatchee). They attributed the equivocal results for most of their study areas to the coarse nature of their barred owl covariate. Dugger *et al.* (2011) described synergistic effects associated with territory composition and presence of barred owls; some NSO pairs retained their territories and continued to survive and successfully reproduce during their study even when barred owls were present, but the effects of reduced old growth forest in the core habitat areas were compounded when barred owls were present - extinction rates of NSO territories nearly tripled when barred owls were detected. Yackulic *et al.* (2014) documented similar findings; the effects of interspecific competition were likely to negatively affect NSO, both through its immediate effects on local extinction and by indirectly lowering colonization.

Most recently, apparent survival, recruitment, and territory colonization and extinction rates were the key vital rates associated with barred owl presence in NSO populations (Franklin *et al.* 2021). Franklin *et al.* (2021) suggested that without barred owl management, near-term extirpation of NSO is likely in portions of the range, and the small populations that may remain in other parts of the range will be highly vulnerable to extirpation due to wildfire or other stressors, resulting in eventual extinction. Dugger *et al.* (2016) found that the removal of barred owls in the Green Diamond study area in northern California had rapid, positive effects on NSO survival and rates of population change. The meta-analysis of the larger, multi-year barred owl removal experiment (Wiens *et al.* 2021) in 5 study areas across the range demonstrated that removal of invasive barred owls had a strong, positive effect on survival of native NSO, and subsequently reduced long-term population declines. Barred owl removal had a positive, but weaker, effect on recruitment of NSO, which was likely a consequence of consistently depressed reproduction of NSO (and diminished availability of new recruits) during the later years of the study. Removal of barred owls also influenced the dispersal dynamics of resident NSO in at least two study areas where NSO from territories without barred owl removal had an increased estimated probability of movement to territories in treatment areas where barred owls had been removed. Both studies suggest that, along with habitat conservation and management, barred owl removal may be able to slow or reverse NSO population declines on at least a localized scale (Diller *et al.* 2016, Wiens *et al.* 2021).

Olson *et al.* (2004) found that the presence of barred owls had a significant negative effect on the reproduction of NSO in the central Coast Range of Oregon (in the Roseburg study area). The conclusion that barred owls had no significant effect on the reproduction of NSO in one study (Iverson 2004) was unfounded because of small sample sizes (Livezey 2005). It is likely that all of the above analyses underestimated the effects of barred owls on the reproduction of NSO because NSO often cannot be relocated after they are displaced by barred owls (E. Forsman, pers. comm., 2006, as cited in USDI FWS 2011b). Anthony *et al.* (2006) found significant evidence for negative effects of barred owls on apparent survival of NSO in two of 14 study areas (Olympic and Wenatchee). They attributed the equivocal results for most of their study areas to the coarse nature of their barred owl covariate. Dugger *et al.* (2011) confirmed the synergistic effects of barred owls and territory habitat characteristics on extirpation and colonization rates of territories by NSO. Extirpation rates of NSO territories nearly tripled when barred owls were detected (Dugger *et al.* 2011).

Monitoring and management of NSO has become more complicated due to their possible reduced detectability when barred owls are present (Kelly *et al.* 2003, Courtney *et al.* 2004, Olson *et al.* 2005, Crozier *et al.* 2006). Evidence that NSO were responding less frequently during surveys led the Service and its many research partners to update the NSO survey protocol (USDI FWS 2012b) and develop a survey protocol using autonomous recording units (USDI FWS 2021a). The recent changes to the NSO survey protocol were based on the probability of detecting NSO when barred owls are present (See Service Memorandum, revised January 9, 2012, “Northern Spotted Owl Survey Protocol” and attached “Protocol for Surveying Proposed

Management Activities That May Impact Northern Spotted Owls" for guidance and methodology).

In an analysis of more than 9,000 banded NSO throughout their range, only 47 hybrids were detected (Kelly and Forsman 2004). Consequently, hybridization with the barred owl is considered to be "an interesting biological phenomenon that is probably inconsequential, compared with the real threat—direct competition between the two species for food and space" (Kelly and Forsman 2004).

There is no evidence that the increasing trend in barred owls has stabilized in any portion of the NSO range in the western United States, and "there are no grounds for optimistic views suggesting that barred owl impacts on NSO have been already fully realized" (Gutiérrez *et al.* 2004). To date, this situation does not appear to have changed.

The most recent meta-analysis of 26 years of survey and capture-recapture data at 11 study areas across the range of the NSO (Franklin *et al.* 2021) indicated barred owl presence on NSO territories was the primary factor negatively affecting apparent survival, fecundity and recruitment, increasing territorial extirpation, decreasing territorial colonization of NSO, and ultimately, continued rates of population decline. In addition to lowering NSO survival and reproduction, competition with barred owl appears to impair the ability of younger NSO to acquire breeding territories (Franklin *et al.* 2021).

The rate of decline of NSO populations in control areas where barred owl removal did not occur by the end of the barred owl removal experiment was severe (approximately 12 percent per year), indicating an increasingly high risk of NSO populations to local extirpations without barred owl control (Wiens *et al.* 2021). Results of the barred owl control experiments across the range indicated that persistence and recovery of NSO populations are possible with active control of the barred owl threat, at least over the short term, in managed areas (Wiens *et al.* 2021). However, recovery of NSO will also require short and long-term availability of older forests and suitable NSO habitat on the landscape (Wiens *et al.* 2021, Franklin *et al.* 2021).

A.4.2. Wildfire

At the time of listing there was recognition that large-scale wildfire posed a threat to the NSO and its habitat (USDI FWS 1990a). Large scale wildfire is now recognized as the primary source of habitat loss on Federal lands; there have been significant losses of nesting/roosting (NR) habitats since 2005, particularly in the reserved land allocations of the Klamath Province and parts of the Oregon Cascades (Davis *et al.* 2011, Davis *et al.* 2016). Table A-2 below also summarizes habitat lost from natural disturbances, the majority of which has resulted from high severity fires. The NWFP recognized wildfire as an inherent part of managing NSO habitat in certain portions of the range. The distribution and size of reserve blocks as part of the NWFP design may help mitigate the risks associated with large-scale fire (Lint 2005).

Wildfire is often considered a primary threat to spotted owls because of its potential to alter habitat rapidly (Bond *et al.* 2009) and is a major cause of habitat loss on Federal lands (Courtney *et al.* 2004, Davis *et al.* 2011, Davis *et al.* 2016). A recent systematic review and meta-analysis of 21 studies, including studies of all three spotted owl subspecies, concluded that most demographic effects of mixed-severity fire are insignificant (Lee 2018), but the authors of several of the included studies have outlined problems with the ecological foundations, statistical methods, and conclusions of the analysis, and counter that stand-replacing fire can threaten spotted owls (Jones *et al.* 2020a).

In some parts of the range, NR habitat is associated with a lower likelihood of high-severity fire, as compared with unsuitable forest cover types (Lesmeister *et al.* 2019). Studies indicate that the effects of wildfire on spotted owls and their habitat are variable, depending on fire intensity, severity, and size. Within the fire-adapted forests of the spotted owl's range, spotted owls likely have adapted to withstand fires of variable sizes and severities (Eyes *et al.* 2017). However, current indications are that hotter, drier summers due to climate change will likely result in larger, more intense fires than historically occurred (USDI FWS 2011).

Mixed and lower severity fires may have little or even beneficial effects to spotted owls (Bond *et al.* 2002, Jones *et al.* 2016); but large, high severity fires have been found to cause reduced survival and occupancy (Jones *et al.* 2016). Site fidelity can influence spotted owl use of burned areas that were previously suitable (Clark 2007, Bond *et al.* 2009, Lee *et al.* 2012), and high severity fires can result in population sinks when NSO return to burned territories (Rockweit *et al.* 2017). In two telemetry studies, California spotted owls avoided large high-severity burned patches, especially those larger than 115 ha (284 ac), a size similar to the maximum historical high-severity patch size of that region (Jones *et al.* 2020b, Kramer *et al.* 2021).

One year following the extensive King Fire in the Sierra Nevada Mountains, Jones *et al.* (2016) documented strong negative California spotted owl population impacts, with declines in occupancy and reproduction associated with severely burned sites; the probability of site extirpation in that study was seven times higher one year after the fire where more than 50 percent of the site (approximately 0.7 mile radius area) burned at high severity (75–100 percent canopy mortality) (p. 303-304). In southwest Oregon, lower occupancy and survival rates of NSO were found in burned areas compared to unburned, but the results were confounded by prior management and post-fire harvest (Clark 2007, Clark *et al.* 2011, Clark *et al.* 2013).

Available data on the direct mortality of spotted owls from fire is limited. In one study, mortality was assumed to have occurred at one site, and NSO were present at only one of the six sites 1 year after a fire (Gaines *et al.* 1997). In 1994, two wildfires burned in the Yakama Indian Reservation in Washington's eastern Cascades, NSO were observed using areas that burned at low and medium intensities, although the amount of home ranges burned was not quantified (King *et al.* 1998). No direct mortality of NSO was observed, even though thick smoke covered several NSO site-centers for a week.

Additional impacts to NSO related to wildfire include forest management that occurs after fires. Post-fire salvage logging typically occurs on the majority of private timberlands, but also occurs on Federal lands to a smaller degree. This type of harvest can directly impact habitat potentially occupied by NSO and can negatively influence ecological processes, which can impair the long-term development of NSO habitat (reviewed in USDI FWS 2011b). Action agencies, working with the Service, are attempting to influence fire severity by designing projects to reduce fire-suppressed vegetation and mimic the effects of historical fire regimes. The effects of this type of management are uncertain and highly debated in the literature (Omi and Martenson 2002, Courtney *et al.* 2004, Irwin *et al.* 2004, Spies *et al.* 2006, Hanson *et al.* 2009, Spies *et al.* 2009, Gaines *et al.* 2010, Ager *et al.* 2012, Odion *et al.* 2014a, Spies *et al.* 2012, Odion *et al.* 2014b, Baker 2015, Baker 2017, Gallagher *et al.* 2018).

A.4.3. West Nile Virus

At this time, no avian diseases, including West Nile virus (WNV) or Highly Pathogenic Avian Influenza (HPAI), are known to be significantly affecting NSO; Recovery Action 17 recommends monitoring for such diseases as needed (USDI FWS 2011).

A.4.4. Sudden Oak Death

Sudden oak death was not listed as particular threat at the time of listing but was recognized as a potential threat to the NSO after it was discovered in Oregon (Courtney *et al.* 2004, USDI FWS 2011). Because of the coastal influence on his pathogen, sudden oak death is not likely to be of consequence rangewide but could compound existing stressors in coastal provinces of the NSO range.

This disease is caused by the fungus-like pathogen, *Phytopthora ramorum*, that was recently introduced from Europe and is rapidly spreading as it is capable of infecting over 100 species of trees and shrubs (APHIS 2011, in Peterson *et al.* 2015). The disease has been found in several different forest types and at elevations from sea level to over 800 m and is now known to extend over 650 km from south of Big Sur, California to Curry County, Oregon (Rizzo and Garbelotto 2003). In some areas it has reached epidemic proportions in oak (Quercus spp.) and tanoak (*Lithocarpus densiflorus*) forests along approximately 300 kilometers (186 miles) of the central and northern California coast (Rizzo *et al.* 2002). Near Brookings, Oregon it has killed tanoak and caused dieback of closely associated wild rhododendron (*Rhododendron* spp.) and evergreen huckleberry (*Vaccinium ovatum*) (Goheen *et al.* 2002), common components of NSO habitat. Despite treatments of infected sites that remove all infected trees and shrubs as well as those occurring within a 300-foot buffer, occurrences of infected sites have increased since 2001 (Peterson *et al.* 2015).

The majority of infected sites in Oregon are concentrated in the Chetco River drainage, but it has been located as far north as Cape Sebastian (Peterson *et al.* 2015). The spores from this pathogen are transmitted through the coastal fog and rain or through contaminated surfaces. During a study completed between 2001 and 2003 in California, one-third to one-half of the hikers present in the study area carried infected soil on their shoes (Davidson *et al.* 2005), creating the potential for rapid spread of the disease. Sudden oak death poses a threat of uncertain proportion because of its potential impact on forest dynamics and alteration of key prey and NSO habitat components (e.g., hardwood trees, forest structure and nest tree mortality); especially in the southern portion of the NSO range (Courtney *et al.* 2004). Eradication treatments themselves have the potential to remove habitat at the stand level as all hardwoods and shrubs identified as carriers are removed.

A.4.5. Inbreeding Depression, Genetic Isolation, and Reduced Genetic Diversity

Inbreeding and other genetic problems due to small population sizes were not considered an imminent threat to the NSO at the time of listing. Earlier studies showed no indication of reduced genetic variation and past bottlenecks in Washington, Oregon, or California (Barrowclough *et al.* 1999, Haig *et al.* 2004). A more recent study however, reported a significant bottleneck influence in the Washington Cascades, an area known to be experiencing a significant population decline, and that other areas with significant population bottlenecks were correlated with declines in population growth rate (Funk *et al.* 2010, as reviewed in Haig *et al.* 2016). Recently, evidence has emerged that inbreeding depression (i.e., reduced fitness resulting from mating of close relatives) in is affecting NSO, though it is not clear whether or to what extent inbreeding depression may be exacerbating current population declines (Miller *et al.* 2018). Northern spotted owls known to have closely-related parents, such as full-sibling pairs, were much less likely to be observed producing offspring themselves (6.8 percent), as compared with owls without closely-related parents (27.2 percent of which were observed to produce offspring), indicating a large reduction in fitness. Rates of inbreeding were highest in the Washington Cascades (12.3 percent), intermediate on the Olympic Peninsula (5.3 percent), and low in Oregon (0.6 percent) and California (1.2 percent) (Miller *et al.* 2018).

The circumstantial case for increasing risk of inbreeding depression, genetic isolation, and reduced genetic diversity also has become stronger in the northern portion of the range. In Washington demography study areas, current effective population sizes are on average fewer than 20 individuals (Gremel 2015, Herter 2016, Lesmeister *et al.* 2017, Lesmeister and Pruett 2017). Populations of this size are highly susceptible to loss of genetic variation and fitness due to genetic drift and other factors (Frankham 1996, Frankham *et al.* 2014). Canadian populations may be even more adversely affected by issues related to small population size including inbreeding depression, genetic isolation, and reduced genetic diversity (Courtney *et al.* 2004, pp. 11-9). A 2004 study (Harestad *et al.* 2004) indicates that the Canadian breeding population was estimated to be less than 33 pairs and annual population decline may be as high as 35 percent. In 2007, a recommendation was made by the Spotted Owl Population Enhancement Team to remove NSO from the wild in British Columbia (USDI FWS 2012a). This recommendation resulted in the eventual capture of the remaining 16 wild NSO in British Columbia for a captive breeding program (USDI FWS 2012a). Low and persistently declining populations throughout the northern portion of the species range (see "Population Trends" below) may be at increased risk of losing genetic diversity.

Hybridization of NSO with California spotted owls, Mexican spotted owls, and barred owls has been confirmed through genetic research (Funk *et al.* 2008, Hamer *et al.* 1994, Gutiérrez *et al.* 1995, Dark *et al.* 1998, Kelly 2001).

A.4.6. Climate Change

Global climate change has the potential to produce entirely new environmental conditions, making predictions about future ecological consequences a more daunting challenge. Recent forecasts indicate that climate change will have long-term and variable impacts on forest habitat at local and regional scales. Locally, this could involve shifts in tree species composition that influence habitat suitability. Frey *et al.* (2016) concluded that old-growth will provide some buffer from impacts of regional warming and/or slow the rate at which some species relying on old-growth must adapt, based on their modeling of the fine-scale spatial distribution, under-canopy air temperatures in mountainous terrain of central Oregon. Similarly, Lesmeister *et al.* (2019) concluded that older forest can serve as a buffer to climate change and associated increases in wildfire, as these areas have the highest probability of persisting through fire events even in weather conditions associated with high fire activity. Regionally, there could be losses of habitat availability caused by advances or retreats of entire vegetative communities, and perhaps prey communities as well. Effects of climate change, including fire and pest incidence, will not only affect currently suitable habitat for the NSO, but they will also likely alter or interrupt forest growth and development processes (Karl *et al.* 2008, Dale *et al.* 2001, Yospin *et al.* 2015) that influence forest turnover rates and the emergence of suitable habitat attributes in new locations. These changes are predicted to be driven by changes in patterns of temperature and precipitation that are projected to occur under climate change scenarios (Mote *et al.* 2014).

Glenn *et al.* (2010) noted that the potential consequences of global climate change on Pacific Northwest forests remain somewhat unclear, though there is potential for changes in forest composition and disturbance patterns that could affect NSO populations. Most models predict warmer, wetter winters and hotter, drier summers for the Pacific Northwest in the first half of the 21st century (Mote *et al.* 2008, Mote *et al.* 2014). This may result in a change in species composition or reduction in the acreage of existing low-elevation forests. The general predicted trend in North American forests is declining occupancy by conifers and displacement by hardwoods. Both the frequency and intensity of wildfires and insect outbreaks are expected to increase over the next century in the Pacific Northwest (Littell *et al.* 2010). One of the largest projected effects on Pacific Northwest forests is likely to come from an increase in fire frequency, duration, and severity. Westerling *et al.* (2006) analyzed wildfires and found that since the mid-1980s, wildfire frequency in western forests has nearly quadrupled compared to the average of the period from 1970-1986. The total area burned is more than 6.5 times the previous level and the average length of the fire season during 1987-2003 was 78 days longer compared to 1978-1986 (Westerling *et al.* 2006). The area burned annually by wildfires in the Pacific Northwest is expected to double or triple by the 2080s (Littell *et al.* 2010). Wildfires are now the primary cause of NSO habitat loss on Federal lands, with about 505,800 acres of NR habitat loss attributed to wildfires from 1993 to 2012 (Davis *et al.* 2016).

In its review of the status of the NSO in California, the California Department of Fish and Wildlife (CDFW) evaluated the possible effects of climate change upon NSO and the forested habitats on which it depends (CDFW 2016). In general, CDFW (2016) determined that climate change is occurring within the NSO entire range, including California, with many climate projections forecasting steady changes in the future. They reported that climate change studies predict future conditions that may negatively impact NSO, such as wet and cold springs, more frequent and severe summer heat waves, decreased fog along the coast, shifts in forest species composition, and increased frequency of severe wildfire events. However, CDFW (2016) also reported that in some instances predicted future conditions, such as increased frequency of low to moderate severity fires and expansion of suitable owl habitat forest types, may be favorable to the NSO in the long-term. They further reported that in California, current rates of temperature and precipitation change predict hotter and drier conditions in some areas of the NSO range, and wetter colder conditions in other areas of the range. They looked at past precipitation and temperature trends and reported that drying trends across most of the NSO range in California, coupled with warmer winters and cooler summers in the interior and cooler winters and warmer summers along the coast, may play a role in both owl and prey population dynamics. CDFW (2016) recommended that further research is necessary to understand how climate change may be affecting NSO in California and throughout its range.

Potential changes in temperature and precipitation have important implications for NSO reproduction and survival. Wet, cold weather during the winter or nesting season, particularly the early nesting season, has been shown to negatively affect NSO reproduction (Olson *et al.* 2004, Dugger *et al.* 2005), survival (Franklin *et al.* 2000, Olson *et al.* 2004, Glenn *et al.* 2011), and recruitment (Glenn *et al.* 2010). Cold, wet weather may reduce reproduction and/or survival during the breeding season due to declines or decreased activity in small mammal populations so that less food is available during reproduction when metabolic demands are high (Glenn *et al.* 2011). Cold, wet nesting seasons may increase the mortality of nestlings due to chilling and reduce the number of young fledged per pair per year (Franklin *et al.* 2000, Glenn *et al.* 2011). Most recently, the relationships between NSO populations and climate were complex and variable, but rangewide, Dugger and others (2016) suggested that survival increased when winters were warmer and drier. This may become a factor in population numbers in the future; given climate change predictions for the Pacific Northwest include warmer and wetter winters.

Drought or hot temperatures during the summer have also been linked to reduced NSO recruitment (Glenn *et al.* 2010). Drier, warmer summers and drought conditions during the growing season strongly influence primary production in forests, food availability, and the population sizes of small mammals that NSO prey upon (Glenn *et al.* 2010).

Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007).

While a change in forest composition or extent is likely as a result of climate change, the rate of that change is uncertain. In forests with long-lived dominant tree species, mature individuals may be able to survive these stresses, so direct effects of climate on forest composition and structure would most likely occur over a longer time scale (100 to 500 years) in some areas than in areas with disturbances such as wildfire or insect outbreaks (25 to 100 years) (McKenzie *et al.* 2009). The presence of high-quality habitat may buffer the negative effects of cold, wet, springs and winters on survival of NSO as well as ameliorate the effects of heat. This habitat might help maintain a stable prey base, thereby reducing the cost of foraging during the breeding season when energetic needs are high (Franklin *et al.* 2000).

Although the scientific literature has explored the link between climate change and the invasion by barred owls, changing climate alone is unlikely to have caused the invasion (Livezey 2009). In general, climate change can increase the success of introduced or invasive species in colonizing new territory. Invasive animal species are more likely to be generalists, such as the barred owl, than specialists, such as the NSO, and adapt more successfully to a new climate than natives.

In summary, effects of climate change may vary across the range, but is likely to exacerbate some existing threats to the NSO such as the projected potential for increased habitat loss from drought-related fire, tree mortality, insects and disease, as well as affecting reproduction and survival during years of extreme weather.

A.4.7. Exposure to Toxicants

Toxicants were not identified as a threat when the NSO was listed, but a growing body of information suggests exposure to anti-coagulant rodenticides, fertilizers, other contaminants, as well as other factors associated with marijuana cultivation represent a growing concern for NSO. Recent accounts show that the scope and scale of exposure from illegal cultivation is increasing on Federal and non-Federal ownerships; these threats extend NSO and many other wildlife species and the resources they depend upon (Thompson *et al.* 2013, Gabriel *et al.* 2013, Wengert *et al.* 2015, CDFW 2016, CEPA 2017b, Gabriel *et al.* 2018, Higley *et al.* 2017). Known grow sites have been found to intersect with both subspecies of spotted owl ranges throughout California. On Forest Service lands in 2014, more than 620,000 marijuana plants on about 1,500 ac (607 ha) were removed from 167 different sites; about 90 percent of which were in California (US Senate 2015). Over 600 trespass grow sites were reported on mixed California ownerships in 2010 (Wengert *et al.* 2015). Increases in mortalities from and exposure to pesticides in fishers in the Sierras and Northern California indicate that toxicants from marijuana cultivation suggest increasing trends (Gabriel *et al.* 2015).

Illegal cultivation is a serious issue in the Klamath Physiographic Province, an area recognized as an important area for NSO populations (Schumaker *et al.* 2014). In Southwestern Oregon in Jackson and Josephine Counties alone, a multi-agency Drug Task force reported a total of 100 illegal marijuana cultivation sites containing approximately 294,090 plants between 2005-2014 (R. Caruthers, pers. comm., 2017). Many of these sites were located within known NSO home ranges, cores, or nest stands (D. Clayton, pers. comm., 2017).

Known exposure and recent data on impacts to barred owls suggest serious implications for NSO. In Hoopa Tribal lands in northwestern California, of 176 barred owls tested for exposure to anticoagulant rodenticides (AR), 65 percent tested positive for one or more second generation AR; many of these were collected from known NSO home ranges (Higley *et al.* 2017). In a separate study in northwestern California, seven out of ten NSO (70 percent) and 34 of 80 barred owls (40 percent) tested positive for AR (Gabriel *et al.* 2018, pp. 5-6). At experimental barred owl removal areas in Oregon and Washington, 19 of 40 (48 percent) of tested barred owl carcasses, as well as one of two opportunistically-obtained NSO carcasses, showed evidence of exposure to ARs (Wiens *et al.* 2019). Most exposures in Oregon and Washington were at trace levels, and AR toxicosis could not be confirmed in any of the tested owls. These exposures in Oregon and Washington could not be definitively attributed to legal rodenticide applications or to illicit marijuana cultivation (Wiens *et al.* 2019).

