



Northern Spotted Owl Annual Report

2021

February 2, 2022



Cover photo: Northern spotted owl (photo credit: HRC Forest Sciences).

TWENTY THIRD ANNUAL REPORT

**Submitted to the United States Fish and Wildlife Service, the California
Department of Fish and Wildlife, the NOAA Fisheries, and the California
Department of Forestry and Fire Protection**

By

Humboldt Redwood Company, LLC

**To fulfill the requirements of the Habitat Conservation Plan, 6.2, Northern
Spotted Owl Conservation Plan**

February 1, 2022

Project Managers/ Primary Authors

Brad S. Mauney

Brad Mauney

Sal Chinnici

Sal Chinnici

Project Description

Title: Northern Spotted Owl Annual Report 2021

Purpose: Northern spotted owl HCP monitoring

Date Initiated: March 1999

Projected End Date: Ongoing

Managers: Sal Chinnici, Director, Forest Sciences, and Brad Mauney, Lead Wildlife Biologist

Report Summary

During the 2021 northern spotted owl survey season a total of 781 calling stations were used to conduct nighttime surveys of the sample quadrats and Timber Harvesting Plans (THP). A total of 923 daytime status and follow-up visits were conducted. All core sites and all activity sites within the sample quadrats were visited to determine occupancy, reproductive status, and reproductive success (if applicable).

Management objective 1 of the HCP, which requires the maintenance of a minimum of 108 activity sites in the HCP area, was met in 2021 with 108 total occupied activity sites including the 108 core sites. There are currently 240 total activity sites (occupied and unoccupied) on the property. Management objective 2, which calls for maintenance of spotted owl pairs on a five-year running average of 80% of core activity sites, was not met in 2021 with a five-year running average of 61%. The pair occupancy rate for 2021 alone was 51.9% (56 of the 108 core sites were occupied by a pair of spotted owls). Management objective 3 requires the maintenance of a five-year running average reproductive rate of at least 0.61 fledged young per pair for the core sites (for those pairs monitored to determine reproductive output). Nesting activity was verified for 29 of the 56 pairs (of the 108 core sites), and a total of 35 young were fledged, resulting in a reproductive rate of 0.63 in 2021. The five-year running average of the reproductive rate for the 23rd year of the HCP is 0.43, below the metric for management objective 3.

HRC continues to have concerns about various threats to our spotted owl population, represented primarily by barred owls. The continuing invasion of barred owls has the potential to reduce or eliminate the HRC spotted owl population regardless of other effects.

We currently recommend continuing the same monitoring strategies for the 2022 season.

TABLE OF CONTENTS

EXECUTIVE SUMMARY3

INTRODUCTION4

STUDY AREA AND METHODS7

 Monitoring, Timber Harvesting Plan (THP), and Site Preparation Surveys8

 Monitoring Surveys8

 Timber Harvesting Plan (THP) Surveys10

 Site Preparation Surveys11

 Activity Site Determination12

RESULTS AND DISCUSSION13

 Barred Owls13

 West Nile Virus (WNV)20

 Sudden Oak Death (SOD).....21

 Follow-up Visits.....23

 Management Objectives 1 and 4.....23

 Management Objective 226

 Management Objective 326

 Activity Site Levels of Protection.....30

 Habitat Conditions32

 Banding Program37

 Regional Trends38

RECOMMENDATIONS39

 Surveys.....39

 Banding40

 Barred Owls40

 Scientific Panel/Management Objectives40

PROJECT REPORT DISTRIBUTION LIST

Susan Sniado
California Department of Fish & Wildlife
Northern California - North Coast Region
610 2nd Street
Eureka, CA 95501

John Peters
U.S. Fish and Wildlife Service
Arcata Fish and Wildlife Office
1655 Heindon Rd.
Arcata, CA 95521

Dominik Schwab
Cal Fire
135 Ridgeway Avenue
Santa Rosa, 95401

Clarence Hostler
NOAA Fisheries
1655 Heindon Road
Arcata, 95521

Chris Curtis
Cal Fire
118 South Fortuna Blvd
Fortuna, CA 95540

EXECUTIVE SUMMARY

The year 2021 was the twenty-third year of surveys and monitoring under the Northern Spotted Owl Conservation Plan (Habitat Conservation Plan or HCP §6.2) of the Humboldt Redwood Company (HRC) HCP. The intent of this report is to briefly summarize the methods, results, and management objectives of this conservation plan. As with previous reports, relevant appendices have been copied to a CD along with this report.

During the 2021 survey season we continued to rely upon the changes in survey methods resulting from the HCP minor modifications of 2002. Monitoring surveys were accomplished using 444 calling stations to cover all potential spotted owl habitat within the 2021 sample quadrats. Overall, a total of 781 calling stations were used to conduct nighttime surveys of the quadrats and Timber Harvesting Plan (THP) surveys. Follow-up visits were conducted to the locale of night contacts to determine the status and location of the owls contacted. A total of 924 daytime status and follow-up visits were conducted. All core sites, and all activity sites within the sample quadrats, were visited to determine occupancy, reproductive status, and reproductive success (if applicable).

Management objective 1 of the HCP requires the maintenance of a minimum of 108 activity sites¹ in the HCP area over the life of the permit. There were 108 total occupied activity sites in 2021, including the 108 core sites. Therefore, management objective 1 was met in 2021. Management objective 2 calls for maintenance of spotted owl pairs on a five-year running average of 80% of the core activity sites in the HCP area. In 2021, 56 of the 108 cores sites were occupied by a pair of spotted owls, for a pair occupancy rate of 51.9% (0.519). The five-year running average for the occupancy rate by pairs is now 61.1% (0.611). Management objective 3 requires the maintenance of a five-year running average reproductive rate of at least 0.61 fledged young per pair for the core sites (for those pairs monitored to determine reproductive output). During the 2021 breeding season, 56 pairs (of the 108 core sites) were monitored for nesting activity and

¹ **Activity site** (or activity center) is the area surrounding and including the nest tree or primary roost tree of a pair of spotted owls or single spotted owl, and where they are consistently located.

reproductive output. Nesting activity was verified for 29 of the 56 pairs. A total of 35 young were fledged, resulting in a reproductive rate of 0.63. The five-year running average of the reproductive rate for the twenty third year of the HCP was 0.43; therefore, it does not meet the target for management objective 3.

In February of 2014 HRC and the U.S. Fish and Wildlife Service (Service) completed a minor modification to the HCP that resulted in an additional timing requirement for THP surveys and an adaptive management requirement for occupancy and probability of detection analysis of HRC spotted owl surveys. Further detail is provided below.

Because the northern spotted owl was elevated at that time to the status of a candidate for state listing, HRC requested and received a Consistency Determination from the California Department of Fish and Wildlife (Department or CDFW) that the conservation measures of the HCP are consistent with the California Endangered Species Act.

HRC continues to have concerns about various threats to our spotted owl population, represented primarily by barred owls, but also including West Nile Virus, potential poisoning threats from trespass and marijuana grows on adjacent ownerships, and Sudden Oak Death. Individually or in concert these stressors have the potential to reduce or eliminate the HRC spotted owl population and its habitat regardless of HCP effects. At present, the actual effect of these factors on our population is unknown, although the negative effects of the barred owl invasion are well-documented throughout the range of the northern spotted owl.

We currently recommend continuing the same monitoring strategies for the 2022 season, including the continued implementation of the revised THP survey requirements related to the occupancy and detection probability analysis completed in 2015.

INTRODUCTION

The purpose of this Northern Spotted Owl (spotted owl or NSO) twenty-third Annual Report is to present the results of surveys and analyses of management objectives for the northern spotted owl (*Strix occidentalis caurina*) on lands of the Humboldt Redwood

Company, LLC (HRC) covered by the HRC Habitat Conservation Plan (HCP), U.S. Fish and Wildlife Service (USFWS, the Service) Permit TE828950-0.

The reporting period is from 1 January 2021 to 1 January 2022, and covers surveys conducted from March to August 2021. The year 2021 was the twenty-third year of surveys and monitoring under the Northern Spotted Owl Conservation Plan (HCP §6.2). Regarding annual surveys, or censuses, HCP §6.2.2 # 2 states:

Monitoring data shall be provided annually to the NSOSRP (Northern Spotted Owl Scientific Review Panel), the USFWS, and CDFW (California Department of Fish and Wildlife, the Department).

As stated in HCP §6.2, the overall conservation strategy for spotted owls is a habitat-based approach that includes the harvest, retention, and recruitment of habitat and essential habitat elements at both the landscape and activity site levels. The strategy also includes measures for disturbance minimization, population monitoring, and adaptive management techniques.

During the twenty-third year of HCP implementation, the northern spotted owl program continues to follow the “quadrat” sampling approach and minor modifications approved in 2002 to monitor the “core” owl sites for occupancy and reproduction.