A.4.8. Disturbance

Northern spotted owls may also respond physiologically to a disturbance without exhibiting a significant behavioral response. In response to environmental stressors, vertebrates secrete stress hormones called corticosteroids (Campbell 1990). Although these hormones are essential for survival, extended periods with elevated stress hormone levels may have negative effects on reproductive function, disease resistance, or physical condition (Carsia and Harvey 2000, Saplosky *et al.* 2000). In avian species, the secretion of corticosterone is the primary non-specific stress response (Carsia and Harvey 2000). The quantity of this hormone in feces can be used as a measure of physiological stress (Wasser *et al.* 1997). Recent studies of fecal corticosterone levels of NSO indicate that low intensity noise of short duration and minimal repetition does not elicit a physiological stress response (Tempel and Gutiérrez 2003, 2004). However, prolonged activities, such as those associated with timber harvest, may increase fecal corticosterone levels depending on their proximity to NSO core areas (Wasser *et al.* 1997, Tempel and Gutiérrez 2004).

The effect of noise on birds is extremely difficult to determine due to the inability of most studies to quantify one or more of the following variables: 1) timing of the disturbance in relation to nesting chronology; 2) type, frequency, and proximity of human disturbance; 3) clutch size; 4) health of individual birds; 5) food supply; and 6) outcome of previous interactions between birds and humans (Knight and Skagan 1988). Additional factors that confound the issue of disturbance include the individual bird's tolerance level, ambient sound levels, physical parameters of sound, and how it reacts with topographic characteristics and vegetation, and differences in how species perceive noise.

Information specific to behavioral responses of spotted owls to disturbance is limited, research indicates that recreational activity can cause Mexican spotted owls (*S. o. lucida*) to vacate otherwise suitable habitat (Swarthout and Steidl 2001) and helicopter overflights can reduce prey delivery rates to nests (Delaney *et al.* 1999). Additional effects from disturbance, including altered foraging behavior and decreases in nest attendance and reproductive success, have been reported for other raptors (White and Thurow 1985, Andersen *et al.* 1989, McGarigal *et al.* 1991).

Although it has not been conclusively demonstrated, it is anticipated that nesting spotted owls may be disturbed by heat and smoke as a result of burning activities during the breeding season.

A.5. Conservation Needs of the Northern Spotted Owl

Based on the above assessment of threats, the NSO has the following habitat-specific and habitat-independent conservation (i.e., survival and recovery) needs:

A.5.1. Habitat-specific Needs

1. Large blocks of habitat capable of supporting clusters or local population centers of NSO (e.g., 15 to 20 breeding pairs) throughout the owl's range;
2. Suitable habitat conditions and spacing between local NSO populations throughout its range that facilitate survival and movement;
3. Suitable habitat distributed across a variety of ecological conditions within the NSO range to reduce risk of local or widespread extirpation;
4. A coordinated, adaptive management effort to reduce the loss of habitat due to catastrophic wildfire throughout the NSO range, and a monitoring program to clarify whether these risk reduction methods are effective and to determine how owls use habitat treated to reduce fuels; and
5. In areas of significant population decline, which now include the entire range, sustain the full range of survival and recovery options for this species in light of significant uncertainty.

A.5.2. Habitat-independent Needs

1. A coordinated research and adaptive management effort to better understand and manage competitive interactions between spotted and barred owls; and
2. Monitoring to understand better the risk that WNV and sudden oak death pose to NSO and, for WNV, research into methods that may reduce the likelihood or severity of outbreaks in NSO populations.

A.6. Conservation Strategy to Address Habitat Loss and Fragmentation

Since 1990, various efforts have addressed the conservation needs of the NSO and attempted to formulate conservation strategies based upon these needs. These efforts began with the ISC's Conservation Strategy (Thomas *et al.* 1990); they continued with the designation of critical habitat (USDI FWS 1992b), the Draft Recovery Plan (USDI FWS 1992a), and the Scientific Analysis Team report (Thomas *et al.* 1993), report of the Forest Ecosystem Management Assessment Team (Thomas and Raphael 1993); and they culminated with the NWFP (USFS and BLM 1994a). Recently, the management strategy for portions of Bureau of Land Management lands in Oregon (2.5 million acres) was modified and is no longer following all measures described in the NWFP (BLM 2016a, entire and BLM 2016b). In comparison to the NWFP land use allocations, the Late-Successional Reserve (LSR) designs of the revised Resource Management Plans (RMPs) make similar contributions to the development and spacing of the large habitat blocks needed for NSO conservation.

The RMPs includes approximately 177,000 more acres (71,629 ha) of LSR and Riparian Reserves than in the NWFP. These land use allocations represent 36 and 27 percent of the RMP lands, respectively, and will be managed for the retention and development of large trees and complex forests across the RMP landscape (USDI FWS 2016). Two additional key provisions differ from previous strategies, including a mitigation that the BLM would participate in, cooperate with, and provide support for an interagency program for barred owl management to implement Recovery Action 30 when the Service determines the best manner in which barred owl management can contribute to the recovery of the NSO. Also, timber sales that would cause the incidental take of NSO from timber harvest would not be authorized until implementation of a barred owl management program has begun (BLM 2016a, 2016b). Overall fundamentals of these large-scale conservation strategies have been based upon the reserve design principles first articulated in the ISC's report, which are summarized as follows:

Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range.

Large blocks of habitat, containing multiple pairs of the species, are superior to small blocks of habitat with only one to a few pairs.

Blocks of habitat that are close together are better than blocks far apart.

Habitat that occurs in contiguous blocks is better than habitat that is more fragmented.

Habitat between blocks is more effective as dispersal habitat if it resembles suitable habitat.

A.6.1. Federal Contribution to Recovery

Since it was signed on April 13, 1994, the NWFP has guided the management of Federal forest lands within the range of the NSO (USFS and BLM 1994a, 1994b). The NWFP was designed to protect large blocks of old growth forest and provide habitat for species that depend on those forests including the NSO, as well as to produce a predictable and sustainable level of timber sales. The NWFP included land use allocations which would provide for population clusters of NSO (i.e., demographic support) and maintain connectivity between population clusters. Certain land use allocations in the plan contribute to supporting population clusters: LSR, Managed Late-successional Areas, and Congressionally Reserved areas. Riparian Reserves, Adaptive Management Areas, and Administratively Withdrawn areas can provide both demographic support and connectivity and dispersal between the larger blocks but were not necessarily designed for that purpose. Matrix areas were to support timber production while also retaining biological legacy components important to old-growth obligate species (in 100-acre owl cores, 15 percent late-successional provision, etc. [USFS and BLM 1994a, USDI FWS 1994]) which would persist into future managed timber stands.

The NWFP with its rangewide system of LSR was based on work completed by three previous studies (Thomas *et al.* 2006): the 1990 Interagency Scientific Committee (ISC) Report (Thomas *et al.* 1990), the 1991 report for the Conservation of Late-successional Forests and Aquatic Ecosystems (Johnson *et al.* 1991), and the 1993 report of the Scientific Assessment Team (Thomas *et al.* 1993).

The Forest Ecosystem Management Assessment Team and the NWFP predicted, based on expert opinion, that the NSO population would decline in the Matrix land use allocation over time, while the population would stabilize and eventually increase within LSR as habitat conditions improved over the next 50 to 100 years (Thomas and Raphael 1993, USFS and BLM 1994a, 1994b). The results of the first decade of monitoring, Lint (2005) did not yield conclusions whether implementation of the NWFP would reverse the NSO declining population trend because not enough time had passed to provide the necessary measure of certainty. However, the results from the first decade of monitoring did not provide any reason to depart from the objective of habitat maintenance and restoration as described in the NWFP (Lint 2005, Noon and Blakesley 2006). Other stressors that occur in suitable habitat, such as the range expansion of the barred owl (already in action) and infection with WNV (which may or may not occur) may complicate the conservation of the NSO. Recent reports about the status of the NSO offer few management recommendations to deal with these emerging threats. However, Franklin *et al.* (2021) suggest that maintaining NSO habitat, even where it is currently unoccupied, will be helpful in allowing for recolonization by NSO if barred owl populations can be reduced, and in allowing for connectivity among areas still occupied by NSO.

A.6.2. Recovery Plan

On June 28, 2011, the Service published the Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011b). The recovery plan identifies threats from competition with barred owls, ongoing loss of NSO habitat as a result of timber harvest, loss or modification of NSO habitat from uncharacteristic wildfire, and loss of amount and distribution of NSO habitat as a result of past activities and disturbances (USDI FWS 2011b). To address these threats, the current recovery strategy identifies five main steps: 1) development of a rangewide habitat modeling framework; 2) barred owl management; 3) monitoring and research; 4) adaptive management; and 5) habitat conservation and active forest restoration (USDI FWS 2011b). The recovery plan lists recovery actions that address each of these items, some of which were retained from the 2008 recovery plan (USDI FWS 2008). The Managed Owl Conservation Areas and Conservation Support Areas recommended in the 2008 recovery plan are not a part of the recovery strategy outlined in the Revised Recovery Plan. The Service completed a rangewide, multi-step habitat modeling process to help evaluate and inform management decisions and critical habitat development (Service 2011b).

The Revised Recovery Plan recommended implementing a robust monitoring and research program for the NSO. The recovery plan encourages these efforts by laying out the following primary elements to evaluate progress toward meeting recovery criteria: monitoring NSO population trends, comprehensive barred owl research and monitoring, continued habitat monitoring; inventory of NSO distribution, and; explicit consideration for climate change mitigation goals consistent with recovery actions (USDI FWS 2011b). The Revised Recovery Plan also strongly encourages land managers to be aggressive in the implementation of recovery actions, including strategies that include active forest management. In other words, land managers should not be so conservative that, to avoid risk, they forego actions that are necessary to conserve the forest ecosystems that are necessary to the long-term conservation of the NSO. But they should also not be so aggressive that they subject NSO and their habitat to treatments where the long-term benefits do not clearly outweigh the short-term risks. Finding the appropriate balance to this dichotomy will remain an ongoing challenge for all who are engaged in NSO conservation (USDI FWS 2011b). The Revised Recovery Plan estimates that recovery of the NSO could be achieved in approximately 30 years (USDI FWS 2011b). The Revised Recovery Plan and the critical habitat designation build on the NWFP and recommends continued implementation of the NWFP and its standards and guides (USDI FWS 2011b).

A.6.2.1. Northern Spotted Owl Recovery Units

The 2011 Final Revised Recovery Plan for the Northern Spotted Owl determined that the 12 existing physiographic provinces meet the criteria for use as recovery units (USDI FWS 2011b). Each recovery unit is essential for the conservation of the NSO. The suite of recovery units is intended to further the re-establishment or maintenance of 1) genetic flow between NSO populations; 2) population and habitat distribution; and 3) NSO meta-population dynamics. Recovery criteria, as described in the 2011 Final Revised Recovery Plan, are measurable and achievable goals that are believed to result through implementation of the recovery actions described in the recovery plan. Achievement of the recovery criteria will take time and are intended to be measured over the life of the plan, not on a short-term basis. The criteria are the same for all 12 identified recovery units. The four recovery criterion are: 1) stable population trend, 2) adequate population distribution in all recovery units except for the Willamette Province, 3) continued maintenance and recruitment of NSO habitat, and 4) post-delisting monitoring (USDI FWS 2011b).

The 2011 Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011b) contains 14 recovery actions that specifically address NSO habitat loss and degradation. Two actions of primary importance are recovery actions 10 and 32:

Recovery Action 10: Conserve NSO sites and high value NSO habitat to provide additional demographic support to the NSO population. This action addresses both NR and foraging habitat.

Recovery Action 32: Because NSO recovery requires well distributed, older and more structurally complex multi-layered conifer forests on Federal and non-Federal lands across its range, land managers should work with the Service…to maintain and restore such habitat while allowing for other threats, such as fire and insects, to be addressed by restoration management actions. These high-quality NSO habitat stands 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 action addresses NR habitat.

Recovery actions 10 and 32 are implemented on reserved areas by the USFS and BLM through the NWFP and the Resource Management Plans (RMPs); these two regulatory actions are discussed in more detail in Section 6. The large reserve network created under the NWFP and RMPs facilitates implementation of recovery actions 10 and 32 by protection of current nesting roosting and foraging habitat, protection of NSO nest sites, and allowing for recruitment of new NSO habitat. Through the section 7 consultation process, the Service reviews the management activities implemented under the NWFP and RMPs and provides technical assistance to the USFS and BLM in making activities within or outside of reserves consistent with recovery actions 10 and 32 to the extent consistent with other land management priorities. NRF habitat associated with both recovery actions 10 and 32 may decrease in local areas, but over the larger area and time, habitat that is associated with these recovery actions is increasing and will continue to increase under both the NWFP and RMPs.

A.6.3. Conservation Efforts on Non-Federal Lands

Non-Federal lands contributed 3,149,700 ac (1,274,638 ha) to the total 12,103,700 ac (4,898,193 ha) of NR habitat available for breeding NSO in 2012 (Davis *et al.* 2016). There are portions of the range where habitat on Federal lands is lacking or of low quality, or where there is little Federal ownership; State and private lands may be important to provide demographic support (pair or cluster protection) and habitat connectivity for NSO in key areas such as southwestern Washington, northwestern Oregon (potentially including parts of the Tillamook and Clatsop State Forests), and northeastern California (USDI FWS 2011b). Timber harvest on State and private lands in Washington, Oregon, and California is regulated by each State's forest practice rules. The level of NSO conservation included in each State's regulations varies. Furthermore, while recovery efforts for the NSO are primarily focused on Federal land, Recovery action 14 in the 2011 Revised Recovery Plan centered on seeking partnership with non-Federal landowners to supplement Federal conservation efforts, including voluntary actions like Habitat Conservation Plans (HCPs) and Safe Harbor Agreements (SHAs). There are a total of 21 current conservation plans in these states, including 7 HCPs and 3 SHAs located in Washington, 2 HCPs and 5 SHAs in Oregon, and 2 HCPs and one SHA in California, with an additional SHA occurring in both Washington and Oregon.

A.6.3.1. U.S. Fish and Wildlife Service Habitat Conservation Plans and Safe Harbor Agreements

The purpose of the HCP and SHA process is to provide for the conservation of endangered and threatened species while at the same time authorizing the incidental take of those species. HCPs are required as part of an application for an incidental take permit. They describe the anticipated effects of the proposed taking; how those impacts will be minimized and mitigated; and how the HCP is to be funded, among other things. The Secretary must issue the permit if statutory issuance criteria are met, including that the applicant will minimize and mitigate the effects of the taking to the maximum extent practicable, the taking will not jeopardize the continued existence of the species, and funding to implement the plan is assured. 16 U.S.C. 1539(a)(2)(B). In developing HCPs, people applying for incidental take permits describe measures designed to minimize and mitigate the effects of their actions and receive formal assurances from the Service that if they fulfill the conditions of the HCP, the Service will not require any additional or different management activities by the participants without their consent. SHAs are voluntary agreements between non-Federal property owners and the Service; in exchange for actions that contribute to the recovery of listed species on non-Federal lands, participating property owners may return the enrolled property to the baseline conditions that existed at the beginning of the SHA. Incidental Take Permits that result from both HCPs and SHAs are intended to allow non-Federal entities to undertake actions that incidentally "take" species protected under the Act.

HCPs are not required to have a net benefit and SHAs are designed to have a temporary net gain for NSO. Under these plans, timber harvest has continued, resulting in the loss of NR, foraging, and dispersal habitat. We do not currently have an analysis of habitat loss on lands without conservation plans compared to habitat loss on lands covered by HCPs and SHAs. Although the HCPs do not provide a net conservation benefit to NSO, they provide mitigation for habitat loss or slow down habitat loss through the required conservation measures. SHAs do provide a net conservation benefit to the NSO, and both conservation plans eliminate uncertainty with respect to landowners' actions in NSO habitat and provide the Service an opportunity to provide technical assistance to landowners in the development of conservation measures included in the agreements. Therefore, in this context, both HCPs and SHAs have contributed to the overall conservation of NSO.

In Washington, there are seven NSO-related HCPs currently in effect covering 2 million ac (80,9371 ha) of non-Federal lands, one of which covers Washington Department of Natural Resources (DNR) lands. These HCPs still allow timber harvest but are designed to retain some nesting habitat and or connectivity over the next few decades. There are four NSO-related SHAs in Washington, with one including some lands in Oregon. The primary intent of SHAs is to maintain or create potential NSO habitat. In addition, there is a long-term habitat management agreement covering 13,000 ac (5,261 ha) in which authorization of take was provided through an incidental take statement (section 7) associated with a Federal land exchange (USDI FWS 2011b). While timber harvest and habitat loss continue on lands covered by these agreements, the plans retain some NR habitat throughout the area or in strategic locations and provide habitat connectivity. Overall, HCPs, and SHAs in Washington provide some protection to NSO and their habitat. However, NR, and foraging habitat continue to decline due to timber harvest on non-Federal lands in Washington.

In Oregon, there are two NSO-related HCPs currently in effect covering 210,400 ac (85,146 ha) of non-Federal lands. These HCPs still allow timber harvest but are designed to retain some nesting habitat and or connectivity over the next few decades. There are two NSO-related SHAs occurring in Oregon. One SHA is a Washington SHA that covered some Oregon lands. The other SHA is a programmatic SHA with the Oregon Department of Forestry with 13 landowners with 3,484 acres enrolled. The primary intent of SHAs is to maintain or create potential NSO habitat. Strategies employed in the programmatic Oregon Department of Forestry SHA include maintaining existing suitable habitat, increasing time between harvests to allow for habitat development, and lightly to moderately thinning younger forest stands that are currently not habitat (to increase tree diameter and stand diversity) (USDI FWS 2011b). There are 4 additional SHAs in Oregon related to the Barred Owl Removal Experiment explained below in the barred owl section. While timber harvest and habitat loss continue on lands covered by these HCPs and SHAs in Oregon, the plans retain some NR habitat throughout the area or in strategic locations and provide habitat connectivity. Overall, HCPs, and SHAs in Oregon provide some protection to NSO and their habitat. However, NRF habitat continue to decline due to timber harvest on non-Federal lands in Oregon.

In California, there are five NSO-related HCPs currently in effect covering 2.6 million ac (1 million ha) of non-Federal lands. These HCPs still allow timber harvest but are designed to retain some nesting habitat and or connectivity over the next few decades. One HCP, with Sierra Pacific Industries, scientific collection of barred owls for research purposes, as well as studies of barred owl effects on spotted owls. There are two NSO-related SHAs in California. The primary intent of SHAs is to maintain or create potential NSO habitat. While timber harvest and habitat loss continue on lands covered by these agreements, the plans retain some NR habitat throughout the area or in strategic locations and provide habitat connectivity. Overall, HCPs, and SHAs in California provide some protection to NSO and their habitat. However, NRF habitat continue to decline due to timber harvest on non-Federal lands in California.

A.6.3.2. State Forest Practice Rules

The majority of NSO conservation is expected from Federal lands, but the Service's primary expectations for private lands are for their contributions to demographic support (pair or cluster protection) to Federal lands, or their connectivity with Federal lands. Timber harvest on State and private lands in Washington, Oregon, and California is regulated by each State's forest practice rules. The level of NSO conservation included in each State's regulations varies Each State's rules are described below.

A.6.3.2.1. Washington

The NSO was listed as endangered species in Washington State by the Washington Fish and Wildlife Commission in 1988 to prioritize conservation for the subspecies (WDFW 2017). Timber harvest on State and private lands in Washington is guided by a number of State laws and policies, except for Washington Department of Natural Resources (WDNR) lands that are covered by an HCP. The Washington State Environmental Policy Act (SEPA) requires analysis of environmental impacts and consideration of reasonable alternatives for actions proposed by the State. State timber harvest activities must also comply with the State Forest Practices Act (Chapter 76.09 RCW), which regulates all forest management activities in Washington. The management of State trust lands, specifically, is guided by the Forest Resource Plan, which was adopted by the Board of Natural Resources in 1992. Among other things, the policies of the Plan require the Washington DNR analyze and potentially modify the impacts of its activities on watersheds, wildlife habitat, special ecological features, wetlands, and other natural resources to maintain healthy forests for future generations.

In 1996, the State Forest Practices Board adopted rules (Washington Forest Practices Board 1996) that would contribute to conserving the NSO and its habitats on non-Federal lands. Adoption of the rules was based in part on recommendations from a Science Advisory Group that identified important non-Federal lands and recommended roles for those lands in NSO conservation (Hanson *et al.* 1993, Buchanan *et al.* 1994). The 1996 rule package was developed by a stakeholder policy group and then reviewed and approved by the Forest Practices Board (Buchanan and Swedeen 2005). The 1996 rules identified 10 landscapes, or Spotted Owl Special Emphasis Areas (SOSEAs) where owl protections on non-Federal lands would be emphasized. Protections provided under the State Environmental Policy Act for those portions of owl sites located beyond the boundaries of the SOSEAs were largely eliminated (Buchanan and Swedeen 2005). The overarching policy goal of the Washington Forest Practices Rules is to complement the conservation strategy on Federal lands, and so the SOSEAs are adjacent to Federal lands. The SOSEAs are designed to provide a larger landscape for demographic and dispersal support for NSO with the long-term goal of supporting a viable population of NSO in Washington.

The Forest Practices Rules for NSO can be described as containing three basic types of provisions: 1) regulations that apply outside SOSEAs, 2) a circle-based protection scheme for NSO sites inside SOSEAs (retain all suitable habitat within 0.7 mi (1 km) of site center and retain 40 percent of suitable habitat within 1.8 to 2.7 mi (2.9 to 4.3 km) radius of home range), and 3) landscape-level planning options for inside SOSEAs. To avoid disturbance of nesting NSO inside SOSEAs, the rules also include timing restrictions from March 1 to August 31 within 0.25 miles of a site center for several potentially disruptive activities (e.g., road construction). Forest practices rules outside the SOSEAs are designed to protect the immediate vicinity of NSO site centers during the nesting season (March 1 to August 31) by restricting harvest within the best 70 ac (28 ha) of habitat around the site center and requiring additional environmental analysis for permitting (of harvesting, road construction, or aerial application of pesticides), but outside the nesting season there are no owl-related protections outside SOSEAs that constrain harvest of suitable NSO habitat in NSO management circles (Buchanan and Swedeen 2005).

Within SOSEAs, the rules were intended to maintain the viability of each NSO site center by establishing that enough suitable habitat should be maintained to protect the viability of owls associated with each NSO site center, or to provide for the goals established in Spotted Owl Special Emphasis Areas. Due to extensive timber harvest activities in the decades leading up to listing of the NSO, most NSO management circles centered on non-Federal lands have far less habitat than the viability threshold identified (see below) when the rule went into effect. Because the rules do not include provisions for restoration of habitat to achieve the viability threshold at NSO sites these circles remain far below those thresholds. For individual site centers, the habitat considered necessary to maintain viability is as follows: (a) all suitable NSO habitat within 0.7 mi (1.1 km) of each NSO site center; (b) at least 5,863 ac (2,373 ha) of suitable NSO habitat within of 2.7 mi (4.3 km) of a site center in the Hoh-Clearwater Spotted Owl Special Emphasis Area on the western Olympic Peninsula, and (c) at least 2,605 ac (1,054 ha) of suitable NSO habitat within 1.8 mi (2.9 km) of a site center in all other Spotted Owl Special Emphasis Areas. At all sites within SOSEAs, any proposed harvest of suitable NSO habitat within a territorial owl circle (status 1, 2, or 3 in the Washington Department of Fish and Wildlife database) would be considered a "Class-IV special" and would trigger State Environmental Policy Act review; such activities would require a Class IV special forest practices permit and an environmental impact statement per the State Environmental Policy Act (Buchanan and Swedeen 2005).

The Forest Practices Board in Washington has a long-standing relationship with the Service and collaborates extensively on owl conservation. The Service provided extensive technical assistance in the development of the Board's existing owl rules. The Board was recognized in the Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011b) for its ongoing owl conservation efforts in Recovery Action 18 encouraged to continue to use its existing processes "to identify areas on non-Federal lands in Washington that can make strategic contributions to NSO conservation over time. The Service encourages timely completion of the Board's efforts and will be available to assist as necessary." The Board convened the Northern Spotted Owl Implementation Team (NSOIT) in 2010 to develop incentives for landowners to achieve conservation goals for NSO and to identify the temporal and spatial allocation of conservation efforts on non-Federal lands. A spatial modeling effort to prioritize private lands for NSO conservation was completed in late 2021, though the final modeling products are not yet available (Dunk *et al.* 2021). A programmatic SHA is in development, to be administered by WDNR. The NSOIT also conducted a pilot project testing different thinning prescriptions in NSO habitat but the project has since been discontinued. These efforts underway have evolved over years of collaboration and are designed to change the dynamic away from fear and resistance to partnership and participation. The Service has provided and is providing funding to support the work of the NSOIT. Overall, State forest practice rules in Washington provide some protection to NSO and their habitat. However, NRF habitat continue to decline due to timber harvest on non-Federal lands in Washington.

A.6.3.2.2. Oregon

The NSO is listed as a threatened species in Oregon (ODFW 2017). The Oregon Fish and Wildlife Commission's long-term goal for species listed as threatened or endangered under the Oregon Endangered Species Act is to manage the species and their habitats so that the status of the species improves to a point where listing is no longer necessary. Timber harvest on non-Federal lands in Oregon is guided by the Forest Practices Act and Forest Practices Rules (ODFW 2014). The Oregon Forest Practices Act restricts timber harvest within 70 ac (28 ha) core areas around sites occupied by an adult pair of NSO capable of breeding (as determined by recent protocol surveys), but it does not provide for protection of NSO habitat beyond these areas (ODFW 2014). In general, no large-scale NSO habitat protection strategy or mechanism currently exists for non-Federal lands in Oregon.

State forests in particular are managed to achieve "greatest permanent value," considering economics, environmental, and cultural goals. Each State Forest has a Forest Management Plan that seeks to implement these ideals. Ultimately, the State's goal is to produce timber revenue and to provide for a range of habitats across ownerships. Specific policies and procedures have been adopted on State lands to protect and conserve the NSO and its habitat. The State Forests Division has an extensive survey program across all districts as part of annual harvest planning (approximately $1.4 million spent in 2016) and conducts density surveys on two districts. Division policy directs districts to avoid any harvest activity on State lands which results in less than 40 percent suitable habitat within the provincial home range of an owl or pair (a 1.2 - 1.5-mi (1.9 - 2.4 km) radius circle centered on a nest site or activity center). Division policy also directs districts to avoid any harvest activity which results in less than 500 ac (202 ha) of suitable habitat within a 0.7-mi (1.1 km) radius (1000 ac (405 ha)) of a nest site or activity center.

In addition, 30 percent of Oregon State forests must be managed for the development of "complex forest structure" and late-seral tree species, which could provide some level of conservation benefit for a number of wildlife species of concern, including the NSO (IEc 2012). The locations of these managed lands are based in part on locations of NSO nest sites. Within these areas, a variety of treatments are employed to promote complex habitat and species diversity. Overall, State forest practice rules in Oregon provide some protection to NSO and their habitat. However, NRF habitat continue to decline due to timber harvest on non-Federal lands in Oregon.

A.6.3.3.3. California

The NSO was listed as an endangered species under the California Endangered Species Act (CESA) in early 2016 (CDFW 2017). The incidental take of state-listed species is prohibited under the California Code of Regulations 783-783.8 and the California Fish and Game Code 2080 (CDFW 2016). Forest management and forest practices on private lands in California, including harvesting for forest products or converting land to another use are regulated by the State under Division 4 of the Public Resources Code, and in accordance with the California Forest Practice Rules (CFPR)(California Code of Regulations, (CCR) Title 14, Sections 895-1115; CFPR)(CFPR 2017). The CFPR require surveys for NSO in NRF habitat and restrict timber harvest within 0.7–1.3 mi (1-2 km) of a NSO activity center. Under this framework, the California Department of Forestry and Fire Protection (CALFIRE) is the designated authority on forest management and forest practices on private lands in California.

All private land timber harvesting in California must be conducted in accordance with a site-specific Timber Harvest Plan (THP, for industrial timberlands) or Nonindustrial Timber Management Plan (NTMP, for non-industrial private timberland owners) that is submitted by the owner and is subject to administrative approval by the CALFIRE. The THP/NTMP must be prepared by a State-registered professional forester and must contain site-specific details on the quantity of timber involved, where and how it will be harvested, and the steps that will be taken to mitigate potential environmental damage. The THP/NTMP and CALFIRE's review process are recognized as the functional equivalent to the environmental review processes required under the California Environmental Quality Act of 1970 (CEQA). The CFPRs require surveys for NSO in suitable habitat and to provide protection around activity centers. Under the CFPRs, no THP or NTMP can be approved if it is likely to result in incidental take of Federally-listed species, unless the take is authorized by a Federal incidental take permit.

For private timber lands in California not covered by a HCP or SHA, the policy of the State with regard to the NSO and timber harvest can be characterized as one of "take avoidance," for which the Service (Arcata and Yreka Fish and Wildlife Offices) has recommended measures to avoid take of NSO, primarily through recommendations for habitat retention, timing of timber operations and survey procedures for NSO (described briefly below). The Director of CALFIRE is not authorized to approve any proposed THP or NTMP that would result in take of a Federally-listed species, including the NSO, unless that taking is authorized under a Federal Incidental Take Permit (review process is outlined in 14 CCR 919.9 and 919.10). This latter point creates an incentive for private landowners to enter into HCPs or SHAs, or to implement take avoidance measures recommended by the Service.

Prior to 2000, the California Department of Fish and Wildlife (then, California Department of Fish and Game; CDFW) reviewed THPs and NTMPs to ensure that take of NSO was not likely to occur. From about 2000 until 2010, the Service assumed this role and reviewed THPs and NTMPs (hundreds per year) for NSO "take avoidance." From 2010, the Service and CALFIRE shared duties for NSO take avoidance review of THPs and NTMPs. Beginning in 2014, the NSO was listed as a candidate species for potential listing under the California Endangered Species Act; consequently, in 2014, CDFW began reviewing a small number of THPs and NTMPs annually for NSO take avoidance. On August 25, 2016, the California Fish and Game Commission recommended that the NSO be added to the State list of threatened and endangered animals. Regarding timber harvest on private lands in California after 2016, the Service, CALFIRE and CDFW have not formally discussed how the agencies will share reviewing duties for NSO take avoidance associated with THPs and NTMPs, but recommended habitat retention standards (i.e., Attachments A and B) and survey recommendations remain in effect. California is currently engaged in discussions with the Service addressing NSO use of post-fire landscapes currently lacking in the California Forest Practice Rules.

For timber harvest activities that occur on non-Federal lands (excluding California State Parks and lands covered under an HCP) within CAL FIRE's Coast Forest District (generally, within the range of the coast redwood), the Service (Arcata Fish and Wildlife Office) provided to CAL FIRE and foresters a document titled, Northern Spotted Owl Take Avoidance Analysis and Guidance for California Coast Forest District ("Attachment A"), dated March 15, 2011. In general, recommended habitat retention guidelines around known active NSO activity centers in include: (1) delineation of a 100 ac (40 ha) "Core Area" comprised of "nesting/roosting" habitat (defined in Attachment A), in which timber harvest does not occur; (2) retention of at least an additional 100 ac (40 ha) of "nesting/roosting" habitat within 0.7 mi (1.1 km) of an activity center; and (3) retention of at least 300 ac (121 ha) of "foraging" habitat (defined in Attachment A) within 0.7 mi (1.1 km) of an activity center.

For timber harvest activities that occur on non-Federal lands within CAL FIRE's Interior Forest District, the Service (Arcata and Yreka Fish and Wildlife Offices) provided to CAL FIRE and foresters a document titled, Attachment B: Take Avoidance Analysis-Interior, dated February 27, 2008. In general, recommended habitat retention guidelines around known active NSO activity centers in include: (1) no harvest within 1,000 ft (305 m) of an activity center; (2) within 0.5 mi (0.8 km) radius (502 ac (203 ha) of an activity center, retention of four habitat types (as defined in Attachment B), including at least 100 ac (40 ha) "high quality nesting/roosting" habitat, 150 ac (61 ha) of "nesting/roosting" habitat, 100 ac (40 ha) of "foraging" habitat and 50 ac (20 ha) "low-quality foraging habitat"; and (3) between 0.5 mi (0.8 km) and 1.3 mi (2 km) radius circles on an activity center (2896 ac (1172 ha)), retention of greater than 935 ac (378 ha) of habitat, including at least 655 ac (265 ha) foraging habitat and at least 280 ac (113 ha) low-quality foraging habitat. Overall, State forest practice rules in California provide some protection to

NSO and their habitat. However, NRF habitat continue to decline due to timber harvest on non-Federal lands in California.

A.7. Recovery Actions to Address Barred Owls

The 2011 Revised Recovery Plan for the Northern Spotted Owl contains ten recovery actions specific to addressing the barred owl threat. These include the establishment of protocols to detect barred owls and document barred owl site status and reproduction (Recovery Action 24), the design and implementation of large-scale control experiments to assess effects of barred owl removal on NSO site occupancy, reproduction, and survival (Recovery Action 29), and the implementation of management strategies to reduce the effects of barred owls on NSO (Recovery Action 30). The manner in which this set of ten Recovery Actions is expected to contribute to NSO recovery is presented in Figure A-2.

Several barred owl recovery actions have been completed, including Recovery Action 29, the Barred Owl Removal Experiment (USDI FWS 2013a, USDI FWS 2013b). This experiment was developed based on a pilot project at Green Diamond Resources study area that demonstrated barred owl removal had rapid, positive effects on NSO survival and the rate of population change (Dugger *et al.* 2016). This experiment was implemented under the direction of US Geological Service, the Hoopa Tribe, and APHIS in partnership with the Service. The research program evaluated the effectiveness of barred owl removal as a potential recovery strategy for NSO on one study area in Washington, two study areas in Oregon, and one study area in northern California. Barred owl removal was implemented on the California study area in fall and winter 2013-2014, and on the Washington and one of the Oregon study areas in fall/winter 2015-2016. Barred owl removal on the final Oregon study area was initiated in fall of 2016. Removal occurred for four consecutive years at each study area, and the experiment is now complete, with removals leading to improvements in NSO apparent survival, recruitment, and rates of population change, as described above in the section describing threats related to barred owls. Separate barred owl removal experiments remain ongoing in several areas in California, including Hoopa and Yurok Tribal lands, and private lands owned by Sierra Pacific Industries and Green Diamond.

Given the positive outcomes of the removal experiment conducted for Recovery Action 29, the Service is developing a barred owl management strategy, and initiated the public review process in 2022 with a notice of intent to develop an Environmental Impact Statement (87 FR 43886). Under the BLM RMPs, the BLM will support barred owl management on their lands as informed by the outcome of the Barred Owl Removal Experiment. In the interim, the BLM is avoiding incidental take of NSO resulting from timber harvest on their lands. This support is intended to mitigate for the adverse effects associated with timber harvest and other resource programs, and result in a net positive impact on the recovery of NSO (USDI FWS 2016). The BLM and a number of other cooperating agencies are participating in the development of the barred owl management strategy. Once the strategy is developed, implementation of barred owl removal is likely to be a necessary condition for the long-term persistence of the NSO.

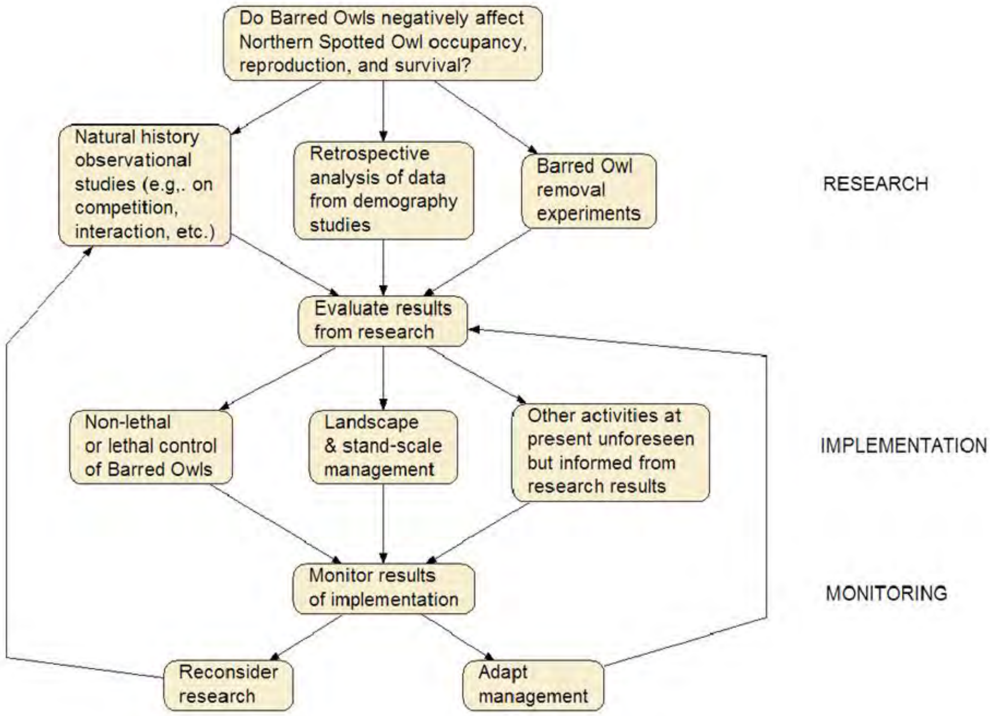

Figure A-2. Flowchart of barred owl Recovery Actions (USDI FWS 2011b).

A.7.1. Safe Harbor Agreements in Oregon for Barred Owl Experiment

There are four SHAs related to the Service's Barred Owl Removal Experiment in Oregon. The SHAs were limited to areas managed by landowners that were willing to work with the Service to provide access for survey and removal of barred owls on their lands within the study areas. Agreements were established with Roseburg Resources Company, Oxbow I LLC, Weyerhaeuser Company, and Oregon Department of Forestry to facilitate successful completion of this research project. The Barred Owl Removal Experiment implemented Recovery Action 29 of the 2011 Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011b). The Barred Owl Removal Experiment was implemented on two study areas in Oregon, one in the Oregon Coast Ranges west of Eugene, Oregon, and one in the forest lands around Canyonville, Oregon.

While the experiment focused on Federal lands, the landscapes involved in the study areas included significant interspersed private and state lands. In the Oregon Coast Ranges study area, this included lands owned by Roseburg Resources Company and Oxbow Timber I, LLC SHA covers 9,400 ac (3,804 ha) of land total, 308 ac (125 ha) of currently unoccupied NSO habitat for which an incidental take permit was issued; Weyerhaeuser Company SHA covers 1,072 ac (434 ha) total, 817 ac (331 ha) of currently unoccupied NSO habitat for which an incidental take permit was issued, and lands managed by Oregon Department of Forestry (SHA covers 20,000 ac (8,093 ha) total, 3,345 ac (1,354 ha) of currently unoccupied NSO habitat for which an incidental take permit was issued). In the Union/Myrtle (Klamath) study area in southern Oregon, this includes lands owned by Roseburg Resources Company (SHA covers 45,100 ac

(18,251 ha) of land total, 7,080 ac (2865 ha) of currently unoccupied NSO habitat for which an incidental take permit was issued). Access to these non-Federal lands enabled the effective and efficient completion of the experiment.

Through these four SHAs, Roseburg Resources Company, Oxbow I LLC, Weyerhaeuser Company, and Oregon Department of Forestry contributed to the conservation of the NSO by allowing the researchers to survey for barred owls on their lands throughout the Study Area and remove barred owls from their lands within the removal portion of the experiment. The section 10 permit issued to them as part of the SHA provides these landowners with short-term incidental take authorization through habitat modification for NSO that may return to non-baseline NSO sites (unoccupied by resident NSO for the three years prior to the initiation of removal on the area) after the removal of barred owls. However, this information and access was crucial to efficient and effective implementation of this experiment. Information from this experiment is critical to the development of a long-term management strategy to address the barred owl threat to the NSO.

A.8. Rangewide Environmental Baseline

The environmental baseline of the species incorporates the effects of all past human activities and natural events that led to the present-day status of the species and its habitat, including all previously consulted on effects (USDI FWS and USDC NMFS 1998).

A.8.1. Habitat Trends

The current habitat trends include some interim information about the large scale 2020 wildfires on Federal lands, but do not include all of the habitat changes resulting from these wildfires. We are still assessing the impacts of the 2020 fires. Interim numbers from the BLM and USFS in Oregon were used for this analysis.

The Service has used information provided by the USFS, BLM, and National Park Service to update the habitat baseline conditions by tracking relative habitat changes over time on Federal lands for NSO on several occasions, since the NSO was listed in 1990 (USFS and BLM 1994b, USDI FWS 2001, Lint 2005, Davis *et al.* 2011, Davis *et al.* 2016, Davis *et al.* 2022a). These NWFP monitoring reports assess the status and trends of NSO habitat across 22.1 million acres of federally administered forest lands in addition to 23.8 million acres of non-Federal forest lands within the range in the United States. The estimate of 7.4 million acres used for the NWFP in 1994 (USFS and BLM 1994b) was believed to be representative of the general amount of NSO habitat on NWFP lands at that time. These periodic rangewide evaluations of NSO habitat (Lint 2005, Davis *et al.* 2011, Davis *et al.* 2016) are used to determine if the rate of change to NSO habitat has been consistent with changes in amount of habitat anticipated under the NWFP and described in the Final Supplemental Environmental Impact Statement (FSEIS; USFS and USDI FWS 1994b).

Each analysis has used more up-to-date and higher quality data than the previous analyses and new analytical methods have been incorporated over time. While this improved the overall quality of the information provided, it also means that individual reports should not be compared directly without fully understanding the processes used to develop the results.

Trends for suitable habitat are largely declining rangewide, with rates of loss varying by province and land allocation. Approximately 8,890,500 acres of NSO NR habitat existed on Federal lands and 3,476,500 acres existed on non-Federal lands in 1993, prior to the implementation of the NWFP (Davis *et al.* 2022a). Twenty-five years into the NWFP, Davis *et al.* (2022a) reported a gross loss of about 2,953,900 acres of NR habitat, representing about 23.7 percent of what was present in 1993. Of the total 2.9 million acres gross loss of NR habitat between 1993 and 2017 on all Federal and non-Federal lands in the range of the NSO, 70 percent (2.1 million acres) were lost to timber harvest (Davis *et al.* 2022a). In fact, the majority of all losses (2,055,700 acres, or 61 percent) were due to timber harvest on private lands (Davis *et al.* 2022a). The majority of NR habitat loss on non-Federal lands was attributed to timber harvest (95 percent, or about 1.8 million acres), compared to only about 25 percent (or 257,700 acres) of the habitat loss on Federal lands. Losses of NR habitat on Federal lands made up approximately 36 percent (1,045,100 acres) of all losses, and were mostly due to wildfire (703,700 acres across all Federal lands), and mostly in reserved land allocations (726,200 acres across all causes) (Davis *et al.* 2022a).

Substantial recruitment of NR habitat occurred between 1993 and 2017 (Davis *et al.* 2022a). Across all lands, there was a 2.1 percent increase in NR habitat between 1993 and 2017. Gains were steepest on non-reserved Federal lands, but a small net increase also occurred in Federal reserves. Habitat recruitment on non-Federal lands nearly balanced losses. The largest net gains occurred in the Oregon and California Coast Ranges, with smaller net gains in the California and Oregon Klamath provinces (Davis *et al.* 2022a). However, large habitat losses have occurred since 2017, most notably during the 2020 fire season. Annual updates of the rangewide NR habitat map are now available (Davis *et al.* 2022b). Gross habitat losses occurred in every province, ranging from 2.1 percent in the Olympic province to 21.8 percent in the California Klamath province, with a total loss of 10.5 percent across the range. These losses obliterated the net gains reported between 1993 and 2017, resulting in net losses of 8.6 percent rangewide. However, net gains persisted in the California and Oregon Coast Range. These maps do not account for habitat recruitment occurring since 2017, and therefore may overestimate net habitat loss. Regardless of the net effect, gross losses of 10.5 percent in only 5 years from 2017 to 2022 undoubtedly represents an acceleration of habitat loss, as compared with gross losses of 23.7 percent over 25 years from 1993 to 2017.

Although the spatial resolution of this rangewide habitat map currently makes it unsuitable for tracking habitat effects at the scale of individual projects, the Service has evaluated the map for use in tracking provincial and rangewide habitat trends and now considers these data as the best available information on the distribution and abundance of extant NSO habitat within its range. The Service also considers habitat effects that are documented through the section 7 consultation process since 1994. The analytical framework of these consultations focuses on the reserve and connectivity goals established by the NWFP land-use allocations (USFS and BLM 1994a), with effects expressed in terms of changes in suitable NSO habitat within those land-use allocations. In February 2013, the Service adopted the 2006/07 satellite imagery data on NSO habitat as the new rangewide habitat baseline for Federal lands, effectively resetting the timeframe for establishing changes in the distribution and abundance of NSO habitat.

These data were refreshed in May of 2017 to reflect the 2012 remotely-sensed layer utilized in Davis *et al.* (2016). Currently, the assessment of local, provincial and rangewide NSO habitat status in this and future Opinions as well as Biological Assessments will rely on these habitat data associated with 2012 imagery to characterize changes in the status of NSO habitat. We are currently developing new methods for combining consultation information with the rangewide habitat map, but at present, we are continuing to use the 2012 baseline along with our documentation of consulted-on acres of habitat modification that have occurred since 2012. We supplement this with information derived from recently-updated habitat maps (see below).

A.8.2. Service's Consultation Database

To update information considered in 2001 (USDI FWS 2001), the Service designed the Consultation Effects Tracking System database in 2002, which recorded impacts to NSO and their habitat at different spatial and temporal scales. In 2011, the Service replaced the Consultation Effects Tracking System with the Consulted on Effects Database located in the Service's Environmental Conservation Online System (ECOS). The ECOS Database corrected technical issues with the Consultation Effects Tracking System. Data are currently entered into the ECOS Database under various categories including; land management agency, land-use allocation, physiographic province, and type of habitat affected.

A.8.2.1. Rangewide Consultation Effects: 1994 to August 25, 2022

Between 1994 and August 25, 2022, the Service has consulted on the proposed removal or downgrade of approximately 330,865 acres of Federal NR habitats (Table A-1) or about 3.6 percent of the 9.09 million acres of NSO NR habitat estimated by Davis *et al.* (2016) to have occurred on Federal lands in 1994. These changes in suitable NSO habitat are consistent with the expectations for implementation of the NWFP, which anticipated a rate of habitat harvested at 2.5 percent per decade (USFS and BLM 1994a).

The Service also tracks habitat changes on non-NWFP lands through consultations including long-term Habitat Conservation Plans, Safe Harbor Agreements, or Tribal Forest Management Plans. Consultations conducted since 1994 have documented the eventual combined reduction of about 525,560 acres of habitat on non-NWFP lands (Table A-1). Most of the losses on non-NWFP lands have yet to be realized because they are part of long-term management plans.