These minor modifications approved in 2002 consisted of three primary components: 1) clarification that the HCP’s spotted owl management objectives apply to the “core” (i.e., Level 1 and Level 2 owl sites, 2) modification of the census techniques to concentrate on sampling “quadrats” made up of watershed units on the covered lands, and 3) modification of survey methods for site preparation activities, recognizing that these activities are different in nature from timber harvesting relative to breeding season disturbance. These minor modifications to the HCP have been appended to previous reports and are incorporated here by reference.

During a September 2003 meeting we also continued discussions with the USFWS and the CDFW regarding the evaluation for retention or removal of activity sites. These discussions eventually led to the development of a mutually agreed-upon survey methodology for removal of unoccupied sites from the HCP list of activity sites.

In 2009 the Habitat Retention Area (HRA) strategy was fully implemented. The intent of the HRAs is to provide long-term nesting and roosting habitat around the most productive NSO activity centers. The USFWS, CDFW, and HRC reviewed habitat and other maps, aerial photography, and known NSO locations to identify HRAs for 80 Level 1 NSO activity centers. The HRAs were developed for activity centers that have a history of occupancy and reproduction. Because a proportion of these sites may be unoccupied in some years, the HRAs are intended to continue to provide nesting and roosting habitat during these unoccupied years given that they may become reoccupied over time. If a Level 1 HRA is unoccupied, a replacement Level 1 activity center is selected from other available sites meeting required criteria. There are currently thirty-six unoccupied HRAs; consequently, we are currently maintaining a total of 116 Level One sites.

On 27 December 2013 the California Fish and Game Commission adopted the Department's findings that the listing of the northern spotted owl as a threatened or endangered species under the California Endangered Species Act (CESA) may be warranted, resulting in candidate status for the spotted owl during the status review period. Under CESA, a candidate species receives protection from "take" as if it were listed, until such time as a status review is conducted and a final listing determination is made.

HRC, the Service, and the Department discussed NSO management and monitoring in light of this change in status and agreed to an HCP minor modification regarding THP surveys and HCP adaptive management. HRC agreed to conduct an occupancy and probability of detection analysis of our NSO survey data from 2003 – 2014 to achieve a better understanding of how many day, and/or nighttime surveys are necessary to detect spotted owls, considering the presence of barred owls in the region. The analysis was completed prior to the 2015 survey season, and will be revisited every five years, or as needed.

Subsequently, because the northern spotted owl is a federally covered species under the HRC HCP, HRC applied for a Consistency Determination through the Department and

received a concurrence letter on 20 February 2014. On 26 August 2016, the California Fish and Game Commission voted to list the NSO as a threatened species in California.

This brief introduction of the 2021 spotted owl program is expanded below. In particular, this report discusses: 1) the study area and methods used in the assessment of spotted owls within that study area, 2) results of the survey efforts, 3) the meaning of the results both biologically and with respect to the management objectives of the HCP, and 4) HRC's year 2022 action plan for the spotted owl conservation plan.

STUDY AREA AND METHODS

The HRC HCP covered lands currently encompass approximately 209,000 acres and are located in coastal Humboldt County in northern California (Map 1). The HCP area is characterized by mountainous terrain, a maritime climate, and dense coniferous forests, primarily dominated by the coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*) forest-types.

In general, field survey methods for spotted owls are conducted following guidelines in the U.S. Fish and Wildlife Service protocol, "Protocol for Surveying Proposed Management Activities That May Impact Northern Spotted Owls" (USFWS 1992). During the 2011 survey season we began to incorporate changes proposed by the USFWS for northern spotted owl surveys in a revised protocol (2011 Northern Spotted Owl Survey Protocol, USFWS 2011a). For example, we used digitally recorded and amplified spotted owl calls consisted of a mix of standard territorial calls (e.g., 4 and 5 note calls), contact hoots and whistles, and agitated calls digitally recorded and broadcast using Wildlife Technologies® MA-15 electronic callers, or Fox Pro ® "Fury" or "Firestorm" electronic callers.

For all survey methods, when a spotted owl response is evoked during the nighttime surveys, presence, and if possible, status is determined with a follow-up daytime visit. Follow-up visits were conducted using daytime walk-ins of the habitat to attempt to locate nesting or roosting owls. Owl sites were checked to determine occupancy and nesting status. The surveyor hikes in to a known historic NSO activity site, or returns to

the site of a survey contact, and uses voice calling and/or amplified calls to contact the spotted owls which may be nesting or roosting at the site. The suitable habitat in an area roughly 0.5 mile around the previous contact is used as a search area. When a single owl, or a pair of spotted owls, is contacted on the follow-up visit the surveyor offers prey items (domestic mice) in an attempt to establish breeding status.