In 2017, the Service updated the NR habitat baseline which impacts are evaluated against, based on the 2012 habitat layer documented in Davis *et al.* (2016) which is the most current evaluation of NSO habitat. The acre values for the Service's 2012 baseline in Table A-2 varies slightly from the acre values in Davis *et al.* (2016), with the total acre variation being 0.09 percent. Davis *et al.* (2016) rounded to the nearest 100 acres, but this does not explain all the variation. In 2016, the BLM in Oregon changed their land use allocations. Therefore, the 2012 base habitat layer was divided by different land use allocations representing reserves and non-reserved lands than was used to produce Davis *et al.* (2016).

Due to raster data (2012 habitat layer) overlaid on polygons (land use allocations representing reserves and non-reserved lands) there is some error in the identification of acres. The use of a different polygon layer, than used for the Davis *et al.* (2016) land use allocations, resulted in different physiographic province reserves and non-reserved lands habitat acres. The combination of errors is extremely small and is still the best available information to use. This highlights that this data is to be used at a landscape level and may not be appropriate at the finer local scale. Since 2012, the acres reported as removed/downgraded are summarized by origin and by province (Table A-2).

Table A-2. Range-wide summary of effects to northern spotted owl nesting and roosting habitat[1] (acres) documented through Act section 7 consultations or technical assistance reports.

Land Ownership	Consulted On Habitat Changes[2]		Other Habitat Changes[3]	
	Removed/ Downgraded	Maintained/ Improved	Removed/ Downgraded	Maintained/ Improved
USFS, BLM, and NPS	330,865	687,106	739,191	169,921
Bureau of Indian Affairs / Tribes	116,446	28,893	3,954	0
Habitat Conservation Plans/Safe Harbor Agreements	340,301	14,545	0	0
Other Federal, State, County, Private Lands	68,813	28,447	3,822	0
Total Changes	**856,425**	**758,991**	**746,967**	**169,921**

1. NSO suitable habitat includes NR habitat, and foraging habitat. NR habitat supports all life-history functions for spotted owls including foraging, and is sometimes referred to as NRF. Foraging-only habitat is a separate category that can include more open and fragmented forests and does not provide structures for NR. Habitat effects summarized in this table are all classified as impacts to NR habitats. Impacts to foraging-only habitat are tracked separately.

2. Includes effects documented through Act section 7 consultations for the period from 1994 to 6/26/2001 (USDI FWS 2001) and all subsequent effects reported in the USFWS Tracking and Integrated Logging System - Northern Spotted Owl Consultation Effects Database (web application and database).

3. Includes effects to NSO NR habitat documented through technical assistance reports resulting from wildfires and other natural causes, private timber harvest, and/or land exchanges not associated with Act section 7 consultations.

Table A-3. Summary of northern spotted owl nesting or roosting[1] habitat (acres) removed or downgraded as documented through Act section 7 consultations on Federal lands. Environmental baseline and summary of effects by state, province, and land use function from 2012 to present.

State	Physiographic Province[2]	Evaluation Baseline (2012)[3]			Nesting/Roosting Habitat Removed/Downgraded[4]							% Provincial Baseline Affected	% Range-wide Effects
					Land Management Effects			Habitat Loss from Natural Events					
		NR Acres in Reserves	NR Acres in Non-Reserves	Total NR Acres	Reserves[5]	Non-Reserves[6]	Total	Reserves	Non-Reserves	Total	Total NR removed/ downgraded		
WA	Eastern Cascades	554,786	224,876	779,662	2,504	55	2,559	123,967	0	123,967	126,526	16.23	21.37
	Olympic Peninsula	714,555	23,084	737,639	1	0	1	0	0	0	1	0.00	0.00
	Western Cascades	957,314	212,325	1,169,639	15	188	203	4,320	0	4,320	4,523	0.39	0.76
	Western Lowlands	12,964	3	12,967	0	0	0	0	0	0	0	0.00	0.00
OR	Cascades East	206,719	133,080	339,799	1,251	8,808	10,059	3,305	1,981	5,286	15,345	4.52	2.59
	Cascades West	1,425,026	949,045	2,374,071	4,569	11,250	15,819	25,804	78,979	104,783	120,602	5.08	20.37
	Coast Range	468,575	38,898	507,473	2,594	2,177	4,771	0	0	0	4,771	0.94	0.81
	Klamath Mountains	706,840	227,726	934,566	9,462	80,958	90,420	47,891	44,880	92,771	183,191	19.60	30.94
	Willamette Valley	3,688	3,938	7,626	0	0	0	0	28,438	28,438	28,438	372.91	4.80
CA	Cascades	120,067	89,316	209,383	0	174	174	0	0	0	174	0.08	0.03
	Coast	113,857	9,999	123,856	0	0	0	0	3,073	3,073	3,073	2.48	0.52
	Klamath	1,143,050	622,027	1,765,077	387	727	1,114	33,333	70,967	104,300	105,414	5.97	17.80
	Total	**6,427,441**	**2,534,317**	**8,961,758**	**20,783**	**104,337**	**125,120**	**238,620**	**228,318**	**466,938**	**592,058**	**6.61**	**99.99**

1. Northern spotted owl suitable habitat includes NR habitat, and foraging habitat. Nesting/roosting habitat supports all life-history functions for spotted owls including foraging, and is sometimes referred to as nesting, roosting, and foraging habitat (NRF). Foraging-only habitat is a separate category that can include more open and fragmented forests, and does not provide structures for NR. Habitat effects summarized in this table are all classified as impacts to NR habitat. Impacts to foraging-only habitat are tracked separately.

2. Defined in the Revised Recovery Plan for the Northern Spotted Owl (USFWS 2011) as Recovery Units as depicted on page A-3.

3. Spotted owl NR (NR) habitat on Federal lands (includes USFS, BLM, NPS, DoD, USFWS) based on GIS data developed for the Northwest Forest Plan 20-year monitoring report for NSO habitat as reported by Davis *et al.* 2016 (PNW-GTR-929). Nesting/roosting habitat acres are approximate values based on 2012 satellite imagery. Values reported here may vary slightly from values reported in PNW-GTR-929.

4. Estimated NR habitat removed or downgraded from land management (e.g., timber sales) or natural events (e.g., wildfires) as documented through section 7 consultation or technical assistance. Effects reported here include acres removed or downgraded from 2012 to present.

5. Reserve land use allocations intended to provide spotted owl demographic support include Late-Successional Reserves identified in the Northwest Forest Plan on National Forests, designated Wilderness, and other Congressionally-reserved lands. Reserves on BLM lands in western Oregon managed under the 2016 revised Land and Resource Management Plans include Late-Successional Reserves, Congressionally-reserved lands, National Landscape Conservation System lands, and some District Designated Reserves (e.g., Areas of Critical Environmental Concern).

6. Non-reserve lands intended to provide spotted owl dispersal connectivity between reserves include USFS and BLM designations for timber production (matrix and harvest land base designations), Adaptive Management Areas, and other non-reserved land use designations.

Recently, the Service modified the database input to account for effects to the habitats that could be used as foraging, but that lack the age or structural characteristics of habitats used for nesting and roosting. This distinction may not be made in all consultations. These data represent effects as reported in individual consultations and likely do not represent the entirety of impacts to foraging habitat within critical habitat since 2012. For many projects, affected foraging likely is captured within the "NR" acres as foraging habitat was lumped into "nesting/roosting/foraging habitat" at the time of consultation. Table A-3 summarizes the acres of foraging habitat removed or downgraded.

More recent data are now available regarding the amount of habitat currently present throughout the range. The most recent NWFP effectiveness monitoring review (Davis *et al.* 2022a) summarizes the amount of habitat present in 2017, and describes changes between 1993 and 2017 due to harvest, wildfire, other natural disturbances, and ingrowth. The NWFP effectiveness monitoring program is now able to provide annual updates to the rangewide habitat map (e.g., Davis *et al.* 2022b), which account for habitat losses but not habitat recruitment. These maps do not provide all information needed to describe the habitat baseline for section 7 consultations. Notably, consulted-on effects are a crucial part of the baseline, whether these effects have already occurred or are anticipated to occur in the future. These maps lack information about habitat removals that have already undergone section 7 consultation, but have not yet been carried out. These maps also do not include information regarding the effects of fires or other habitat losses that have occurred since the maps were produced. However, they do provide important context to understand the rangewide habitat baseline, especially because these maps measure effects of fire and already-implemented timber harvest in a repeatable, consistent way, unlike the ad hoc methods described above and reflected in tables A-1 through A-3. Tables A-4 and A-5 display information derived from 2017 and 2022 habitat maps, for Federal and non-Federal lands respectively (Davis *et al.* 2022a, Davis *et al.* 2022b). Note that the 2022 figures reflect the effects of fires that occurred during (and prior to) the 2021 fire season, but do not reflect the 2022 fire season.

The 2022 fire season included multiple large fires burning in the California Coast Range and California Klamath, Oregon Klamath and Oregon Western Cascades, and Washington Western and Eastern Cascades. Most notably, the Cedar Creek fire has, as of October 25, 2022, burned a total of 127,283 acres (including all NSO habitat categories and non-habitat) of the Willamette National Forest, mostly within the Oregon Western Cascades but also extending across the crest of the Cascades. Other notable fires include the McKinney fire, which burned a total of 60,138 acres, and the Six Rivers Lightning Complex, which burned a total of 41,600 acres, both in the California Klamath province; the Rum Creek fire, which burned a total of 21,347 acres in the Oregon Klamath province; the Pasayten Complex, which burned a total of 17,998 acres, and the White River and adjacent Irving Peak fires, which together burned a total of 14,412 acres, all in the Washington Eastern Cascades province; and the Bolt Creek fire, which burned a total of 11,511 acres in the Washington Western Cascades province. Estimates of habitat loss from these fires are likely to be available in early 2023.

Table A-4. Summary of northern spotted owl foraging habitat[1] (acres) removed or downgraded as documented through Act section 7 consultations on Federal lands. Summary of effects by state, province, and land use function from 2012 to present.

State	Physiographic Province2	Foraging Habitat Removed/Downgraded3						
		Land Management Effects			Habitat Loss from Natural Events			
		Reserves4	Non-Reserves5	Total	Reserves	Non-Reserves	Total	Total Foraging Habitat removed/ downgraded
WA	Eastern Cascades	0	0	0	0	0	0	0
	Olympic Peninsula	0	0	0	0	0	0	0
	Western Cascades	0	10	10	0	0	0	10
	Western Lowlands	0	0	0	0	0	0	0
OR	Cascades East	124	2,738	2,862	0	124	124	2,986
	Cascades West	263	1,746	2,009	0	0	0	2,009
	Coast Range	24	2,050	2,074	0	0	0	2,074
	Klamath Mountains	242	6,867	7,109	0	0	0	7,109
	Willamette Valley	0	0	0	0	0	0	0
CA	Cascades	571	248	819	0	0	0	819
	Coast	0	1	1	0	8,036	8,036	8,037
	Klamath	1,454	655	2,109	15,521	16,122	31,643	33,752
	Total	2,678	14,315	16,993	15,521	24,282	39,803	56,796

1. Northern spotted owl suitable habitat includes NR habitat, and foraging habitat. Nesting/roosting habitat supports all life-history functions for NSO including foraging, and is sometimes referred to as nesting, roosting, and foraging habitat (NRF). Foraging-only habitat is a separate category that can include more open and fragmented forests and does not provide structures for NR. Habitat effects summarized in this table are all classified as impacts to NR habitat. Impacts to foraging-only habitat are tracked separately.
2. Defined in the Revised Recovery Plan for the Northern Spotted Owl (USDI FWS 2011) as Recovery Units as depicted on page A-3.
3. Northern spotted owl NR (NR) habitat on Federal lands (includes USFS, BLM, NPS, DoD, USDI FWS) based on GIS data developed for the Northwest Forest Plan 20-year monitoring report for NSO habitat as reported by Davis *et al.* 2016 (PNW-GTR-929). Nesting/roosting habitat acres are approximate values based on 2012 satellite imagery. Values reported here may vary slightly from values reported in PNW-GTR-929. Estimated NR habitat removed or downgraded from land management (e.g., timber sales) or natural events (e.g., wildfires) as documented through section 7 consultation or technical assistance. Effects reported here include acres removed or downgraded from 2012 to present.
4. Reserve land use allocations intended to provide NSO demographic support include Late-Successional Reserves identified in the Northwest Forest Plan on National Forests, designated Wilderness, and other Congressionally-reserved lands. Reserves on BLM lands in western Oregon managed under the 2016 revised Land and Resource Management Plans include Late-Successional Reserves, Congressionally-reserved lands, National Landscape Conservation System lands, and some District Designated Reserves (e.g., Areas of Critical Environmental Concern).
5. Non-reserve lands intended to provide NSO dispersal connectivity between reserves include USFS and BLM designations for timber production (matrix and harvest land base designations), Adaptive Management Areas, and other non-reserved land use designations.

Table A-5. Changes in northern spotted owl nesting/roosting habitat over time, Federal lands.

	Nesting/Roosting forest area estimates from bookend maps			Explanation for losses, 1993-2017[2]						Total Changes Over Time			
State and physiographic province	1993	2017[3]	2022[4]	Harvest	Wildfire	Insect	Other	Total explained loss 1993-2017	Estimated habitat ingrowth 1993-2017[5]	Net area change 1993-2017	Estimated area change 2017-2022	Net percent change 1993-2017	Estimated percent change 2017-2022
	Thousand acres											*Percent*	
Washington:													
Olympic Peninsula	719.0	732.3	723.8	3.6	3.4	0.3	6.7	14.1	27.4	13.3	-8.5	1.9	-1.2
Western Lowlands	12.3	10.9	10.3	1.8	0.0	0.0	0.0	1.8	0.4	-1.4	-0.6	-11.1	-5.7
Western Cascades	1,382.4	1,380.2	1,353.0	14.9	5.8	1.8	10.2	32.7	30.5	-2.2	-27.2	-0.2	-2.0
Eastern Cascades	730.4	673.5	549.0	31.3	75.2	22.7	7.4	136.7	79.8	-56.9	-124.5	-7.8	-18.5
Total	*2,844.1*	*2,797.0*	*2,636.1*	*51.6*	*84.4*	*24.9*	*24.2*	*185.2*	*138.1*	*-47.1*	*-160.9*	*-1.7*	*-5.8*
Oregon:													

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[2] Explanations for losses are not available for 2022 habitat estimates

[3] All 1993 and 2017 figures from Davis *et al.* 2022a, Table A1, except as noted

[4] All 2022 figures calculated from Davis *et al.* 2022b. These figures do not account for habitat recruitment since 2017, or for the 2022 fire season.

[5] Calculated by subtracting 1993 bookend estimate from the sum of the 2017 bookend estimate and the total explained loss

	Nesting/Roosting forest area estimates from bookend maps			Explanation for losses, 1993-2017[2]						Total Changes Over Time			
State and physiographic province	**1993**	**2017[3]**	**2022[4]**	**Harvest**	**Wildfire**	**Insect**	**Other**	**Total explained loss 1993-2017**	**Estimated habitat ingrowth 1993-2017[5]**	**Net area change 1993-2017**	**Estimated area change 2017-2022**	**Net percent change 1993-2017**	**Estimated percent change 2017-2022**
Coast Range	413.6	559.4	562.2	22.9	0.2	0.0	0.1	23.3	169.1	145.8	2.8	35.3	0.5
Willamette Valley	6.2	8.8	8.7	0.5	0.0	0.0	0.0	0.5	3.1	2.6	-0.1	42.0	-0.8
Western Cascades	2,251.2	2,333.7	2,074.2	68.5	68.0	2.1	3.3	141.8	224.3	82.5	-259.5	3.7	-11.1
Klamath	1,087.6	1,121.6	998.3	40.3	178.6	0.3	1.4	220.6	254.6	34.0	-123.3	3.1	-11.0
Eastern Cascades	283.9	288.9	270.6	19.6	20.0	2.7	1.0	43.4	48.4	5.0	-18.3	1.7	-6.3
Total	*4,042.5*	*4,312.3*	*3,914.0*	*151.9*	*266.8*	*5.1*	*5.8*	*429.6*	*699.4*	*269.8*	*-398.3*	*6.7*	*-9.2*
California:													
Coast Range	106.8	128.5	126.0	2.6	7.7	0.0	0.3	10.6	32.3	21.7	-2.5	20.3	-1.9
Klamath	1,722.9	1,727.2	1,306.6	40.6	329.3	7.5	14.9	392.4	396.7	4.3	-420.6	0.2	-24.4
Cascades	174.2	190.7	170.4	11.0	15.5	0.8	0.1	27.4	43.9	16.5	-20.3	9.4	-10.7
Total	*2,003.9*	*2,046.4*	*1,603.0*	*54.2*	*352.5*	*8.3*	*15.3*	*430.3*	*472.8*	*42.4*	*-443.4*	*2.1*	*-21.7*
NWFP total	**8,890.5**	**9,155.7**	**8,153.0**	**257.7**	**703.7**	**38.3**	**45.3**	**1,045.1**	**1,310.3**	**265.1**	**-1,002.7**	**3.0**	**-11.0**

Table A-6. Changes in northern spotted owl nesting/roosting habitat over time, non-Federal lands.

	Nesting/roosting forest area estimates from bookend maps			Explanation for losses, 1993-2017[1]						Total Changes Over Time			
State and physiographic province	1993	2017[2]	2022[3]	Harvest	Wildfire	Insect	Other	Total explained loss 1993-2017	Estimated habitat ingrowth 1993-2017[4]	Net area change 1993-2017	Estimated area change 2017-2022	Net percent change 1993-2017	Estimated percent change 2017-2022
	Thousand acres											*Percent*	
Washington:													
Olympic Peninsula	151.7	137.7	127.7	74.2	0	0.5	0.1	74.8	60.8	-14.0	-10.0	-9.2	-7.2
Western Lowlands	222.4	135	122.4	152.8	0	0.3	0	153.1	65.7	-87.4	-12.6	-39.3	-9.3
Western Cascades	407.2	272.8	259.7	164.5	0.4	0.3	0	165.2	30.8	-134.4	-13.1	-33.0	-4.8
Eastern Cascades	285.7	219.2	197.3	122.9	13.9	5.5	0.1	142.4	75.9	-66.5	-21.9	-23.3	-10.0
Total	*1,067.0*	*764.7*	*707.2*	*514.4*	*14.4*	*6.5*	*0.2*	*535.5*	*233.2*	*-302.3*	*-57.5*	*-28.3*	*-7.5*
Oregon:													
Coast Range	277.9	325.2	285.9	264.8	0.3	0.4	0	265.5	312.8	47.3	-39.3	17.0	-12.1
Willamette Valley	82.7	76.8	68.5	48.8	0	0.1	0	48.9	43.0	-5.9	-8.3	-7.1	-10.8

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[1] Explanations for losses are not available for 2022 habitat estimates

[2] All 1993 and 2017 figures from Davis *et al.* 2022a, Table A3, except as noted

[3] All 2022 figures calculated from Davis *et al.* 2022b. These figures do not account for habitat recruitment since 2017, or for the 2022 fire season.

[4] Calculated by subtracting 1993 bookend estimate from the sum of the 2017 bookend estimate and the total explained loss

	Nesting/roosting forest area estimates from bookend maps			Explanation for losses, 1993-2017[1]						Total Changes Over Time			
State and physiographic province	**1993**	**2017[2]**	**2022[3]**	**Harvest**	**Wildfire**	**Insect**	**Other**	**Total explained loss 1993-2017**	**Estimated habitat ingrowth 1993-2017[4]**	**Net area change 1993-2017**	**Estimated area change 2017-2022**	**Net percent change 1993-2017**	**Estimated percent change 2017-2022**
	Thousand acres											*Percent*	
Western Cascades	448.7	295.4	214.4	339.4	2.2	0.5	0	342.1	188.8	-153.3	-81.0	-34.2	-27.4
Klamath	340.3	365	320.8	188.7	13.7	0.4	0.1	202.9	227.6	24.7	-44.2	7.3	-12.1
Eastern Cascades	98.4	68.9	55.0	46.9	9.5	0.7	0.1	57.2	27.7	-29.5	-13.9	-30.0	-20.2
Total	*1,248.0*	*1,131.2*	*944.6*	*888.6*	*25.6*	*2*	*0.3*	*916.5*	*799.7*	*-116.8*	*-186.6*	*-9.4*	*-16.5*
California:													
Coast Range	681.6	1050.6	1026.7	232	9	0.1	0	241.1	610.1	369.0	-23.9	54.1	-2.3
Klamath	315.6	381.6	342.7	87.5	23.3	0.6	0.1	111.5	177.5	66.0	-38.9	20.9	-10.2
Cascades	164.4	143.6	129.1	75.4	9.8	1	0	86.2	65.4	-20.8	-14.5	-12.7	-10.1
Total	*1,161.5*	*1,575.8*	*1,498.5*	*395*	*42*	*1.8*	*0.1*	*438.9*	*853.2*	*414.3*	*-77.3*	*35.7*	*-4.9*
NWFP total	**3,476.5**	**3,471.8**	**3,150.3**	**1,797.9**	**82**	**10.3**	**0.6**	**1,890.8**	**1,886.1**	**-4.7**	**-321.5**	**-0.1**	**-9.3**

A.8.3. Other Past Habitat Trend Assessments

In 2005, the Washington Department of Wildlife released the report, "An Assessment of Spotted Owl Habitat on Non-Federal Lands in Washington between 1996 and 2004" (Pierce *et al.* 2005). This study estimates the amount of NSO habitat in 2004 on lands affected by state and private forest practices. The study area is a subset of the total Washington forest practice lands, and statistically-based estimates of existing habitat and habitat loss due to fire and timber harvest are provided. In the 3.2 million acre study area, Pierce *et al.* (2005) estimated there were 816,000 acres of suitable NSO habitat in 2004, or about 25 percent of their study area. Based on their results, Pierce *et al.* (2005) estimated there were less than 2.8 million acres of NSO habitat in Washington on all ownerships in 2004. Most of the suitable owl habitat in 2004 (56 percent) occurred on Federal lands, and lesser amounts were present on state and local lands (21 percent), private lands (22 percent) and tribal lands (1 percent). Most of the harvested NSO habitat was on private (77 percent) and state-local (15 percent) lands.

A total of 172,000 acres of timber harvest occurred in the 3.2 million acre study area, including harvest of 56,400 acres of suitable NSO habitat. This represented a loss of about 6 percent of the owl habitat in the study area distributed across all ownerships (Pierce *et al.* 2005). Approximately 77 percent of the harvested habitat occurred on private lands and about 15 percent occurred on State lands. Pierce and others (2005) also evaluated suitable habitat levels in 450 NSO management circles (based on the provincial annual median NSO home range). Across their study area, they found that owl circles averaged about 26 percent suitable habitat in the circle across all landscapes. Values in the study ranged from an average of 7 percent in southwest Washington to an average of 31 percent in the east Cascades, suggesting that many owl territories in Washington are significantly below the 40 percent suitable habitat threshold used by the State as a viability indicator for NSO territories (Pierce *et al.* 2005).

Moeur *et al.* (2005) estimated an increase of approximately 1.25 to 1.5 million acres of medium and large older forest (greater than 20 inches dbh, single and multi-storied canopies) on Federal lands in the NWFP area between 1994 and 2003. The increase occurred primarily in the lower end of the diameter range for older forest. In the greater than 30-inch dbh size class, the net area increased by only an estimated 102,000 to 127,000 acres (Moeur *et al.* 2005). The estimates were based on change-detection layers for losses due to harvest and fire and re-measured inventory plot data for increases due to ingrowth. Transition into and out of medium and large older forest over the 10-year period was extrapolated from inventory plot data on a subpopulation of Forest Service land types and applied to all Federal lands. Because size class and general canopy layer descriptions do not necessarily account for the complex forest structure often associated with NSO habitat, the significance of these acres to NSO conservation remains unknown.

A.9. Population Trends

There are no estimates of the historical population size and distribution of NSO, although they are believed to have inhabited most old-growth forests throughout the Pacific Northwest prior to modern settlement (mid-1800s), including northwestern California (USDI FWS 1989).

The current range of the NSO extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California, as far south as Marin County (USDI FWS 1990a). The range of the NSO is partitioned into 12 physiographic provinces (Figure A-1) based on recognized landscape subdivisions exhibiting different physical and environmental features (USDI FWS 1992a). The NSO has become rare in certain areas, such as British Columbia, southwestern Washington, and the northern coastal ranges of Oregon.

Because the existing survey coverage and effort are insufficient to produce reliable rangewide estimates of population size, demographic data are used to evaluate trends in NSO populations. Analysis of demographic data can provide an estimate of the finite rate of population change (λ), which provides information on the direction and magnitude of population change. A λ of 1.0 indicates a stationary population, meaning the population is neither increasing nor decreasing. A λ of less than 1.0 indicates a decreasing population, and a λ of greater than 1.0 indicates a growing population. Demographic data, derived from studies initiated as early as 1985, have been analyzed periodically to estimate trends in the populations of the NSO (Anderson and Burnham 1992, Burnham *et al.* 1994, Forsman *et al.* 1996, Anthony *et al.* 2006, Forsman *et al.* 2011, Dugger *et al.* 2016, Franklin *et al.* 2021).

The most recent meta-analysis (Franklin *et al.* 2021) found continued declines in virtually all demographic parameters evaluated (Table A-5). Estimates of annual rates of population change, occupancy rates, and realized population change showed continuing declines across the range, and the annual rate of decline has increased in most areas, including southern Oregon and northern California. Populations in all study areas are declining, including those study areas that had been relatively stable in earlier analyses (Franklin *et al.* 2021). Notably, the rate of realized population change for NSO in demographic study areas in Washington, as well as the Coast Range and Klamath study areas in Oregon, showed declines of 75 percent or more between 1995 and 2017.

Other Oregon study areas showed declines of over 60 percent over the same time period. In California, declines ranged from more than 60 percent over the same time period, to 30 percent at Hoopa between 1995 and 2013, to exclude the period when barred owl removal was conducted at Hoopa (Franklin *et al.* 2021). These findings indicate that these populations are declining over time and the rate of decline is increasing. The probability of occupancy has declined in all three states over the past two decades (Franklin *et al.* 2021). The lowest recent occupancy rates were observed in Washington study areas, as well as the Coast Range and Tyee study areas in Oregon, where 2017 occupancy rates were below 25 percent. The other Oregon study areas had 2017 occupancy rates of approximately 25 percent. In California, 2017 occupancy rates were between 25 and 50 percent; 2017 data were not given for Hoopa, which was between 50 and 75 percent occupied in 2013.

Current estimates of the rangewide NSO population are not available. Two methods of estimating populations have previously been described - records of known sites and population modeling. There is no central database containing all known site information, but the number of known sites was documented in 1995 in a Federal Register notice (USDI FWS 1995). Population modeling was conducted for the 2012 critical habitat designation, and further research has been conducted using the same population modeling framework. We can also combine each of these methods of population estimation with information from the most recent demographic meta-analysis to update these earlier estimates.

As of July 1, 1994, there were 5,431 known site-centers of NSO pairs or resident singles: 851 sites (16 percent) in Washington, 2,893 sites (53 percent) in Oregon, and 1,687 sites (31 percent) in California (USDI FWS 1995). The actual number of currently occupied NSO locations across the range is unknown because many areas remain unsurveyed (USDI FWS 2011b).

In addition, many historical sites are no longer occupied because NSO have been displaced by barred owls, timber harvest, or severe fires, and it is possible that some new sites have been established due to reduced timber harvest on Federal lands since 1994. The totals above represent the cumulative number of locations recorded in the three states, not population estimates. Even in 1994, it is not likely that all known sites were occupied simultaneously. Furthermore, the number of NSO associated with each site is likely to vary from year to year, and some NSO ("floaters") are not associated with a site.

Estimated populations were modeled during the 2012 critical habitat designation which projected a steady-state rangewide population size of roughly 3,000 female NSO. Note that this steady-state population estimate was not meant to be a measure of actual population size, but rather an estimate of landscape capacity, given the amount of suitable habitat (modelled based on 2006 satellite imagery) and competition with barred owls. Steady-state population estimates varied regionally from low in the north, especially the northwest (e.g., far fewer than 100 female NSO in the North Coast Olympics and West Cascades North modeling regions), to high in parts of southern Oregon and northern California (e.g., between around 400 and 750 females each in the Inner California Coast, Klamath East, Klamath West, Redwood Coast, and West Cascades South modeling regions) (Dunk *et al.* 2012). These estimates likely over-represent the numbers of females as this modeling effort does not reflect the effects of habitat loss since 2006, or of increasing encounter rates with barred owls in the southern portion of the range.

Additionally, the actual number of currently occupied NSO locations across the range is unknown because many areas remain un-surveyed (USDI FWS 2011a) and many historical sites are no longer occupied because NSO have been displaced by barred owls, timber harvest, or severe fires. However, displaced NSO may survive in new territories or as floaters, and so may still be present in the population. Other factors such as impacts of anticoagulant rodenticides have likely negatively affected localized NSO populations (Gabriel *et al.* 2018). Another unmeasured factor might include the possibility that some new sites have been established due to reduced timber harvest on Federal lands since 1994. At 10 long-term study areas where local NSO populations have been tracked since 1995 or before, without barred owl management, the average annual rate of population change from 1995 through 2017 was -5.3 percent (Franklin *et al.* 2021). This rate of decline has not been consistent throughout the entire 22-year period, but rather, it was shallower in the earlier years and has become steeper in recent years. In 2016, the annual rate of change for 1985 through 2013 was estimated to be -3.8 percent, and in 2011, the annual rate of change for 1990 through 2006 was estimated to be -2.9 percent (Dugger *et al.* 2016, Forsman *et al.* 2011).

If we simplistically assume that all 5,431 sites known in 1994 were occupied in 1995, and that site occupancy has decreased proportionally to the rate of population change, we would expect that approximately 1,318 (calculated as 5,432*0.947^26) of these sites would remain occupied in 2021. More realistically, it is likely that some of these sites were unoccupied in 1995, but also that some number of other sites were occupied in 1995 but remained unknown due to lack of survey. Furthermore, the rate of decline in site occupancy may have outpaced the decline in the population, as barred owls have displaced NSO, increasing the proportion of floaters in the population. Because these realistic considerations include some sources of overestimation and other sources of underestimation, all of unknown magnitude, it is not clear whether this might be an overestimate or an underestimate of the number of currently occupied sites.

Similarly, if we simplistically assume that 3,074 females were present in the rangewide population in 2006, as estimated for the steady-state population in the critical habitat modeling exercise, and that the number of females has declined by 5.3 percent per year since then, we would expect that 1,358 (calculated as 3,074*0.947^15) females would be present in the 2021 rangewide population. More realistically, it is not clear how well the steady-state population estimates approximated the actual 2006 NSO population, and the rate of population change between 2006 and 2021 has likely been steeper than -5.3.

Based on both of these adjustments to earlier estimates of the number of sites and females in the population, we hypothesize that there are likely 3,000 or fewer individuals present in the rangewide population as of 2021.

In the northern-most portion of the range in British Columbia, few NSO are remaining. Chutter *et al.* (2004) suggested immediate action was required to improve the likelihood of recovering the NSO population in British Columbia. In 2007, personnel in British Columbia captured and brought into captivity the remaining 16 known wild NSO (USDI FWS 2011b). Prior to initiating the captive-breeding program, the population of NSO in Canada was declining by as much as 10.4 percent per year (Chutter *et al.* 2004). As of 2016, this program included 17 NSO, eight of which were born in captivity (British Columbia 2017). The program is targeted produce annually up to 20 captive-born owls ready for release back into the wild until the population reaches 200; the first year of release expected to occur in the spring of 2018. The amount of previous interaction between NSO in Canada and the United States is unknown.

Table A-7. Summary of most recent northern spotted owl population trends from in demographic study areas in Washington, Oregon, and California 1985-2017 (Derived from Franklin et al. 2021, pp. 10-18).

Study Area	Apparent Survival	Territory Colonization	Territory Extirpation	Occupancy Rates	Population Trend	Mean Lamba[a]	% 1995 Pop Size in 2017
Washington							
CLE	Declining	Declining	Increasing	Declining	Declining	0.91	<20%
RAI	Declining	Declining	Increasing	Declining	Declining	0.94	25%
OLY	Declining	Declining	Increasing	Declining	Declining	0.91	<20%
Oregon							
COA	Declining	Declining	Increasing	Declining	Declining	0.92	<25%
HJA	Declining	Declining	Increasing	Declining	Declining	0.96	<40%
TYE	Declining	Not significant	Increasing	Declining	Declining	0.96	<40%
KLA	Declining	Declining	Increasing	Declining	Declining	0.93	<25%
CAS	Declining	Declining	Increasing	Declining	Declining	0.96	<40%
California							
NWC	Declining	Not significant	Increasing	Declining	Declining	0.98	50%
HUP[b]	Declining	Not significant	Increasing	Declining	Declining	0.98	70%
GDR	Declining	Not significant	Increasing	Declining	Declining	0.94	<40%

[a] Approximate estimates from Franklin *et al.* 2021, pp. 11-12 and Figure 7; lambda estimates not listed by study area.

[b] Trends calculated only through 2012, prior to commencement of barred owl removal

[c] Data used for occupancy modeling in the GDR study area excluded treatment areas after Barred Owl removals began in 2009.

A.10. Northern Spotted Owl Critical Habitat-Legal Status

Critical habitat for the NSO includes approximately 9,373,676 acres in 11 units and 60 subunits in California, Oregon, and Washington (USDI FWS 2021b). This acreage resulted from the November 10, 2021 final rule's exclusion of approximately 204,294 acres within the Harvest Land Base for BLM and some tribal lands in Oregon (USDI FWS 2021b) from the 2012 critical habitat designation (USDI FWS 2012a).

Designation of critical habitat serves to identify those lands that are necessary for the conservation and recovery of the listed species. In this case, the Service's primary objective in designating critical habitat was to identify capable and existing essential NSO habitat and highlight specific areas where management of the NSO and its habitat should be given highest priority. The expectation of critical habitat is to ameliorate habitat-based threats. The recovery of the NSO requires habitat conservation in concert with the implementation of recovery actions that address other, non-habitat-based threats to the species, including the barred owl (USDI FWS 2012a). The conservation role of NSO critical habitat is to "adequately support the life-history needs of the species to the extent that well-distributed and inter-connected NSO nesting populations are likely to persist within properly functioning ecosystems at the critical habitat unit and range-wide scales" (USDI FWS 2012a). The specific conservation roles of the subunits included in the action area are described below in the Environmental Baseline.

A.11. Physical or Biological Features and Primary Constituent Elements

When designating critical habitat, the Service considers "the physical or biological features [PBFs] essential to the conservation of the species and which may require special management considerations or protection" (50 CFR §424.12; USDI FWS 2012a). "These include but are not limited to: (1) space for individual and population growth and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing (or development) of offspring; and (5) habitats that are protected from disturbance or are representative of the historical, geographical, and ecological distributions of a species" (USDI FWS 2012a). The final critical habitat rule states that "for the NSO, the physical or biological features essential to the conservation of the species are forested areas that are used or likely to be used for nesting, roosting, foraging, or dispersing" (USDI FWS 2012a). The final critical habitat rule for the NSO provides an in-depth discussion of the PBFs, which may be referenced for further detail (USDI FWS 2012a).

The final rule for critical habitat defines the primary constituent elements (PCEs) as the specific elements of the PBFs that are considered essential to the conservation of the NSO and are those elements that make areas suitable as nesting, roosting, foraging, and dispersal habitat (USDI FWS 2012a). In 2016, the Service returned to the use of statutory reference of PBFs rather than PCEs when evaluating and discussing the availability and function of, as well as the effects to the attributes of critical habitat in the adverse modification analysis (USDI FWS and USDC NOAA 2016). References to PCE here are to be consistent with cited critical habitat rule. The PCEs should be arranged spatially such that it is favorable to the persistence of populations, survival and reproductive success of resident pairs, and survival of dispersing individuals until they are able to recruit into a breeding population (USDI FWS 2012a). Within areas essential for the conservation and recovery of the NSO, the Service has determined that the PCEs (or PBFs) are:

1. PBF1. Forest types that may be in early-, mid-, or late-seral stages and that support the NSO across its geographic range;
2. PBF2. Habitat that provides for nesting and roosting;
3. PBF3. Habitat that provides for foraging;
4. PBF4. Habitat to support the transience and colonization phases of dispersal, which in all cases would optimally be composed of nesting, roosting, or foraging habitat (PCEs 2 or 3), but which may also be composed of other forest types that occur between larger blocks of nesting, roosting, or foraging habitat (USDI FWS 2012a).

Some critical habitat subunits may contain all of the PBFs and support multiple life history requirements of the NSO, while some subunits may contain only those PBFs necessary to support the species' particular use of that habitat. All of the areas designated as critical habitat, however, do contain PCE 1, forest type. As described in the final rule, PCE 1 always occurs in concert with at least one other PCE (PCE 2, 3, or 4; USDI FWS 2012a). Northern spotted owl critical habitat does not include meadows, grasslands, oak woodlands, aspen woodlands, or manmade structures and the land upon which they are located (USDI FWS 2012a).

A.11.1. PCE 1 (PBF 1): Forest Types

The primary forest types that support the NSO are: Sitka spruce, western hemlock, mixed conifer, mixed evergreen, grand fir, Pacific silver fir, Douglas-fir, white fir, Shasta red fir, redwood/Douglas-fir, and moister ponderosa pine (USDI FWS 2012a).

A.11.2. PCE 2 (PBF 2): Nesting and Roosting Habitat

Nesting and roosting habitats provide structural features for nesting, protection from adverse weather conditions, and cover to reduce predation risk for adults and young. Unlike foraging habitat, structural conditions of nesting roosting habitats do not vary much across the range. The final rule describes characteristics associated with nesting and roosting habitats sufficient for foraging by territorial pairs, moderate to high canopy cover (60 to over 80 percent), multilayered and multispecies canopies with large overstory trees (20 to 30 inches dbh), basal area greater than 240 square feet per acre, high diversity of tree diameters, high incidence of large live trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence), large snags and large accumulations of woody debris on the ground, and sufficient open space beneath the canopy for flight (USDI FWS 2012a, p. 72051). Nesting and roosting habitats also function as foraging and dispersal habitat (USDI FWS 2012a).

A.11.3. PCE 3 (PBF 3): Foraging Habitat

Foraging habitat varies across the range, depending upon ecological conditions and disturbance regimes that influence vegetation structure and prey species distributions. Across most of the owl's range, nesting and roosting habitat is also foraging habitat, but in some regions (particularly in the southern portion of the range) NSO may additionally use other habitat types for foraging as well (differences in foraging habitats between ecological provinces are discussed below).

A.11.4. PCE 4 (PBF 4): Dispersal Habitat

Northern spotted owl dispersal habitat is habitat that supports the transience and colonization phases of owl dispersal, and in all cases would optimally be composed of nesting, roosting, or foraging habitat (PCE 2 or 3), but which may also be composed of other forest types that occur between larger blocks of NSO nesting, roosting, or foraging habitat. In cases where nesting, roosting, or foraging habitats are insufficient to provide for dispersing or nonbreeding owls, the specific dispersal PCEs are: habitat supporting transience phase of dispersal (protection from avian predators, minimal foraging opportunities, younger and less diverse forests that provide some roosting structures and foraging opportunities) and habitat supporting the colonization phase of dispersal (nesting, roosting, and foraging habitat but in smaller amounts than needed to support a nesting pair) (USDI FWS 2012a).

A.12. Zones of Habitat Associations used by Northern Spotted Owls

Differences in patterns of habitat associations used by the NSO across its range suggest four different broad zones of habitat use, which we characterize as the (1) West Cascades/Coast Ranges of Oregon and Washington, (2) East Cascades, (3) Klamath and Northern California Interior Coast Ranges, and (4) Redwood Coast (Figure A-3). We configured these zones based on a qualitative assessment of similarity among ecological conditions and habitat associations within the 11 different regions analyzed during the critical habitat designation process (see USDI FWS 2012a). These four zones capture the range in variation of some of the PBFs essential to the conservation of the NSO. Habitat modeling indicates that vegetation structure has a dominant influence on owl population performance, with habitat pattern and topography also contributing. High canopy cover, high density of large trees, high numbers of sub-canopy vegetation layers, and low to moderate slope positions are all important features. Summarized below are the PBFs for each of these four zones, emphasizing zone-specific features that are distinctive within the context of general patterns that apply across the entire range of the NSO.

A.12.1. West Cascades/ Coast Ranges of Oregon and Washington

This zone includes five regions west of the Cascade crest in Washington and Oregon (Western Cascades North, Central and South; North Coast Ranges and Olympic Peninsula; and Oregon Coast Ranges; USDI FWS 2011b). Climate in this zone is characterized by high rainfall and cool to moderate temperatures. Variation in elevation between valley bottoms and ridges is relatively low in the Coast Ranges, creating conditions favorable for development of contiguous forests. In contrast, the Olympic and Cascade ranges have greater topographic variation with many high-elevation areas supporting permanent snowfields and glaciers. Douglas-fir and western hemlock dominate forests used by NSO in this zone. Root diseases and wind-throw are important natural disturbance mechanisms that form gaps in forested areas. Flying squirrels (*Glaucomys sabrinus*) are the dominant prey, with voles and mice also representing important items in the NSO diet.

Nesting habitat in this zone is mostly limited to areas with large trees with defects such as mistletoe brooms, cavities, or broken tops. The subset of foraging habitat that is not NR habitat generally has slightly lower values than nesting habitat for canopy cover, tree size and density, and canopy layering. Prey species (primarily the northern flying squirrel) in this zone are associated with mature to late-successional forests, resulting in small differences between nesting, roosting, and foraging habitats.

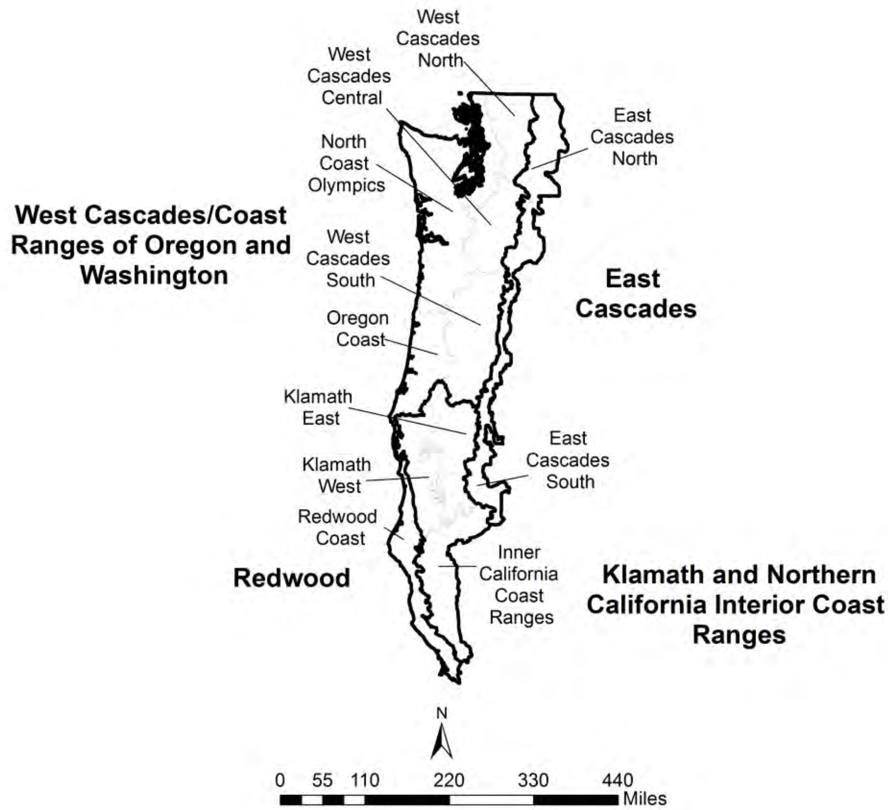

Figure A-3. Regions and zones of habitat associations used by northern spotted owls in Washington, Oregon, and California.

A.12.2. East Cascades

This zone includes the Eastern Cascades North and Eastern Cascades South regions (USDI FWS 2011b). This zone is characterized by a continental climate (cold, snowy winters and dry summers) and a high frequency of natural disturbance due to fires and outbreaks of forest insects and pathogens. Flying squirrels are the dominant prey species, but the diet of NSO in this zone also includes relatively large proportions of bushy-tailed woodrats (*Neotoma cinerea*), snowshoe hare (*Lepus americanus*), pika (*Ochotona princeps*), and mice (*Microtus spp*. (Forsman *et al.* 2001).

Our modeling indicates that habitat associations in this zone do not show a pattern of dominant influence by one or a few variables (USDI FWS 2011b). Instead, habitat association models for this zone included a large number of variables, each making a relatively modest contribution (20 percent or less) to the predictive ability of the model. The features that were most useful in predicting NSO habitat quality were vegetation structure and composition, and topography, especially slope position in the north. Other efforts to model habitat associations in this zone have yielded similar results (e.g., Garm *et al.* 2010, Loehle *et al.* 2011).

Relative to other portions of the NSO' range, nesting and roosting habitat in this zone includes relatively younger and smaller trees, likely reflecting the common usage of dwarf mistletoe (*Arceuthobium douglasii*) brooms (dense growths) as nesting platforms (especially in the north). Forest composition that includes high proportions of Douglas-fir is also associated with this nesting structure. Additional foraging habitat in this zone generally resembles nesting and roosting habitat, with reduced canopy cover and tree size, and reduced canopy layering. High prey diversity suggests relatively diverse foraging habitats are used. Topographic position was an important variable, particularly in the north, possibly reflecting competition from barred owls (Singleton *et al.* 2010). Barred owls, which have been present for over 30 years in the northern portions of this zone, preferentially occupy valley-bottom habitats, possibly compelling NSO to establish territories on less productive, mid-slope locations (Singleton *et al.* 2010).

A.12.3. Klamath and Northern California Interior Coast Ranges

This zone includes the Klamath West, Klamath East, and Interior California Coast regions (USDI FWS 2011b). This region in southwestern Oregon and northwestern California is characterized by very high climatic and vegetative diversity resulting from steep gradients of elevation, dissected topography, and large differences in moisture from west to east. Summer temperatures are high, and NSO occur at elevations up to 5,800 feet. The western portions of this zone support a diverse mix of mesic forest communities interspersed with drier forest types. Forests of mixed conifers and evergreen hardwoods are typical of the zone. The eastern portions of this zone have a Mediterranean climate with increased occurrence of ponderosa pine. Douglas-fir/dwarf mistletoe is rarely used for nesting platforms in the western part of the NSO range but is commonly used in the east.

The prey base for NSO in this zone is correspondingly diverse, but dominated by dusky-footed woodrats, bushy-tailed woodrats, and flying squirrels. Northern spotted owls have been well studied in the western Klamath portion of this zone (Forsman *et al.* 2004, p. 217), but relatively little is known about NSO habitat use in the eastern portion and the California Interior Coast Range portion of the zone.

Our habitat association models for this zone suggest that vegetation structure and topographic features are nearly equally important in influencing owl population performance, particularly in the Klamath. High canopy cover, high levels of canopy layering, and the presence of very large dominant trees were all important features of nesting and roosting habitat. Compared to other zones, additional foraging habitat for this zone showed greater divergence from nesting habitat, with much lower canopy cover and tree size. Low to intermediate slope positions were strongly favored. In the eastern Klamath, the presence of Douglas-fir was an important compositional variable in our habitat model (USDI FWS 2011b).