MONITORING, TIMBER HARVESTING PLAN (THP), AND SITE PREPARATION SURVEYS

As discussed above, minor modifications to the HCP that were approved by the CDFW and USFWS in 2002 affected the survey methodology for monitoring, THP, and site preparation activities. For monitoring, or census purposes, a quadrat sampling design was implemented to replace a complete census. THP survey methods were refined as a result of experience from the first three years of HCP implementation. In addition, surveys for site preparation activities were modified in recognition of the characteristics and duration of activities that are involved, and the potential for disturbance to spotted owls during the breeding season.

Monitoring Surveys

The Northern Spotted Owl Conservation Plan, HCP §6.2.2, # 2 reads:

PALCO shall conduct complete annual censuses to monitor all activity sites on the ownership and to determine numbers of pairs, nesting pairs, and reproductive rates. PALCO may use a sampling methodology, rather than a complete census, provided that the sampling proposal has been reviewed by the NSOSRP and approved by the USFWS and CDFW. Monitoring data shall be provided annually to the NSOSRP, the USFWS, and CDFW.

The USFWS, CDFW, NSOSRP, and PALCO had agreed that using a sampling methodology, rather than a complete census is likely to have several benefits for the population of spotted owls on HRC's covered lands as well as for HRC staff. Following agreement between PALCO, the USFWS, and the CDFW that the HCP management objectives (HCP §6.2.1) for pair occupancy and reproduction apply to the core sites as in HCP §6.2, Table 7, the objectives of a sampling methodology were therefore clarified.

Thus, the objectives of sampling a subset of the covered lands each year via night surveys include:

- Tracking known sites within the quadrats surveyed,
- Finding new sites that may be used as part of the minimum level (core) sites,
- Inventorying sites related to management activities, and
- Tracking the number and location of sites within a given geographical area over time, to help provide information on the effects of management activities.

The quadrat approach relies on large hydrologic areas containing multiple owl territories as the basic sampling units (Map 1). The hydrologic units are based on significant watershed areas (e.g., Freshwater Creek, Elk River), using the dividing ridgelines as the boundaries between units. Where necessary to maximize sampling efficiency, hydrologic units were combined into logical units, resulting in a total of 20 quadrats. In other words, if a hydrologic unit on the periphery of the covered lands contained a relatively small portion of HRC covered property, then it was incorporated into an adjoining, logical unit. During the 2021 season, quadrats 8, 12, 14, and 19 were surveyed (Monument, Larabee Creek, Petrolia, and Yager Creek). The basic methods and reporting requirements of the quadrat sampling approach are as follows:

1. Using USFWS night survey protocol techniques, conduct three survey visits of all suitable habitat in the four quadrats for that sample year.
2. Use daytime follow-up visits (again using USFWS techniques) to check occupancy and reproductive status of all known sites in the quadrat (including any core sites).
3. In addition to the visits in item # 2, use daytime follow-up visits to check occupancy and status of any sites contacted on the night surveys.
4. In addition to calculating the values of pair occupancy and reproductive rate for the management objectives of HCP §6.2.1 for the core sites, also calculate the results of the same values for all sites monitored in the quadrats. These combined data will be used to track pair occupancy and reproductive trends over time, and

will be compared to information gathered on spotted owls at other study sites in northern California.

5. Prior to 1 June each year HRC shall report to the USFWS and the CDFW on the quantity and distribution of suitable spotted owl habitat in the quadrats and on the covered lands as a whole. This information will be used to help understand potential reasons why management objectives may not be met, and potential means of correction (e.g., HCP §6.2.3 # 6).
6. All survey and status visit results, as well as habitat information from item # 5, will be reported annually in the HCP Annual Report, due each year on 1 February.

Timber Harvesting Plan (THP) Surveys

The methods for surveying THPs in HCP §6.2.2 # 3 also underwent minor modification in 2002, as a result of discussions and agreement between the CDFW, USFWS and PALCO. Refinements in the THP surveys were primarily in the areas of timing of surveys, and clarification in procedural language. The modifications have been included in previous reports and correspondence and are incorporated here by reference.

Additions were made to the THP survey language in 2009, and again in 2012, to clarify the meaning of “continuous operations”, as follows:

- (a) *Note: HRC and the Wildlife Agencies agree that in this context, “maintained continuously” means that:*
 - i) *Operations can only be shut down for a maximum of 5 consecutive days, including weekends,*
 - ii) *Only 3 of the 5 shut down days can be non-weather related,*
 - iii) *Operations must occur for 3 consecutive days between any consecutive 5 day shutdown period, and*
 - iv) *During any consecutive fixed 10 day period beginning February 21 there must be at least 5 days of operations.*
 - v) *If item iii) is applied, there must be 5 consecutive days of operations following the 5-day shutdown, 3-day operations, 5-day shutdown event.*
- (b) *In this context hauling of logs or equipment does not constitute “continuing operations”.*

Most recently, the February 2014 HCP minor modification required a change in survey timing, and an adaptive management requirement for a survey analysis, with the results intended to guide future survey effort.

THP survey modification:

For new operations, except site preparation, initiated in the period beginning February 21 and ending on or before August 31, the THP area and a 1,000-foot buffer shall be surveyed. Three survey visits, each separated by at least one week, shall occur prior to the start of operations, but after March 1. At least one visit shall occur on or after April 1. Survey efforts may be modified pursuant to HCP Section 6.2.3, Item 8 within the constraints of a minimum of three visits, and a maximum of six visits range. (Minor modification added language is underlined).

Adaptive management addition:

8. *In 2014, and at five-year intervals thereafter, HRC shall conduct an analysis of spotted owl occupancy and detection probabilities using their accumulated survey data. The analysis shall include appropriate covariates for other factors that explain detectability. The Wildlife Agencies will review the appropriateness of the analysis methods. The results will be evaluated to determine the appropriate number of night and/or daytime survey visits necessary to maintain $\geq .90$ confidence interval, (e.g., $CI = 1 - (1 - p_{survey})^{n_{surveys}}$) to detect a spotted owl, if present, for new operations initiated in the period beginning February 21 and ending on or before August 31. Survey efforts will be modified accordingly to maintain this confidence interval, within the constraints of a minimum of three visits, and a maximum of six visits range. HRC, the Wildlife Agencies, and/or the NSOSRP will meet to review the results and determine modifications, if necessary.*

During the 2021 survey season, for new timber operations we conducted six nighttime surveys of the THP area and buffer. There were 24 THPs that received six nighttime surveys and a subset of 8 THPs that received continuous operations surveys.

SITE PREPARATION SURVEYS

Site preparation activities, e.g., those activities undertaken following timber harvest and in preparation for reforestation of a site, typically have little potential for disturbance of breeding, and are of relatively short duration (the methods of surveying for spotted owls for these kinds of activities also were subject to minor modification during 2002). Again, the surveys as described in the modified HCP §6.2.2 # 3 have been appended to previous reports. There were no site preparation-specific surveys conducted in 2021.

ACTIVITY SITE DETERMINATION

As in past years under the HCP, occupancy and reproductive criteria used were consistent with those outlined by the USFWS protocol, along with guidance received from the USFWS and the CDFW. Further, in 2002 the CDFW, USFWS and PALCO discussed and agreed upon a method for determining the establishment and also possibly the location of activity centers based on audio contacts only, and in 2003 agreed upon standards for removal of unoccupied sites. These methods have been discussed and appended in previous reports.

Following a resolution meeting and discussion with the Department, the Service and the HCP Monitors in the fall of 2013, Appendix D of this report was modified to include additional information regarding unoccupied activity centers. Based on those discussions and using the guidance of the “Decision Tree”, the following twenty sites (seven of these sites are Level One sites with an HRA and would not have been a candidate for removal) have been identified as unoccupied. However, considering the recent influx of barred owls and other factors HRC opted again for a conservative approach in 2021 and *have not* removed these sites from the GIS layer for 2021 (site location, watershed):

Table 1. HCP NSO Sites that met the criteria for ‘dropped’ status but were retained.

HRC Activity Center Number	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Site Name
32	ONE	No Contact	No Contact	ONE	Upper Cooper Mill MMCA
33	ONE	No Contact	No Contact	ONE	Middle Cooper Mill MMCA
41	ONE	No Contact	No Contact	ONE	Road 24/Allen Creek MMCA
61	THREE	No Contact	No Contact	THREE	Lower Kiler Crk
142	THREE	No Contact	No Contact	THREE	Lower Monument Crk
163	ONE	No Contact	No Contact	ONE	Road 3, Yager Creek
209	ONE	No Contact	No Contact	ONE	Lower McGinnis Creek
212	ONE	No Contact	No Contact	ONE	Lower Pritchard Creek
216	THREE	No Contact	No Contact	THREE	Strawberry Creek
219	THREE	No Contact	No Contact	THREE	McGinnis Crk North
227	THREE	No Contact	No Contact	THREE	Middle Monument Creek
274	TWO	M	No Contact	THREE	Middle Dinner Creek
300	TWO	U	No Contact	THREE	Upper Balcom Creek