A.12.4. Redwood Zone

This zone is confined to the northern California coast, and is represented by the Redwood Coast region (USDI FWS 2011b). It is characterized by a maritime climate with moderate temperatures and generally mesic conditions. Near the coast, frequent fog delivers consistent moisture during the summer. Terrain is typically low-lying (0 to 3,000 feet). Forest communities are dominated by redwood, Douglas-fir–tanoak (*Lithocarpus densiflorus*) forest, coast live oak (*Quercus agrifolia*), and tanoak series. Dusky footed woodrats are the dominant prey items for NSO in this zone.

Habitat association models for this zone diverged strongly from models for other zones. Topographic variables (slope position and curvature) had a dominant influence with vegetation structure having a secondary role. Low position on slopes was strongly favored, along with concave landforms.

Several studies of NSO habitat relationships suggest that stump-sprouting and rapid growth of redwood trees, combined with high availability of woodrats in patchy, intensively managed forests, enables NSO to occupy a wide range of vegetation conditions within the redwood zone. Rapid growth rates enable young stands to develop structural characteristics typical of older stands in other regions. Thus, relatively small patches of large remnant trees can also provide nesting habitat structure in this zone.

A.13. Climate Change and Range-wide Northern Spotted Owl Critical Habitat

There is growing evidence that recent climate change has impacted a wide range of ecological systems (Stenseth *et al.* 2002, Walther *et al.* 2002, Ådahl *et al.* 2006, Karl *et al.* 2009, Moritz *et al.* 2012, Westerling *et al.* 2011, Marlon *et al.* 2012). Climate change, combined with effects from past management practices, is exacerbating changes in forest ecosystem processes and dynamics to a greater degree than originally anticipated under the NWFP. Environmental variation affects all wildlife populations; however, climate change presents new challenges as systems change beyond historical ranges of variability. In some areas, changes in weather and climate may result in major shifts in vegetation communities that can persist in particular regions. (See expanded discussion in environmental baseline section above).

Climate change will present unique challenges to the future of NSO populations and their habitats. Northern spotted owl distributions (Carroll 2010) and population dynamics (Franklin *et al.* 2000, Glenn *et al.* 2010, Glenn *et al.* 2011a) may be directly influenced by changes in temperature and precipitation. In addition, changes in forest composition and structure as well as prey species distributions and abundance resulting from climate change may impact availability of habitat across the historical range of the subspecies. The 2011 Northern Spotted Owl Revised Recovery Plan provides a detailed discussion of the possible environmental impacts to the habitat of the NSO from the projected effects of climate change (USDI FWS 2011b).

Because both NSO population dynamics and forest conditions are likely to be influenced by large-scale changes in climate in the future, we have attempted to account for these influences in our designation of critical habitat by recognizing that forest composition may change beyond the range of historical variation, and that climate changes may have unpredictable consequences for both Pacific Northwest forests and NSO. Our critical habitat designation also recognizes that forest management practices that promote ecosystem health under changing climate conditions will be important for NSO conservation.

A.14. Current Condition of Rangewide Critical Habitat

The current condition of critical habitat incorporates the effects of all past human activities and natural events that led to the present-day status of the habitat (USDI FWS and NMFS 1998). The rangewide condition was "reset" as of December 4, 2012, after the 2012 critical habitat revision. There has not yet been an update to the database based on the 2021 critical habitat exclusions. In addition, our quantitative assessment of the current condition of rangewide critical habitat does not include the full impacts of the 2020 fires but does include some interim numbers that represent the impacts on BLM and USFS lands in Oregon.

While the quantitative assessment of recent large fires and the 2021 critical habitat exclusions have not been updated in the database, this issue is currently being addressed as of December 5, 2022. Also, the 2021 final critical habitat rule considered the effects of both exclusions and the 2020 (but not 2021) wildfires and concluded that "Although some subunits have experienced a partial or temporary reduction in connectivity in places, overall, the critical habitat units and the range wide network designated in 2012 will continue to provide demographic support and connectivity for the NSO as intended" (USDI FWS 2021b).

With the database updates pending, a quantitative analysis of the critical habitat baseline may not be available, but the Service has information on the Critical Habitat units and subunit levels across the range for use in any Adverse Modification analysis.

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Associated Federal Register Documents

55 FR 26114: Determination of Threatened Status for the Northern Spotted Owl. Final Rule. Published in the Federal Register on January 26, 1990. 26114-26194.

57 FR 1796: Endangered and Threatened Wildlife and Plants; determination of critical habitat for the northern spotted owl. Final Rule. Published in the Federal Register on January 15, 1992. 1796-1838.

58 FR 14248: Final Rule to List the Mexican Spotted Owl as a Threatened Species. Final Rule. Published in the Federal Register on March 16, 1993. 14248-14271.

73 FR 29471: Proposed Revised Designation of Critical Habitat for the Northern Spotted Owl (*Strix occidentalis caurina*). Proposed rule. In addition, this document announced that the Final Recovery Plan for the Northern Spotted Owl is available. Published in the Federal Register on May 21, 2008. 29471-29477.

73 FR 47326: Revised Designation of Critical Habitat for the Northern Spotted Owl; Final Rule. Published in the Federal Register on Federal Register on August 13, 2008. 47326-47522.

76 FR 38575: Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). Notice of document availability: revised recovery plan. Published in the Federal Register on July 1, 2011. 38575-38576.

76 FR 63719: 12-Month Finding on a Petition to List a Distinct Population Segment of the Red Tree Vole as Endangered or Threatened. Proposed Rule. Published in the Federal Register on October 13, 2011. 63720-63762.

77 FR 71876: Designation of Revised Critical Habitat for the Northern Spotted Owl. Final Rule. Published in the Federal Register on December 4, 2012. 71876-72068.

78 FR 57171: Experimental Removal of Barred Owls to Benefit Threatened Northern Spotted Owls; Record of Decision for Final Environmental Impact Statement. Notice of availability September 17, 2013. 57171-57173.

80 FR 19259. 90-Day Findings on 10 Petitions. Notice of petition findings and initiation of status reviews. Published in the Federal Register on April 10, 2015. 19259-19263.

85 FR 81144. 12-Month Finding for the Northern Spotted Owl. Published in the Federal Register on December 15, 2020. 81144-81152.

86 FR 62606: Revised Designation of Critical Habitat for the Northern Spotted Owl. Final rule; withdrawal and revision. Published in the Federal Register on November 10, 2021. 62606-62666.

Appendix B. Recovery Unit Assessment for the California Cascades and California Klamath Physiographic Provinces

B.1. Introduction

As described in section 2.2 of the Biological Opinion (BO), recovery units are useful for informing the effects of a proposed action and our jeopardy determination. When a proposed Federal action appreciably impairs or precludes the capacity of a recovery unit from providing for both the survival and recovery, the action may also represent jeopardy to the species. When using this type of analysis, a BO should describe how the consequences and effects of the proposed Federal action not only affect the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species (USDI FWS and NMFS 1998).

Our analysis of the project's effects on the two recovery units is addressed in chapter 9 of the BO. This Appendix addresses existing conditions and the intended conservation role in the Recovery Units for northern spotted owl (NSO) in the action area. It also includes:

- A summary of the Recovery Actions most relevant to vegetation management and post-fire management actions on Federal lands from the Recovery Plan for the NSO.
- A summary of the rangewide NSO population, as population estimates for the three recovery units are not available.
- A summary of information regarding barred owls and their impacts to NSO, including recent barred owl observations in the three recovery units.

Refer to Appendix A for details on the legal status, physical description, biology, and threats to the NSO. Appendix A also includes information concerning rangewide habitat and population trends, and various habitat metric tables incorporate the effects of all past human activities and natural events that led to the present-day status of the species and its habitat (USDI FWS and USDC NMFS 1998, Davis *et al*. 2011, 2015, 2022).

B.2. Summary of Recovery Actions for the Northern Spotted Owl

There are 14 recovery actions that specifically address habitat loss and degradation in the Recovery Plan for the Northern spotted owl (USDI FWS 2011). Two recovery actions address habitat loss and degradation. They are of primary importance for Federal land managers:

- Recovery Action 10: "Conserve NSO sites and high value NSO habitat to provide additional demographic support to the population." This recovery action addresses known sites as well as nesting, roosting, and foraging habitat. Interim guidance consists of a framework to help determine and prioritize NSO sites and high value habitat for conservation (USDI FWS 2011).
- Recovery Action 32: "Because recovery requires well distributed, older and more structurally complex multi-layered conifer forests on Federal and non-Federal lands

across its range, land managers should work with the Service…to maintain and restore such habitat while allowing for other threats, such as fire and insects, to be addressed by restoration management actions. These high-quality NSO habitat stands 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 recovery action primarily addresses nesting/roosting habitat, but forest stands or patches meeting the described conditions are a subset of nesting, roosting and foraging habitat (USDI FWS).

Because maintaining or restoring forests with high-quality habitat will provide additional support for reducing key threats faced by NSO, protecting these forests should provide them with high-quality refugia habitat from negative competitive interactions with barred owls that are likely occurring where the two species' home ranges overlap.

The Recovery Plan strongly emphasizes the importance of addressing threats from habitat loss, barred owls, and climate change (USDI FWS 2011). It cautions that land managers should not be so conservative that, to avoid risk, they forego actions necessary to conserve forest ecosystems which are necessary to the long-term conservation of the NSO. But they should also not be so aggressive that the immediate impacts on NSO and its habitat from treatments are more damaging than the potential long-term benefits. Finding the appropriate balance to this dichotomy remains an ongoing challenge for those engaged in NSO conservation (USDI FWS 2011).

Both the Recovery Plan and the 2012 (and 2021) critical habitat designations build on the Northwest Forest Plan (NWFP) and recommend continued implementation of the NWFP and its standards and guidelines (USDI FWS 2011). This includes being consistent with the direction for Late-Successional Reserves and other land allocation management direction.

In addition to recovery actions regarding habitat, there are 10 recovery actions specific to addressing barred owl threats. The Service has undertaken Recovery Action 30 (designing and implementing large-scale control experiments to assess the effects of barred owl removal on NSO site occupancy, reproduction, and survival). We are currently in the public comment period for the Draft management strategy and Draft EIS (as of November 19, 2023) for Recovery Action 31. This recovery action addresses barred owl management and reducing their negative effects on NSO to help meet the recovery criteria (USDI FWS 2011).

B.3. Summary of the Rangewide Population Status of NSO

There is little information regarding the total number of NSO within their range. Existing field surveys are not extensive or consistent enough to produce reliable estimates of the rangewide population size. Since the mid-1990s, rangewide demographic data from 11 long-term monitoring areas has been used as a surrogate to evaluate NSO population trends. Based on the demographic data, the most recent population meta-analysis found:

1. Populations experienced significant annual declines of 6-9 percent on six study areas and annual declines of 2-5 percent on five other study areas, and

2. Annual declines translated to a 35 percent reduction in the number of NSO populations remaining within seven study areas since 1995, and
3. Barred owl presence in NSO territories is the primary factor negatively affecting apparent NSO survival, recruitment, and ultimately, rates of population change (Franklin *et al*. 2021).

The recent meta-analysis indicates NSO populations potentially face extirpation if the negative effects of barred owls are not ameliorated while maintaining NSO habitat across their range (Franklin *et al*. 2021). Weather and climate were additional factors associated with NSO population decline. The decades of habitat loss and degradation, combined with the recent expansion of barred owl populations throughout the NSO range, are the primary reasons for their rangewide population decline. Given this, NSO populations have a reduced ability to withstand additional impacts from ongoing and future threats.

Because rangewide population estimates are lacking, other methods have been used to understand the rangewide status of NSO. "Minimum known alive" estimates have been reported (Birdlife International 2016) but are out of date and vastly underestimate the true number of NSO due to limited survey coverage. Without an empirical study on total population size, the best available information we use for the purpose of this BO is from Dunk *et al*. (2012). These authors used model simulations over time in response to various habitat scenarios to estimate the total number of NSO. This modeling effort was started for the Recovery Plan and finalized during development of the final critical habitat rule (USDI FWS 2012). The modeling scenario for the critical habitat rule (composite 11) was selected because it: 1) had a pessimistic habitat change scenario, and 2) reflected the final critical habitat network as reserve areas. All composites and simulations were based on estimates of a reasonable middle ground on implementation of barred owl control (i.e., a midpoint between no barred owl control and complete barred owl eradication).

Using composite 11, the model simulations found there were an estimated 6,662 NSO (95 percent confidence intervals of 5,954-6,944 individuals). Assuming all female NSO are part of a pair, this projected a steady-state rangewide population size of roughly 3,074 female NSO in 2006. If we simplistically assume that 3,074 females were present in the rangewide population in 2006, as estimated for the steady-state population in the critical habitat modeling exercise, and that the number of females has declined by 5.3 percent per year since then, we would expect 1,358 females would be present in the 2021 rangewide population. More realistically, it is not clear how well the steady-state population estimates approximated the actual population in 2006, and the rate of population change between 2006 and 2021 has likely been steeper than -5.3. Based on the adjustments to earlier estimates of the number of sites and females in the population, we hypothesize there are likely 3,000 or fewer individuals present in the rangewide population as of 2021.

While the purpose of the modeling was not intended to predict actual population size or future trends, it did provide general insights into population size through the lens of NSO habitat carrying capacity and other factors. Additionally, the actual number of currently occupied locations across the range is unknown because many areas remain un-surveyed (USDI FWS 2011, p. A-2). Many historical sites are no longer occupied because NSO have been displaced by barred owls, timber harvest, or severe fires. However, displaced owls may survive in new territories or as floaters, and so may still be present in the population.

What is also not accounted for here is the habitat loss from recent large wildfires since 2012 and the effects those natural events had on the rangewide NSO population. Population modeling based on carrying capacity of suitable habitat to support territorial NSO pairs was recently completed for the 25-year report on the status and trends of NSO habitat. The analysis extended from 1993 through 2017 (Davis *et al*. 2022). Based on the analysis, and despite overall net increases in nesting/roosting forest on Federal lands during the monitoring period, the analysis showed the population of territorial NSO on Federal lands decreased by an estimated 61.8 percent. A primary cause for population declines on Federal lands was displacement by the invasive barred owl (Davis *et al*. 2022). A full accounting of the status of the species is included in Appendix A and was last updated in December 2022.

B.4. Recovery Units

For monitoring, management, and regulatory purposes, the range of the NSO is divided into 12 physiographic provinces (USDI FWS 1992, Davis and Lint 2005). These provinces are based largely on the regional distribution of major forest types and state boundaries from southern British Columbia in Canada, and extending south to Marin County in California. Most of the 12 physiographic provinces are assessed for demographic trends (USDI FWS 2011).

California includes three physiographic provinces: the California Coast Range, the California Cascades, and the California Klamath (Thomas *et al*. 1990, USDI FWS 2011). NSO are also known to occur on the Modoc National Forest, though this area is outside of a mapped physiographic province.

The Recovery Plan determined the 12 physiographic provinces also meet the criteria for use as recovery units (USDI FWS 2011). The Service's analytical framework for conducting Jeopardy analysis describes that recovery units can be useful for informing the effects of a proposed action and our jeopardy determination.

When a proposed Federal action appreciably impairs or precludes the capacity of a recovery unit from providing for both the survival and recovery, the action may also represent jeopardy to the species as a whole. When using this type of analysis, a BO should describe how the consequences of the proposed Federal action not only affect the recovery unit's capability, but the relationship of the recovery unit to both the survival and recovery of the listed species as a whole (USDI FWS and NMFS 1998).

The following sections address the two recovery units affected by the South Fork Sacramento Public Safety and Forest Restoration project, the existing conditions based on the best available data at this time, and their intended conservation role for the northern spotted owl.

B.4.1. California Cascades Recovery Unit

This recovery unit and physiographic province encompasses about 2.5 million acres. This province is located at the eastern extent of the NSO range in California. It is characterized as having relatively gentle terrain, low annual precipitation and dry forest types; influencing the distribution and quality of suitable NSO habitat in the province and the action area (USDA-FS and USDI-BLM 1994). It lies south of the Oregon Eastern and Western Cascades, and east of the California Klamath Province, and is recognized as providing an important contribution to NSO conservation. This contribution has been attributed to the positive influences of ownership patterns, past management and regulations, and the distribution and connectivity of high-quality older forest habitats (Thomas *et al*. 1990, USDI FWS 1990, 1992).

In the warmer, drier physiographic provinces (i.e., the Washington and Oregon Eastern Cascades, the California Cascades, and the Oregon and California Klamath Provinces), fire is more frequent, less intense, and is an integral part of the internal dynamics of a typical stand. In these drier provinces, fire control and timber harvest have decreased the abundance of some types of old growth, such as ponderosa pine, that are dependent on frequent, low-intensity fires (USDA-FS and USDI-BLM 1994).

B.4.1.1. Ecological Importance of the California Cascades

The 1990 Conservation Strategy for the Northern Spotted Owl referred to the California Cascades Province as the “Cascade/Modoc Province” (Thomas *et al.* 1990). It identified ‘Areas of Special Concern’ where, as a result of both natural conditions and human-related activities, NSO habitat is negatively affected (Thomas *et al.* 1990). The Shasta-McCloud Management Unit of the Shasta-Trinity National Forest, the eastern portions of Scott and Salmon River Ranger Districts on the KNF and all of Goosenest Ranger District were all included in the ‘Shasta-McCloud Area of Concern’ (a large proportion of the then Cascade/Modoc and current California Cascades Province).

The strategy describes that while these areas include forest, site quality is poor because of the drier, warmer climate and poor soils (e.g., extensive areas of old lava flows). Single species, ponderosa pine forest, primarily on portions of the McCloud Flats area and the lower elevation areas of the Goosenest Ranger District, lack the multiple canopies and other structural attributes that support suitable NSO habitat.

Areas of suitable habitat at mid- and upper-slope positions where ponderosa pine/white fir, mixed conifer, and true fir forest types occur in this area are limited in distribution and fragmented where they occur. This makes conserving the habitat that is available more important to the continued use of the area by NSO for demographic support, gene flow and connectivity. Because of the dry climate, poor soils, pine-dominated forests at lower elevations, and long history of logging, the remaining habitat in this geographic area was highlighted as important for NSO (Thomas *et al.* 1990).

The strategy also highlighted that the area could not support large, multi-pair habitat conservation areas or HCAs, because of the existing conditions, and patchiness of habitat. The strategy therefore designated category 2 HCAs (consisting of 2-19 NSO pairs), category 3 HCAs (single pair, home-range size) and category 4 (single pair, 80 acres) to encompass areas of best available habitat, or future habitat to support NSO. At that time, the overall recommendation for the ‘Shasta-McCloud Area of Concern’ was to establish HCAs with a maximum 7-mile spacing and to protect the 1.2-mile radius around known pairs (Thomas *et al.* 1990).

The 1990 Conservation Strategy acknowledged that the long-term viability for NSO in this area was considered at risk. Owl densities were very low because of the patchy distribution of suitable habitat, resulting from the checkerboard land ownership and different land-use histories (logging, ranching). The owl densities on Forest Service lands in the region, however, were considered high (about 1.8 pairs per 10,000 acres). All known pairs in the area, at the time, were confined to Forest Service lands. As a consequence, owls appeared to occur at high densities, but the situation was much less favorable for owl viability. This is because of the relatively small HCA sizes, the distance between them, and the lack of NSO and habitat on intervening lands. This pattern, generally true for all identified 'Areas of Special Concern', substantially added to the risk of long-term viability for the NSO, and the importance of the existing habitat and future use by NSO (Thomas *et al.* 1990).

In addition to the 1990 Conservation Strategy, the 1992 draft Recovery Plan describes the important linkage the California Cascades Province provides for local demographic support, as well as with the California spotted owl. The province is generally fragmented by large landscape features (Mt. Shasta and Shasta Valley), large areas of unsuitable soils, and naturally marginal habitats (ponderosa pine stands). Its importance however is that it serves as the linkage between the NSO and California spotted owl ranges. While the low population numbers and low amounts and poorly distributed suitable habitat limit the overall province's contribution to recovery, the important objectives in the province are to maintain the link between the two sub-species, and to provide local demographic stability to known and future NSO pairs and individuals.

The province also contains the Goosenest Adaptive Management Area or AMA, as designated under the Northwest Forest Plan (NWFP) and KNF Forest Plan. The Goosenest AMA Ecosystem Analysis describes the importance of the area with respect to terrestrial wildlife habitats:

> "Well-distributed late-seral habitat in the Goosenest AMA is necessary to maintain the link between the Oregon Cascades and the Sierra Nevada range [California Spotted Owl]. The natural limited late-seral habitat types in the AMA; white fir/mixed conifer, mixed conifer, and red fir, make it important to provide late-seral habitat. The red fir and mixed conifer communities in the AMA provide habitat for late-seral dependent wildlife [such as NSO, northern goshawk, and marten] and are an important link to the late-seral habitats on the Shasta-Trinity National Forest. Maintaining well-distributed blocks of late-seral habitat in these communities will help ensure that a local event that removes late-seral habitat will not sever the link" (USDA-FS 1996).

B.4.1.2. Northern Spotted Owl Demographics in the California Cascades

There are no demographic study areas in the California Cascades physiographic province. The closest demographic study area in terms of distance, climate, vegetation and habitat similarity to the action area, is the Southern Cascades Study Area (SCSA) in southern Oregon (see Dugger *et al*. 2016 and 2017-2021 for the most recent annual reports). The Northwestern California demographic study area overlaps the project action area. The vegetation, climate, and weather patterns that can affect prey, nesting success and survival are similar between the RSA and the California Cascades province, given the dry forest landscapes. However, there is a much higher continuum of suitable and dispersal habitat and more mountainous terrain west of the Cascades, in the California Klamath Province.

Monitoring results from the SCSA show similar results to the RSA and other reports from NFWP monitoring areas[1]regarding barred owls increasing overall, and a steady decrease of NSO detections (Franklin and others, various years). The annual SCSA reports also show NSO persist in cores that have high value habitat (Dugger *et al.* 2012) and increased NSO reproduction in "better weather" years. While productivity in 2014 on the SCSA in 2014 was better than average, the total number of NSO detected and the number of previously banded owls identified were the lowest recorded for the study (Dugger *et al.* 2016).

Based on a review of the 2021 reports compiled for the 2020 monitoring season in the NWFP demographic study areas, NSO detections are continuing to decline and barred owl detections are increasing range-wide. The exception is at the Green Diamond Study area in the California Coast Range recovery unit, where annual barred owl removal occurs.

While there are no demographic study areas in the California Cascades Province, long-term monitoring of NSO has occurred on the Goosenest Ranger District (Woodbridge and Cheyne 1994, USDA-FS various years), and Shasta-McCloud Management Unit to the south (see below).

There are approximately 33 NSO territories on the Goosenest Ranger District of the Klamath National Forest in the northern extent of the recovery unit. The 2021 Antelope Fire affected seven of these territories, though surveys in 2022 show at least two of the sites remain occupied (I. Gansberg, pers. comm., 2022).

When more intensive monitoring of NSO territories and project-level surveys began in the late 1980s and early 1990s on the Shasta-McCloud Management Unit, there were approximately 35 known territories on the Unit (with 20 on the McCloud Ranger District). Approximately 15 of these territories have been confirmed to be consistently occupied by single NSO or reproducing or non-reproducing NSO pairs from before 1989 through 2020 (USDA-FS 1989-2019). For the remainder of the territories, status was unknown due to lack of funding to complete annual surveys that were not project-specific, resulting in some incomplete information regarding NSO occupancy and reproduction over that time span. On an annual basis, there is an average of 10 territories with confirmed occupancy by NSO, but not all historic territories are surveyed on an annual basis. The earliest known presence of barred owls on the Unit was in 1997 and at least three of the known NSO territories on the McCloud Ranger District directly south of the action area have shifted their locations, presumably due to competition with barred owls. Barred owl/NSO reproduction was documented in 2009 and again in 2013 at one territory on the McCloud Ranger District. Numerous observations of spotted owl and barred owl hybrids have been reported in recent years. In addition, there has been active removal of barred owls, under permit, near NSO territories by private land management and researchers on the Unit since fall 2014. These removal efforts are not continuous or widespread across the recovery unit, however.

[1] Reports are available to the public online at: https://www.fs.usda.gov/r6/reo/monitoring/

B.4.1.3. Vegetation in the California Cascades

The forest landscapes of both the California Cascades and Klamath mountains are unique due to the complex interactions among gentle and steep topography, mountains, forest and vegetation types, regional climate, land ownership patterns, and past and ongoing forest management. Winters are cold, snowy and wet with hot, dry summers. Summers are a dry Mediterranean-type, but thunderstorms are relatively common. This results in productive forests where fires were historically frequent, and possibly large, that spanned a spectrum of severity. These variations in severity and frequency create a mosaic of vegetation types, ages, and structural variability that are uniquely resilient to fire (Halofsky *et al.* 2011, Williams and Baker 2012). The natural conditions and past timber harvest of the California Cascades province contribute to a more fragmented landscape relative to the California Klamath Province. It is also characterized by a denser checkerboard of Federal and private ownerships where management regimes have exacerbated habitat fragmentation.

The California Cascades Province is in the southern Cascades ecological section M261D (McNab and Avers 1994), which extends along the eastern slopes of the Cascades from the Crescent Ranger District of the Deschutes National Forest south to the Shasta-McCloud area. Topography here is gentler and less dissected than the glaciated northern section of the eastern Cascades. The area is represented by a large expanse of recent volcanic soils (Franklin and Dyrness 1974), large areas of lodgepole pine, and increasing presence of red fir and white fir. Ponderosa pine is a dominant forest type at mid-to lower elevations, with a narrow band of Douglas-fir and white fir at middle elevations providing the majority of NSO habitat. Dwarf mistletoe provides an important component of nesting habitat, enabling NSO to nest in stands of relatively younger, smaller trees.

B.4.1.4. Fire in the California Cascades

One of the primary threats to NSO is past and current habitat loss and barred owls are now the primary negative influence on population decline (Davis *et al.* 2015, Dugger *et al.* 2015, USDI FWS 2011, 2012, Franklin *et al.* 2021). While loss from timber harvest has slowed considerably since the subspecies' listing in 1990, NSO habitat loss from high severity fires in some portions of the range remain high.

The 20-year monitoring report for the 'Status and Trend of Late-successional and Old-growth Forests' describes that portions of the NWFP area have been set back by decades from achieving the intended older forest abundance, diversity and connectivity under the Plan, particularly because of large wildfires in the fire-prone portions of the NWFP area (Davis *et al.* 2015). The report also describes:

1. Large wildfires are the leading cause of NSO habitat loss on Federal lands. And most of the fire-related losses have occurred within the network of large reserves that were designed for the protection and restoration of habitat for long-term NSO conservation.

2. Range-wide, the nesting/roosting habitat lost from fire (505,800 acres) represents about 31 percent of the total habitat loss.

3. In the fire-prone portions of the NSO range, loss rates exceeded the expected 2.5 percent rate for the 20-year period at rates of 3.9-7.4 percent per decade, including the California Cascades Province.

4. Other physiographic provinces that experienced significant amounts of habitat loss to wildfire include the Oregon Western Cascades (63,000 acres) and the Washington Eastern Cascades (52,100 acres).

5. Wildfire-related loss represents about 41 percent of the acres in the entire NSO range (Davis *et al.* 2015).

Climate projections indicate the California Cascades province may experience a continuation of current weather and precipitation trends, resulting in dry summers and low fuel moisture. These trends will increase the risk of large-scale wildfires, which will further reduce NSO habitat in the province. And, an increased frequency of large wildfires this century has already been observed (Davis *et al.* 2015).

Most fires that have occurred in NSO habitat in the California Cascades Province over the past 20 years have been small, given the extensive road networks that allow for rapid suppression response. The exceptions include the 2021 Antelope Fire, portions of the 2018 Hirz and Delta Fires, the 2012 Bagley Fire, and the 2009 Chalk Goose Fire.[2]

B.4.1.5. Other Threats in the California Cascades

The other primary natural threats to NSO habitat in the province are tree mortality resulting from high stocking densities, black stain root disease in ponderosa pine and white fir, *Heterobasidion* (annosus) root disease in white fir, and red fir and white fir-mistletoe infections with subsequent bark beetle attacks. These conditions, combined with fire suppression, result in stands that are more susceptible to high severity fire effects and potential NSO habitat loss.

The topography and dry site conditions that influence forest vegetation are the primary factors that limit suitable habitat in the California Cascades. Mortality from overstocking, disease, and insect attacks in ponderosa pine at lower elevations; past management; and past and ongoing timber harvest on private lands continues to influence the current quality and spatial distribution of NSO habitat.

B.4.1.6. NSO Habitat Conditions in the California Cascades

The distribution and quality of suitable and dispersal habitat for the NSO in this province is strongly influenced by the local physiographic and climatic conditions, as well as the history of forest management on Forest Service lands and private lands managed for timber production.

Located near the edge of the NSO geographic range, the province historically supported open eastside pine forests described by Mayer and Laudenslayer (1988) on lower-elevation gentle

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[2] The Mt. Hebron, Deer and Klamathon Fires primarily occurred in non-suitable habitat or dispersal habitat.

slopes and flat terrain. These ponderosa pine stands typically lack multi-layered/multi-species components of other mixed-conifer or hardwood species, as well as structural characteristics associated with suitable NRF (nesting/roosting and foraging) habitat selected by NSO (Irwin *et al.* 2007, USDI FWS 2011).While reduced in extent from historic conditions, given historic logging, more recent Forest management activities on private and Federal lands and the departure from the natural fire regime due to 100 years of fire suppression, ponderosa pine forest currently occupies a sizeable proportion of the Province, constituting a habitat type considered naturally unsuitable or of low quality for NSO. Conifer and hardwood species diversity and NSO habitat quality increase with mid- and higher-slope position, due to a corresponding increase in elevation, surface water availability, and an increase in water.

B.4.1.6.1. Nesting and Roosting Habitat

Stands selected for nesting and roosting are dominated by large trees, have structural complexity, contain multiple canopy layers, contain high densities of coarse wood, and are characterized by a mix of tree age class. This habitat is generally typified by a multi-layered, multi-species canopy dominated by large overstory trees; moderate to high canopy closure (70-90 percent); a high incidence of trees with large cavities and other types of deformities; numerous large snags; an abundance of large down logs; and open space within and below the upper canopy that allows for maneuvering (Thomas *et al.* 1990, USDI FWS 2011, 2012). Nesting platforms (brooms, broken top trees with leaders or snags) must be present. Nest sites are typically closer to seasonal watercourses and found in the lower slope positions. Mistletoe in sugar pine and Douglas fir is commonly associated with nests and nesting habitat (Dunk *et al.* 2012). Refer to Appendix A for range-wide discussion of NSO nesting/roosting habitat attributes.

As described in Appendix C of the Recovery Plan, some area-specific definitions of habitat have been developed in parts of the NSO range. Variation in habitat structure and use across the NSO range drives the need for province-specific definitions that use forest composition and structure so NSO habitat can be described in forest-management terms. The province-specific definitions may also incorporate spatial and abiotic features that help determine where NSO nest and roost.

It is important to understand that for most of the California Cascades, and areas of known NSO nesting on the Goosenest Ranger District, that NSO use stands with higher basal areas for nesting and roosting (USDA-FS and USDI FWS 2009, 2010, Woodbridge and Cheyne 1994), but also use stands with smaller trees or what can be typified as foraging habitat (USDI FWS 2008). Refer to chapters 4 and 6 of the BO for additional information regarding nesting, roosting, foraging, and dispersal habitat.

B4.1.6.2. Foraging Habitat

There is a high degree of overlap in NSO foraging behavior between “nesting/roosting” (NR) and “foraging” habitats. NSO often forage in stands classified as NR, and also nest or roost in stands classified as foraging habitat, as evidenced in the California Cascades province.

Forest structural features typically used to describe NSO foraging habitat include canopy cover, tree size, and basal area. Other attributes such as tree species composition, canopy layering, presence of edges and small openings, and landscape position are also influential (Irwin *et al.* 2007 and 2011, Solis and Gutierrez 1990, Ward *et al.* 1998, Zabel *et al.* 1995).

Consistent with the high degree of variability described in research publications, our criteria for evaluating foraging habitat for NSO consists of a range of stand conditions frequently used by owls rather than a single threshold value. The presence of trees ≥20-24” dbh is considered an important attribute of foraging habitat (USDI FWS 2009, Irwin *et al.* 2007, 2012, 2015). While most studies suggest some degree of selection for higher basal areas (160-220 ft^2/ac) for foraging, a substantial amount of foraging (44 percent) occurred within stands with basal areas ranging from 125-160 ft^2/ac (USDI FWS 2009; Irwin *et al.* 2007, 2012). NSO also require sufficient space below and through the canopy to maneuver while hunting (Thomas *et al.* 1990).

Stands with at least 40 percent canopy cover are considered minimal foraging habitat, based on radio telemetry locations (Zabel *et al.* 1992). Average tree diameters at foraging locations vary, with selection for medium to large trees (>18-20” dbh) and considerable use (41-87 percent of locations) of smaller size classes (Zabel *et al.* 1992, USDI FWS 2009). Forest stands with 40 percent canopy closure and a basal area of 80-120 ft^2/ac can provide dispersal conditions for NSO (defined as areas that provide minimal foraging opportunities and protection from predators). But stands in this basal area range of smaller size class 11” dbh trees are more valuable when they occur in a mosaic of stands containing higher quality habitat. Managing for the minimum definition of low-quality foraging habitat is not expected to provide sufficient foraging habitat for NSO (USDI FWS 2009).

The use of foraging habitat, and the subsequent evaluation of effects of treating such habitat, is influenced by its proximity and connectivity to NR habitat. During the breeding season, foraging decreases with increased distance from nest stands or nesting habitat, and therefore stands greater than one mile from suitable NR habitat may have a lower probability of use by foraging owls (Bart 1995; Bingham and Noon 1997; USDI FWS 2009, 2011). Refer to Appendix A for range-wide discussion of NSO foraging habitat attributes.

B.4.1.6.3. Habitat for the Prey of Northern Spotted Owl

The primary prey for NSO in the California Cascades Province includes northern flying squirrels (which prefer denser stands of mature trees), dusky-footed and bushy-tailed woodrats (which occupy diverse habitats including shrubby openings; mid, early and late successional habitats; and rocky outcrops). An NSO pellet analysis for the Klamath National Forest (USDA-FS 1989) showed that flying squirrel and woodrats comprised the highest percentage of the NSO diet. On the Goosenest Ranger District in the California Cascades recovery unit, flying squirrel, woodrat, vole, deer mice, and pocket gophers were the main prey (USDA-FS 1996). As elevation increases, the prey base for NSO shifts from dusky-footed woodrats towards flying squirrels (Farber and Whitaker 2005).

Snags, down wood, and decaying live trees are important for these prey species. Several important species, including northern flying squirrel, dusky-footed woodrat, Douglas’ squirrel, and some deer mouse and chipmunk species, use cavities in snags and decaying live trees for nesting, denning, and food storage (Maser *et al.* 1981, Carey 1991, McComb 2003, Martin *et al.* 2004). Other “defects” on live trees, for example, “witches’ brooms” provide foraging, nesting, and resting structures for northern flying squirrels, bushy-tailed woodrats, chipmunks, and birds (Parks *et al.* 1999).

Down wood provides small mammals, such as woodrats, western red-backed voles, Douglas' squirrels, and chipmunks, with cover, under-snow and food storage spaces, runways for moving above the forest floor, and material for dens (Maser *et al.* 1981, Carey 1991, McComb 2003). Down wood is also an important resource for truffles and mushrooms, which are primary foods for northern flying squirrels, western red-backed voles, and many other small mammals.

Some studies have found densities of flying squirrels are highest in old forests, or old forests of mixed conifer-deciduous composition (Carey *et al.* 1992, Carey and Johnson 1995, Smith 2007, Richie *et al.* 2009). Other studies suggest flying squirrels are generalists and use a range of seral stages or stand ages, and that canopy cover and distance between trees may be more important than seral stage or species composition (Rosenberg and Anthony 1992, Waters and Zabel 1995, Ransome and Sullivan 1997).

B.1.2.6.4. Dispersal Habitat

Dispersal habitat helps maintain stable populations by filling territorial vacancies. These dispersal areas also facilitate gene flow across the range of the species (USDI FWS 2012). Population growth can only occur if there is adequate habitat in an appropriate configuration to allow for dispersal across the landscape. Both locally and across the range, it provides an important connectivity function among blocks of higher value NRF habitats and it is essential to NSO conservation (USDI FWS 2011, 2012).

Dispersal habitat should be well-distributed across the landscape, and is generally considered adequate if about 50 percent of the assessed landscape meets the 40 percent canopy/11" dbh tree conditions (Forsman *et al.* 2002, Thomas *et al.* 1990, USDI FWS 2012). But in order for NSO to successfully move across a landscape, and eventually occupy a territory, dispersal habitat must also be in proximity to suitable foraging and roosting habitat. At a minimum, dispersal habitat consists of stands with adequate tree size and canopy cover to provide protection from avian predators and minimal foraging opportunities (USDI FWS 2011, 2012). These areas may include younger and less diverse forest stands than foraging habitat, but should contain some roost structures for temporary resting, canopy cover that provides shelter and cover from predators, and foraging habitat for dispersing juveniles, subadults or single adults (USDI FWS 2012, Sovern *et al.* 2015).

Thomas *et al.* (1990) suggested that management practices, such as visual and riparian corridors, streamside management zones, geologic reserves and other special management zones can provide habitat attributes conducive to dispersal between habitat areas.

Dispersal success is highest when dispersers can move through forests that have characteristics of nesting, roosting, and foraging habitats. Dispersing juveniles appear to select stands with relatively high canopy closure of about 66 percent (Sovern *et al.* 2015). Similar findings for the presence of older trees and denser canopy closure are described for the Oregon Coast range and parts of Washington (Miller *et al.* 1997, Buchannan *et al.* 1995, Herter *et al.* 2002).

Successful juvenile dispersal is also likely dependent on locating unoccupied suitable habitats in close proximity to other occupied sites (LaHaye *et al.* 2001). Fledglings of both sexes generally disperse from nest cores from September to November (Forsman *et al.* 2002; Gutiérrez 1985). Juveniles use temporary dispersal locations before acquiring a home range territory and the median natal dispersal distance from fledging to a permanent settlement is about 10 miles for males and 15.5 miles for females (Forsman *et al.* 2002). NSO can and will disperse across a wide range of forest conditions and levels of habitat fragmentation, and where corridors of forest exist within fragmented landscapes, these areas primarily serve to support relatively rapid movements rather than colonization (USDI FWS 2011).

B.4.2.6.5. Non-Habitat

Areas classified as non-habitat are not suitable for NSO nesting, roosting or foraging. They do not contain the minimum dispersal habitat elements and are not considered capable due to species composition, stand age or tree size or general soil conditions that prohibit development into dispersal or suitable habitat. This includes ponderosa pine stands, as these are forest types rarely used by NSO (Thomas *et al.* 1990, Zabel *et al.* 1992, Irwin *et al.* 2007, 2012, USDI FWS 2009, 2011, 2012). It also includes large open meadows, early- and mid-seral/pole size stands of small diameter trees, lodgepole-dominated stands, and non-forested lands such as brushfields, grasslands and barrens.

Based on an assessment of suitable habitat conditions after the 2021 wildfires, there is an approximate 294,906 acres of nesting/roosting and 503,600 acres of foraging habitat in the California Cascades province on Federal lands (Davis *et al*. 2022-Northwest Forest Plan Habitat Monitoring Maps for the northern spotted owl).

B.4.1.7. Barred Owls in the California Cascades

All National Forests in or adjacent to the action area and the private industrial timberlands with large-scale survey efforts in the three provinces have confirmed occupancy and nesting by barred owls. Based on the incidental detections during NSO surveys, barred owls do not currently appear to be as densely distributed in the California Cascades province as in the California Coast Range province, or northern parts of the range (see Figure B-1). Given that NSO surveys are limited across all three provinces, there is likely a higher density of barred owls on the landscape. In addition, they are being detected at a higher frequency in project areas surveyed for NSO throughout all provinces (USDI FWS 2000-2023 consultation records for various projects).

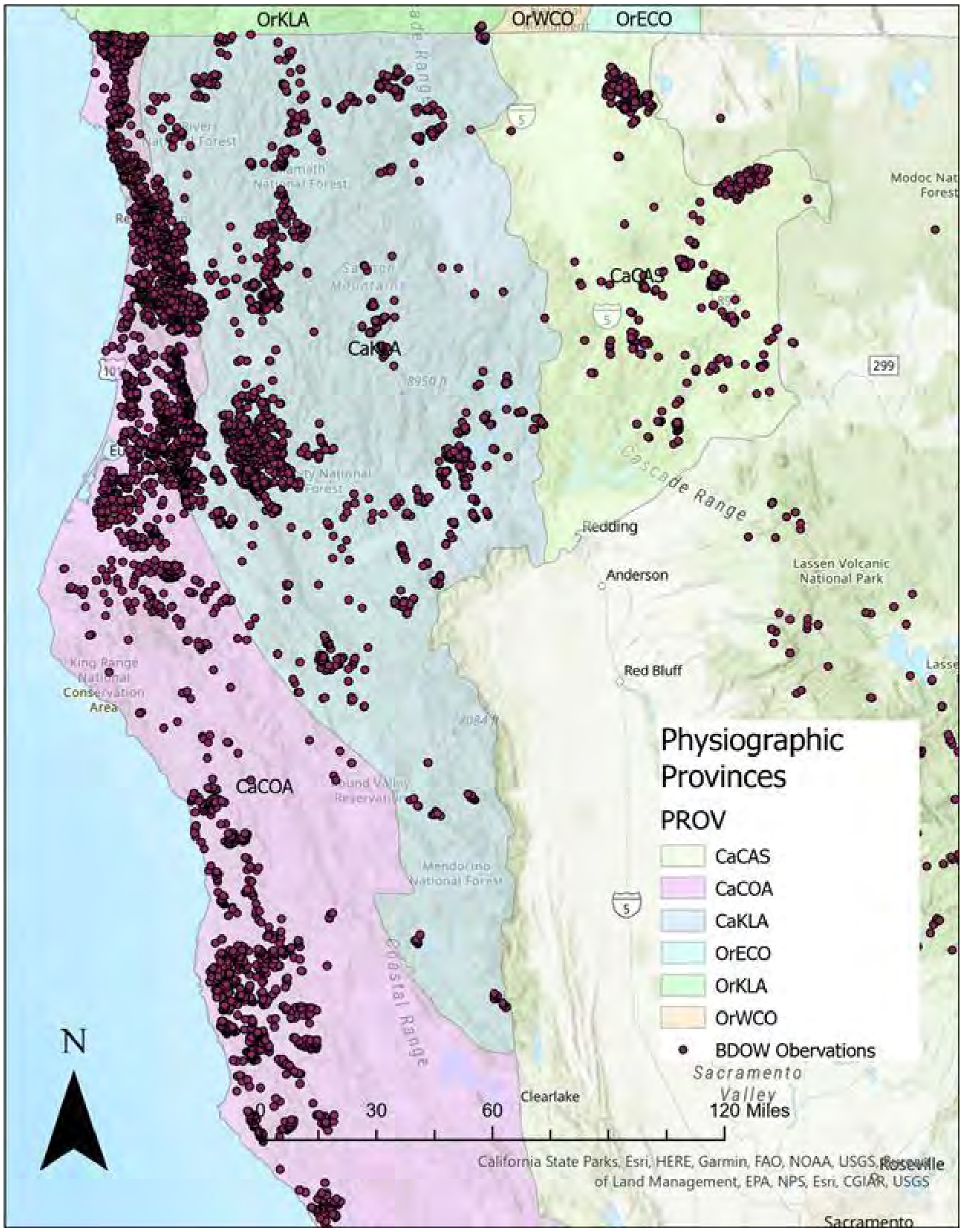


Figure B-1. Barred owl detections in the two NSO recovery units in the action area.

There is little uncertainty regarding the barred owl's impact on NSO and their populations (Franklin *et al*. 2021). NSO can be displaced because of fire or habitat reductions and may have increased difficulty in finding new territories to colonize or in expanding their home ranges to compensate for habitat reductions when barred owls are present on the landscape. In areas where NSO and barred owl compete directly for resources, maintaining larger amounts of older forest (NR habitat) may help NSO to persist in the short term (Dugger *et al.* 2011, 2016).

B.4.2. California Klamath Recovery Unit

This recovery unit and physiographic province encompasses about six million acres and extends from the Oregon border with California, south to the Clear Lake Basin within the Inner Coast Range. It lies between the California Coast and California Cascades Provinces and is bordered to the north by the Oregon Klamath Province. Most of the land in past and current large-scale NSO conservation plans within the California Klamath Province are considered essential to NSO conservation. This is because they help maintain habitat linkages, provide demographic support among NSO populations, support dispersal, maintain the potential for genetic interchange between populations, and temper (to a certain extent) the adverse effects caused by competition with barred owls (USDI FWS 2012).

B.4.2.1. Ecological Importance of the California Klamath Recovery Unit

Both the Oregon and California Klamath Provinces are recognized as providing an important contribution to NSO conservation. This contribution has been attributed to the positive influences of large Federal ownership patterns, past management and regulations, and the distribution and connectivity of high-quality older forest habitats (Thomas *et al*. 1990, USDI FWS 1990, 1992, 2011). A 2014 study concluded both provinces are strongholds for the rangewide population, with continued reproduction that plays a critical role in maintaining population stability (Schumaker *et al*. 2014). Both provinces contain portions of the Klamath East (KLE), Klamath West (KLW), and Interior California Coast (ICC) modeling regions as evaluated in the 2011 Recovery Plan (USDI FWS 2011) and the 2012 final critical habitat rule analysis. The authors describe both provinces as containing a "source" population of NSO. They also emphasize the importance of targeting habitat protection and restoration for the NSO in key areas to avoid further adverse changes in landscape connectivity necessary for NSO conservation (Shumaker *et al*. 2014). The Service considers the Late-Successional Reserves in the provinces to be such key areas.

B.4.2.2. Northern Spotted Owl Demographics in the California Klamath

Population data of NSO for the California Klamath Province is not available. Across the "Interior California Coast" modeling region, which covers the entire action area and is wholly part of the California Klamath Province, population simulations based on known NSO pairs indicated 571-652 female NSO (using 95 percent confidence intervals) may be present (Composite 11, Dunk *et al*. 2012). We assume this would likely result in about 1,142 to 1,304 total NSO if each female is assumed to be part of a pair. It is unclear how accurately these numbers portray the actual current population status given the increase in barred owls since and the occurrence of large wildfires since that time. However, because no other estimates exist, the Dunk *et al*. (2012) simulations represent the best available projections for numbers of NSO in the recovery unit for the purposes of this document.

As described above, the demographic trends are generally declining across the NSO range, including those in and near the action area (Dugger *et al*. 2016, Franklin *et al*. 2021). In sum, these findings cause concern for recruitment, genetic diversity and vigor, as well as overall long-term population stability of NSO within the California Klamath Recovery Unit.