HRC Activity Center Number	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Site Name
332	ONE	No Contact	No Contact	ONE	Yager Creek MMCA
348	THREE	No Contact	No Contact	THREE	Larabee Ranch
351	THREE	No Contact	No Contact	THREE	Upper Wolverton Gulch
354	THREE	No Contact	No Contact	THREE	Upper Larabee Creek
357	THREE	No Contact	No Contact	THREE	North Fork Yager Creek
370	THREE	No Contact	No Contact	THREE	Sockeye/Larabee
376	THREE	No Contact	No Contact	THREE	Yager Creek Road 3

RESULTS AND DISCUSSION

Monitoring surveys were accomplished using 444 calling stations to cover all potential spotted owl habitat within the 2021 sample quadrats. In comparison, during the 2020 season we used 375 calling stations to cover the habitat within the sample quadrats on HCP covered lands. Overall, a total of 781 calling stations were used to conduct nighttime surveys of the quadrats, activity centers and THPs in 2021.

Surveys in 2021 resulted in the equivalent of 3,609 nighttime survey visits, in comparison to 3,375 survey visits in 2020.

BARRED OWLS

HRC has continued tracking detections of barred owls (*Strix varia*), as did the previous landowner, since the species began responding to spotted owl calls on surveys starting in 1991. Mapping of the detections and nest sites illustrates: 1) greater activity to date in the northern areas of the ownership, as would be expected given the known southward movement of the barred owl invasion, 2) greater numbers of detections along riparian corridors, and 3) an indication of barred owl preference for the old growth MMCA's and Reserves (Map 2).

Given the evidence from Washington, Oregon, and other regions of California that barred owls can have a significant impact on occupancy and reproduction of spotted owls in spite of habitat retention efforts (Anthony et al. 2004, Courtney et al. 2004, USFWS 2008, Gutiérrez et al. 2007, USFWS 2011b, Dugger et al. 2016), HRC remains concerned

about the potential for barred owls to disrupt the management goals of the HCP for spotted owls. In fact, the Service has recognized that barred owls appear to be a greater threat to the recovery of spotted owls than was envisioned at the time of the spotted owl listing in 1990, and as a result has recommended immediate and coordinated action (USFWS 2008, USFWS 2011b).

Results of a pilot barred owl removal study on Green Diamond Resource Company lands in northern California indicated that the lethal removal of barred owls allowed recovery of northern spotted owl populations in the treated (barred owl removal) portions of the study area (Diller et al. 2016).

The USGS began a barred owl removal study in 2015 on three study areas in Oregon and Washington and by the end of the study period in 2019 had removed a total of 2,066 barred owls from the three study areas (Wiens et al. 2020).

According to Wiens et al. (2019) they observed an overall 63 percent decline in numbers of territorial pairs of spotted owls in control areas with a concurrent 19 percent increase in treatment (removal) areas. The pattern of change was most prominent in the Oregon Coast Range, where they observed an approximate 50 percent increase in the number of pairs of Spotted Owls in the treatment area with a 91 percent decrease in control areas.

According to Wiens et al. (2018) the initial experimental removals of barred owls had little measurable effect on occupancy and reproduction of spotted owls after the first 1-2 years of study implementation. Preliminary results of site-usage by pairs of barred owls indicated that removals were effective in reducing the study population by 19–43 percent with 2–3 years of removal effort (Wiens et al. 2019).

By the end of the 2019 season, post-removal changes were the most pronounced in the Oregon Coast Range study area, where the number of spotted owl pairs detected in treated (removal) areas had doubled during the study period yet decreased by 91% in the control areas (Wiens et al. 2020). The declining trend of spotted owls has continued in the control areas, with an overall 83% decline in territorial pairs over the 4-year period, whereas there was a 12% increase in the number of pairs detected in treated sites.

Wiens et al. (2021) concluded that lethal removal of barred owls in their study areas had a strong, positive effect on the survival of sympatric spotted owls and a weaker but positive effect on spotted owl dispersal and recruitment. After removal of barred owls from northern spotted owl territories, the estimated mean annual rate of population change for spotted owls stabilized in areas with removals, but continued to decline in areas without removals.

Barred owl activity in our study area continues to indicate that there are established barred owl territories with reproductively active pairs, in addition to what appears to be a “floater” population; that is, singles that are available to disperse into unoccupied territories. Interestingly, in 2021, there was an overall decrease in the total number of barred owl detections, with 41 total detections, compared to 57 total detections in 2020 (Figure 1). This decrease in barred owl detections could be attributed to annual variation in survey areas (typically northern areas of HRC like Freshwater and Elk River have a higher preponderance of barred owls). Since we began tracking the barred owl invasion, there have been 70 Level 1 sites that appear to have been displaced or disrupted by the presence of barred owls, including those shown below:

Table 1.5. Summary of Level One sites that have been affected by barred owls.

HRC Activity Center Number	LEVEL ONE WTH HRA	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Historic Barred Owl Detections within 0.5 mile?
3	YES	ONE	No Contact	No Contact	ONE	Yes
4	YES	ONE	PN1J	PN1J	ONE	Yes
5	YES	ONE	No Contact	PU	ONE	Yes
11	YES	ONE	No Contact	No Contact	ONE	Yes
13	YES	ONE	PU	PU	ONE	Yes
14	YES	ONE	No Contact	No Contact	ONE	Yes
16	YES	ONE	No Contact	No Contact	ONE	Yes
19	YES	ONE	No Contact	No Contact	ONE	Yes
22	YES	ONE	PU	No Contact	ONE	Yes

HRC Activity Center Number	LEVEL ONE WTH HRA	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Historic Barred Owl Detections within 0.5 mile?
23	YES	ONE	M	PN2J	ONE	Yes
26	YES	ONE	No Contact	No Contact	ONE	Yes
27	YES	ONE	PU	PU	ONE	Yes
28	YES	ONE	PU	M	ONE	Yes
30	YES	ONE	PU	PU	ONE	Yes
32	YES	ONE	No Contact	No Contact	ONE	Yes
33	YES	ONE	No Contact	No Contact	ONE	Yes
35	NO	ONE	PU	PN1J	ONE	Yes
39	YES	ONE	PU	PU	ONE	Yes
41	YES	ONE	No Contact	No Contact	ONE	Yes
50	YES	ONE	PU	M	ONE	Yes
51	YES	ONE	No Contact	No Contact	ONE	Yes
52	YES	ONE	F	No Contact	ONE	Yes
58	YES	ONE	M	M	ONE	Yes
62	NO	ONE	PU	PU	ONE	Yes
65	YES	ONE	PNF	PN2J	ONE	Yes
85	YES	ONE	PU	PU	ONE	Yes
88	YES	ONE	PN1J	PNF	ONE	Yes
91	NO	ONE	PNN	PNN	ONE	Yes
92	NO	TWO	M-nighttime audio only	PU	ONE	Yes
97	YES	ONE	No Contact	No Contact	ONE	Yes
98	NO	ONE	PN2J	F	ONE	Yes
99	YES	ONE	No Contact	No Contact	ONE	Yes
101	NO	ONE	PN2J	PN1J	ONE	Yes

HRC Activity Center Number	LEVEL ONE WTH HRA	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Historic Barred Owl Detections within 0.5 mile?
123	YES	ONE	No Contact	No Contact	ONE	Yes
125	YES	ONE	PNN	PN2J	ONE	Yes
130	YES	ONE	No Contact	No Contact	ONE	Yes
133	NO	TWO	F	PNF	ONE	Yes
137	NO	ONE	PU	PN2J	ONE	Yes
147	YES	ONE	No Contact	No Contact	ONE	Yes
154	YES	ONE	PU	PU	ONE	Yes
163	YES	ONE	No Contact	No Contact	ONE	Yes
165	YES	ONE	PU	PU	ONE	Yes
170	YES	ONE	No Contact	No Contact	ONE	Yes
196	YES	ONE	No Contact	No Contact	ONE	Yes
197	YES	ONE	No Contact	No Contact	ONE	Yes
209	YES	ONE	No Contact	No Contact	ONE	Yes
217	YES	ONE	PU	F	ONE	Yes
218	YES	ONE	No Contact	No Contact	ONE	Yes
234	YES	ONE	No Contact	No Contact	ONE	Yes
236	NO	ONE	PNN	PN2J	ONE	Yes
254	YES	ONE	PU-nighttime audio only	PU	ONE	Yes
260	YES	ONE	F	No Contact	ONE	Yes
272	YES	ONE	M	No Contact	ONE	Yes
293	YES	ONE	No Contact	No Contact	ONE	Yes
310	NO	ONE	PNF	M	ONE	Yes
319	YES	ONE	No Contact	No Contact	ONE	Yes