B.4.2.3. Vegetation in the California Klamath Province

The forest landscapes of the California Klamath Province are unique due to the complex interactions among topography, land surface forms (e.g., forests, grasslands), forest and vegetation types, and the regional climate. The steep, dissected topography dominates much of this landscape, generally resulting in more flammable fuels on southwest aspects and in upper slope positions, where more severe fires occur (Weatherspoon and Skinner 1995, Taylor and Skinner 1998). Climate is characterized by cool wet winters and hot dry summers. The Klamath Mountains have dry Mediterranean-type summers with relatively frequent thunderstorms. These conditions result in productive forests that historically experienced frequent fires that ranged in severity and size.

As a consequence of diverse soil conditions, aspect, and variable fire regimes, vegetation in the California Klamath Province is very diverse. At high elevations, forests are dominated by Douglas-fir and true fir, whereas mixed Douglas-fir, Douglas-fir hardwood, and pine forests are common at the lower elevations. NSO in this region are associated with landscapes containing mosaics of vegetation types. Occupied sites, in particular, show a high degree of vegetative heterogeneity with more variable patch sizes and more perimeter edge than in other regions (Franklin and Gutiérrez 2002). In the Klamath region, ecotones, or edges between older forests and other seral stages, may contribute to improved access to prey (Franklin and Gutiérrez 2002).

Along the eastern edge of the province, natural conditions and past timber harvest contribute to a more fragmented landscape than what we observe in the western portion of the province. The east side is also characterized by a checkerboard of Federal and private ownerships where management regimes have exacerbated habitat fragmentation. About 75 percent of the land in this province falls within Federal ownership, primarily under the jurisdiction of the U.S. Forest Service.

B.4.2.4. Fire in the California Klamath Province

Fire is a naturally occurring disturbance factor in the Klamath Mountains that changes forest composition and diversity. Variations in fire frequency and severity create a mosaic of vegetation types that range in age and structural composition and are uniquely resilient to these mixed severity fire conditions (Halofsky *et al*. 2011, Williams and Baker 2012). Fire is also recognized as a significant driver in maintaining or increasing current levels of late-successional and old-growth forests in the west (Agee 1993, Agee and Skinner 2005, Davis and Lint 2005, Davis *et al*. 2011, 2015, 2022, USDI FWS 2011, 2012, Lesmeister *et al*. 2019, 2021). A recent analysis of 472 wildfires across the NSO range, and their intensity and area burned between 1987-2017, showed that under most wildfire conditions the microclimate of interior patches of NSO nesting forest likely mitigated fire severity and functioned as fire refugia. These areas burned at a lower severity than the surrounding landscape or did not burn. The authors suggest "with a changing climate, the future of interior forest as fire refugia is unknown, but the trends suggest older forests can dampen the effect of increased wildfire activity and be an important component of landscapes with fire resiliency" (Lesmeister *et al*. 2021).

Historic fire patterns in the province have been significantly altered over the last century because of fire suppression efforts resulted in denser forests with smaller openings than what historically occurred with a natural fire return interval (Skinner 2005). Pre-settlement fire-return rates averaged 11 to 20 years at lower elevations and 37 years at higher elevations. At that time, most fires were characterized as low to moderate severity, resulting in the mortality or reduction of understory trees and shrubs but survival of larger mid and overstory trees (Agee 1993). The effectiveness of fire suppression reduced the overall acreage burned in much of the province until recently. Prior to 2012, more remote and inaccessible areas continued to burn as they had historically, but we have seen a marked increase in the severity and frequency of large scale fires over the last decade in all areas of the province. Conditions have been exacerbated by reduced infrastructure, staffing and local markets to conduct small tree thinning and fuels reduction treatments, as well as hotter spring and summer temperatures with below average snowpack and rainfall.

At the rangewide scale and throughout the monitoring period, NR forest mostly occurred on Federal lands (there was an estimated 71.9 percent in 1993 and 72.5 percent in 2017). A loss of about 1,045,100 acres of NR forest on Federal lands is estimated to have occurred since implementation of the NWFP in 1994. Most losses (69.4 percent) occurred in the federally reserved land use allocations (Davis *et al*. 2022). This includes late-successional reserves, where conservation for NSO and other late successional species is prioritized (Davis *et al*. 2015). On Federal lands across the range, wildfires accounted for 67.3 percent of NR forest loss, with timber harvest accounting for 24.7 percent (Davis *et al*. 2022). Despite these losses, a rangewide increase of NR forest is estimated on about three percent of Federal lands due to ingrowth.

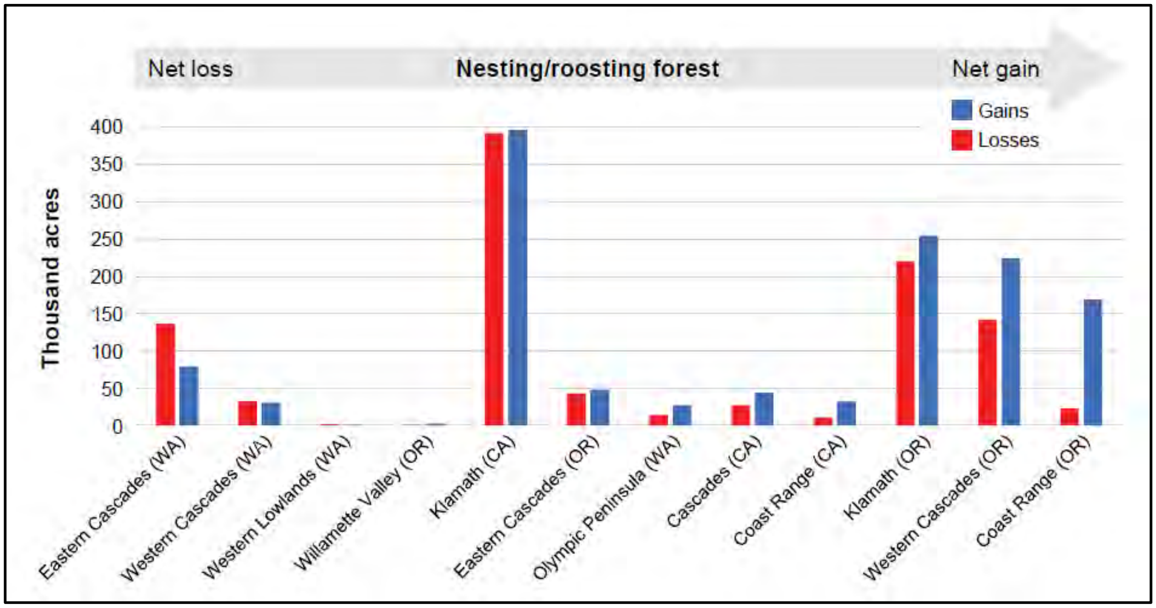
The wildfires over the last decade strongly influenced the amount and distribution of NSO habitat in the California and Oregon Klamath Provinces (Davis *et al*. 2022, 2015). Overall, the California Klamath and Oregon Klamath Provinces had the most NR forest loss when compared with the other provinces; 394,200 acres and 220,600 acres, respectively. The 25-year monitoring report for the NWFP describes, however, that gains from ingrowth in these and other provinces offset the losses (Davis *et al*. 2022).

While monitoring shows a net increase in NR forest on Federal lands across the NSO range, habitat fragmentation has increased. In addition, approximately 1.47 million acres of dispersal habitat, which provides for connectivity and gene flow, has been lost on Federal lands since 1993. Wildfires accounted for approximately 68 percent of this loss, with timber harvest accounting for 23 percent (Davis *et al*. 2022).

The 2022 fire season included multiple large fires burning in the California Coast Range and California Klamath Provinces. Notable fires include the McKinney fire, which burned a total of 60,138 acres, and the Six Rivers Lightning Complex, which burned a total of 41,600 acres.

Climate projections also indicate the Klamath and Interior California Coast regions may experience a continuation of current weather and precipitation trends resulting in the drier springs and summers, lower fuel moisture, and increased temperatures. These trends will increase the risk of large-scale wildfires, which can further reduce NSO habitat in the California Klamath Province. See Appendix A for more information regarding the impacts of wildfire on NSO and late-successional habitats.

Table B-1. Figure 7 from the 25-Year NWFP Monitoring Report displaying losses and gains in nesting/roosting forest on Federal lands.



B.4.2.5. NSO Habitat in the California Klamath Province

As described for the California Cascades recovery unit, northern spotted owls use structurally complex mid- and late-successional mixed conifer forests for nesting and roosting. Habitat attributes usually associated with these forests typically do not develop until 150-200 years of age (Thomas *et al*. 1990). In a sample of NSO "intensive use" and roosting sites, forest stands were determined to contain trees with the mean age ranging from 73-367 years (Thomas *et al*. 1990). In the Klamath Provinces (both California and Oregon), NSO use a broad range of habitat types for foraging, including forests composed of smaller trees with lower canopy cover (USDI FWS 2012).

<u>B.4.2.5.1. Nesting and Roosting Habitat</u>

In the California Klamath Province, NSO strongly select for specific habitat conditions and resources that occur along a broad gradient of vegetation structure strongly influenced by abiotic features (e.g., slope, elevation) and spatial arrangement of habitat patches. Forest stands selected for nesting and roosting are structurally complex and dominated by large trees. They contain multiple canopy layers, and high densities of coarse wood; are characterized by a mixed age class; and are typically close to seasonal watercourses and in lower slope positions. Douglas fir mistletoe is a common feature associated with nests and nesting habitat (Dunk *et al*. 2012).

In 2009, the Service developed structural parameters to classify nesting, roosting, foraging, and low-quality foraging habitat for NSO in the California Interior Region (USDI FWS 2009). This information was shared with private commercial timberland managers, CAL FIRE, and the state to avoid take on private lands during Timber Harvest Plan implementation. The 2009 science support document for take avoidance was based on expert opinion and publications and research from occupied NSO activity centers in the California and Oregon Klamath Provinces.

A more recent modeling effort for the development of a Relative Habitat Suitability (RHS) model was completed for the Recovery Plan and to assist in the designation of critical habitat. In those RHS models, the amount of NR edge and NR habitat accounted for about 76 percent of the total predictive power of the model to identify nest sites in the Western Klamath modeling region (USDI FWS 2012). Using forest metrics alone, NR models were best defined as areas having, 1) a diversity of large diameter trees, QMD of dominant conifers ≥20 inches, and ≥75 percent canopy cover (USDI FWS 2012).

B.4.2.5.2. Foraging Habitat

As described for the California Cascades recovery unit, there is a high degree of overlap in use between NR and foraging habitats.

B.4.2.5.3. Habitat for the Prey of Northern Spotted Owl

As described for the California Cascades recovery unit, snags, down wood, and decaying live trees are key resources for NSO prey. Several important prey species, including northern flying squirrel (*Glaucomys sabrinus*), dusky-footed woodrat (*Neotoma fuscipes*), Douglas' squirrel (*Tamiasciurus douglasii*), and some deer mouse (*Peromyscus* spp.) and chipmunk (*Neotamias* spp.) species use cavities in snags and decaying live trees for nesting, denning, and food storage (Maser *et al*. 1981, Carey 1991, McComb 2003, Martin *et al*. 2004). Other "defects" on live trees provide important resources for prey. For example, "witches' brooms" provide foraging, nesting, and resting structures for northern flying squirrels, bushy-tailed woodrats, chipmunks, and birds (Parks *et al*. 1999). Down wood provides small mammals, such as woodrats, western red-backed voles, Douglas' squirrels, and chipmunks, with cover, under-snow and food storage spaces, runways for moving above the forest floor, and material for dens (Maser *et al*. 1981, Carey 1991, McComb 2003). Down wood is also an important resource for truffles and mushrooms, providing the primary food sources for northern flying squirrels, western red-backed voles, and many other small mammals.

The primary prey species for NSO in the California Klamath Province are northern flying squirrels (which prefer denser stands of mature trees), and dusky-footed and bushy-tailed woodrats (which occupy diverse habitats including shrubby openings; mid, early and late successional habitats; and rocky outcrops). Relationships of northern flying squirrels with seral stages and forest structure have been a topic of considerable research and debate. Some studies have found that densities of flying squirrels are highest in old forests, or old forests of mixed conifer-deciduous composition (Carey *et al*. 1992, Carey and Johnson 1995, Smith 2007, Richie *et al*. 2009, and others). Other studies suggest the flying squirrel is a generalist species with respect to seral stage or stand age, and that canopy cover and distance between trees may be more important than seral stage or species composition (Rosenberg and Anthony 1992, Waters and Zabel 1995, Ransome and Sullivan 1997). Richie *et al*. (2009) found landscape composition to be a significant influence in flying squirrel occurrence; they were found more frequently within landscapes containing greater amounts of old forest cover.

Zabel *et al*. (1995) and Carey *et al*. (1992) found where woodrats are a primary food source, NSO home ranges are significantly smaller and contain significantly more edge habitat and less older forest than other areas in the range. In these areas, NSO are more likely to use a variety of habitats, including younger stands, brushy openings in older stands, and edges between forest types in response to higher prey density in some of these areas (Solis 1983, Sakai and Noon 1993, Carey *et al*. 1999, Sakai and Noon 1997, Franklin *et al*. 2000). The density of dusky-footed woodrats appears to be highest in sapling/bushy pole timber 15 to 40 years old and in older forests that have openings with abundant bushy understory (Sakai and Noon 1993, Hamm 1995, Carey *et al*. 1999, Hamm and Diller 2009).

B.4.2.5.4. Dispersal Habitat

Specific data on dispersal habitat use is not available for the California Klamath Province. A study from the eastern Washington Cascades suggests dispersing juveniles select stands with relatively high canopy closure, similar to those selected by adults for roosting (about 66 percent cover) (Sovern *et al*. 2015). Similar findings for the presence of older trees and denser canopy closure are described in earlier studies in the Oregon Coast range and in parts of Washington (Buchannan *et al*. 1995, Miller *et al*. 1997, Herter *et al*. 2002).

While dispersal habitat also includes nesting, roosting, and foraging habitat, any forest with adequate tree size and canopy cover to provide protection from avian predators and some foraging opportunities supports dispersal (USDI FWS 2011, 2012). It may include younger and less diverse forest stands than foraging habitat, but should contain some roosting structures for temporary resting and foraging habitat for dispersing juveniles (USDI FWS 2011, 2012). It should also be well-distributed across the landscape. Thomas *et al*. (1990) suggests management practices, such as visual corridors, riparian corridors, streamside management zones, geologic reserves, and other special management zones, provide habitat attributes conducive to NSO dispersal between habitat areas.

Based on an assessment of suitable habitat conditions after the 2021 wildfires, there is an approximate 1.6 million acres of nesting/roosting and 915,373 acres of foraging habitat in the California Klamath province on Federal lands (Davis *et al*. 2022-Northwest Forest Plan Habitat Monitoring Maps for the northern spotted owl).

B.5. Summary of Barred Owl Impacts to Northern Spotted Owl

Recovery objectives in the Recovery Plan for dry forests include maintaining sufficient NSO habitat in the short-term to allow them to persist in the face of threats from barred owl expansion and habitat loss from wildfires. While large wildfires continue to be a leading cause of NSO habitat loss on Federal lands, competition from barred owls is considered the primary cause of population decline (USDI FWS 2011, Dugger *et al.* 2016, Franklin *et al.* 2021). Barred owls have expanded their distribution across the range of the NSO and are now distributed throughout all of the provinces across the range (see discussion in Appendix A).

All National Forests in northern California in the range of the NSO (Klamath, Shasta-Trinity, Six Rivers, Mendocino), those in proximity such as the Rogue River-Siskiyou and Modoc National Forests, and the private industrial timberland managers with large-scale survey efforts, have confirmed occupancy and nesting by barred owls (USDI FWS 2000-2021 consultation records for various projects).

Data from both the nearby Willow Creek Study Area and the overlapping Regional Study Area in northwestern California show numerous detections over the years, reporting increases in the number of NSO territories with barred owl detections since 1991 and accelerating in recent years (Franklin *et al.* 2011 to 2015). Beginning in 2008, these two areas initiated barred owl-specific surveys. The proportion of surveyed NSO territories with barred owl detections across all of the Demographic Study Areas have shown marked increases each year since that time (Dugger *et al.* 2016, Franklin *et al*. 2021).

The available data suggests strong demographic effects to NSO and negative inter-specific interactions between the two species (Franklin *et al*. 2021, Courtney *et al.* 2004, Gutiérrez *et al.* 2007, Hamer *et al.* 2007, Livezy and Fleming 2007, Monahan and Hijamans 2007, Wiens *et al.* 2010, 2014, Dugger *et al.* 2011, 2016, Van Lanen *et al.* 2011). There is current evidence that barred owls occur in higher densities than NSO in many parts of the range (Hamer *et al.* 2007, Singleton *et al.* 2010, Wiens *et al.* 2014, 2011). In a recent study, the highest densities were in the Oregon Coast Range, with up to 20 barred owls per NSO territory reported (Wiens *et al.* 2017).

Barred owls and NSO share similar habitats and likely compete for food resources (Hamer *et al.* 2001, Gutiérrez *et al.* 2007, Livezey and Fleming 2007, Wiens *et al.* 2014). Barred owl diets are more diverse than NSO diets and include species associated with riparian and other moist habitats (e.g., fish, invertebrates, frogs, and crayfish), along with more terrestrial and diurnal species (Smith *et al.* 1983, Hamer *et al.* 2001, Gronau 2005, Wiens *et al.*, 2014). Where the two species overlap, barred owls may be taking primary prey of NSO, reducing availability and density of NSO prey. This can lead to a depletion of prey such that NSO cannot find an adequate amount of food to support reproduction or individual survival (Gutiérrez *et al.* 2007, Livezey and Fleming 2007). These impacts are likely having additional effects on ecosystem processes and food webs of other species (Holm *et al.* 2017).

In addition to competition for prey, barred owls compete for habitat (Hamer *et al.* 1989, Dunbar *et al.* 1991, Herter and Hicks 2000, Pearson and Livezey 2003, Wiens *et al.* 2014). Barred owls were initially thought to be more closely associated with early-successional forests than NSO, based on studies conducted on the west slope of the Cascades in Washington (Hamer *et al.* 1989, Iverson 1993). More recent studies show they frequently use mature and old-growth forests (Pearson and Livezey 2003, Gremel 2005, Schmidt 2006, Singleton *et al.* 2010). The most recent rangewide meta-analysis indicates barred owl colonization of NSO territories is more likely in lower-elevation territories in most of the demographic study areas (Franklin *et al.* 2021).

Most recently, apparent survival, recruitment, and territory colonization and extinction rates were the key vital rates associated with barred owl presence in NSO populations (Franklin *et al.* 2021). The authors suggest that without barred owl management, near-term extirpation of NSO is likely in portions of the range, and the small populations that may remain in other parts of the range will be highly vulnerable to extirpation from wildfire or other stressors, resulting in eventual extinction. Dugger *et al.* (2016) found the removal of barred owls in the Green Diamond study area in northern California had rapid, positive effects on NSO survival and rates of population change. Removal of barred owls here resulted in increases in NSO occupancy with an estimated survival rate of 0.859 compared with 0.822 in areas where barred owls were not removed (Diller *et al.* 2016). The study area had an overall lower density of barred owls compared with other portions of the NSO range, but the results suggest NSO are likely to recolonize their former territories following barred owl removal.

The meta-analysis of the larger, multi-year barred owl removal experiment (Wiens *et al.* 2021) in five demographic study areas across the range also demonstrates the removal of invasive barred owls has a strong, positive effect on survival of native NSO, and subsequently reduced long-term NSO population declines. Removal of barred owls also influenced the dispersal dynamics of resident NSO in at least two study areas where NSO from territories that did not have barred owl removal showed an increased estimated probability of movement to territories where barred owls had been removed. The results of the barred owl control experiments across the NSO range indicate that persistence and recovery of NSO populations are possible with active control, at least over the short term, in managed areas (Wiens *et al.* 2021).

The research and literature clearly demonstrate the negative influence barred owls are having on NSO site occupancy, fecundity, reproduction, apparent survival, and detectability. The data indicates that over the last 26 years, they are significantly contributing to NSO population declines (Olson *et al.* 2005, Forsman *et al.* 2011, Dugger *et al.* 2011, 2016, Franklin *et al.* 2021).

As barred owls have expanded, the occupancy of historical and new NSO territories is declining and NSO territory extinction is increasing. Where barred owls and NSO overlap in spatial distribution, habitat use, and prey use, there is a high potential for interference competition (Wiens *et al.* 2014, Dugger *et al.* 2011). Spatial avoidance may be one way for NSO to reduce these competitive interactions; however, this may put them at greater risk for predation and limit the resources available to them. Habitat loss will likely further constrain the two species to the same set of limited resources, thereby increasing competitive pressure and leading to additional negative impacts to NSO (Wiens *et al.* 2014). However, NSO recovery will also require short and long-term availability of older forests and suitable habitat on the landscape (Wiens *et al.* 2021, Franklin *et al.* 2021).

The current condition for barred owls and NSO further supports previous recommendations to conserve and preserve high-quality habitat (Forsman *et al.* 2012, 2011, Dugger *et al.* 2011, USDI FWS 2011, 2012). NSO can be displaced because of fire or habitat reductions from forest management. They may have increased difficulty in finding new territories to colonize, or in expanding their home ranges to compensate for habitat reductions when barred owls are present on the landscape. In areas where NSO and barred owl compete directly for resources, maintaining larger amounts of older forest (NR habitat) may help NSO persist in the short term (Dugger *et al.* 2011, 2016).

There are current information gaps regarding 1) the ecological interactions between NSO and barred owls (USDI FWS 2011), and 2) the effects of forest management on their interactions (Courtney *et al*. 2004, USDI FWS 2011). These factors are not fully understood or described, and ongoing and future monitoring may provide further understanding.

While the scientific literature has explored the link between climate change and the invasion by barred owls, changing climate alone is unlikely to have caused the invasion (Livezey 2009). In general, climate change can increase the success of introduced or invasive species in colonizing new areas. Invasive animal species are more likely to be generalists, like the barred owl, than specialists, such as the NSO. Generalists can typically adapt more successfully to a changing climate. Recent forecasts indicate climate change will have long-term and variable impacts on forest habitat at local and regional scales. Locally, this could involve shifts in tree species composition that influence habitat suitability. Frey *et al.* (2016) concluded that old-growth habitat will provide some buffer from the impacts of regional warming or slow the rate at which some species relying on old-growth habitat must adapt. This finding is based on modeling of the fine-scale spatial distribution, below-canopy air temperatures, in central Oregon's mountainous terrain. Similarly, Lesmeister *et al.* (2019) concluded that older forest can serve as a buffer to climate change and associated increases in wildfire, as these areas have the highest probability of persisting through fire events even in weather conditions associated with high fire activity.

Appendix A includes more detailed information on the effects of interspecific competition between NSO and barred owls, site occupancy information, and the effects of barred owl removal.

SOUTH FORK SACRAMENTO PUBLIC SAFETY AND FOREST RESTORATION PROJECT

Alternative 4 - Smoke Disturbance Area

0 1 2 4 Miles

- Project Boundary
- 1.3 Mile NSO Action Area Buffer
- Smoke Disturbance Area Quartermile Buffer of NRF Habitat > 2 acres
- Areas Exempt From Seasonal Smoke Restrictions
- NSO Nesting/Roosting Habitat
- NSO Foraging Habitat
- NSO Dispersal Habitat
- NSO Activity Center
- NSO Nest Core
- NSO Home Range
- 1 - Basic Custodial Care (Closed)
- 2 - High Clearance Vehicles
- 3 - Suitable for Passenger Cars
- 4 - Moderate Degree of User Comfort
- County Roads
- Other Roads
- Trails
- Existing Campground
- Private Campground
- Existing Picnic Area
- Existing Trailhead
- Perennial Streams
- Intermittent Streams
- Ephemeral Streams
- Lake/Pond/Reservoir
- National Forest Land
- Other Ownership

FWS-000520