HRC Activity Center Number	LEVEL ONE WTH HRA	2020 Level of Protection	2020 Status	Current Protocol Status	Level of Protection for 2021	Historic Barred Owl Detections within 0.5 mile?
320	YES	ONE	PN1J	M	ONE	Yes
321	YES	ONE	PU	PN2J	ONE	Yes
329	YES	ONE	PU	No Contact	ONE	Yes
331	YES	ONE	No Contact	PU	ONE	Yes
332	YES	ONE	No Contact	No Contact	ONE	Yes
346	NO	ONE	PU	PN2J	ONE	Yes
347	NO	ONE	PN2J	PNF	ONE	Yes
366	NO	ONE	PU	PN1J	ONE	Yes
368	NO	ONE	M	F	ONE	Yes
369	NO	ONE	M	PU	ONE	Yes
380	NO	TWO	U	PN1J	ONE	Yes
382	NO	ONE	PU	PN1J	ONE	Yes
540	YES	ONE	No Contact	No Contact	ONE	Yes
574	YES	ONE	F	M	ONE	Yes

N/C=no contact, M=single male, F=single female, P=pair, PU=pair unknown status, PN=pair nesting, PNN=pair non-nesting, PNF=pair nest failed, PN1J=pair nesting 1 juvenile, PN2J=pair nesting 2 juveniles.

The number of barred owl detections over time within 0.5 mile of spotted owl activity centers is shown in Figure 1.

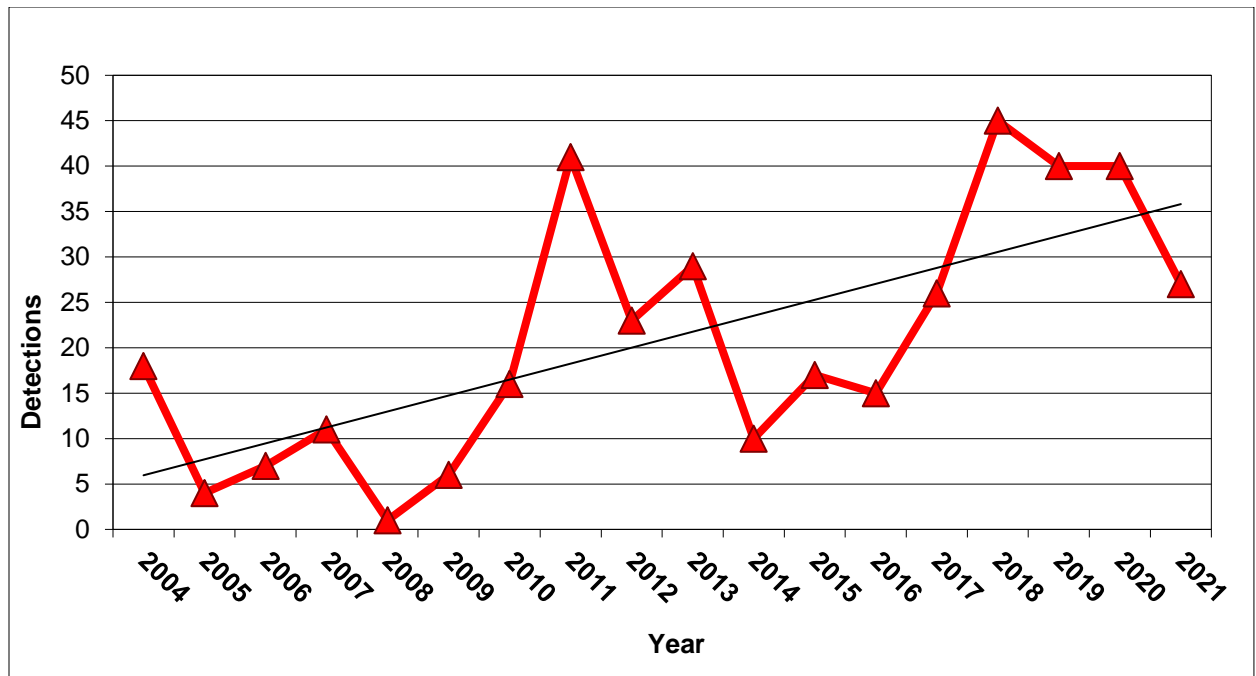


Figure 1. Barred owl detections within 0.5 mile of spotted owl activity sites on HRC lands 2004-2021.

In 2021 there were 26 detections of barred owls on night and daytime surveys at HCP spotted owl sites including:

- 85 (Bridge/Byron Creek)
- 123 (Root Creek)
- 253 (Blue Slide Creek/Kneeland)
- 284 (Bear River)
- 310 (Four Creeks/Bear River)
- 391 (Kneeland)

In contrast, over the last several years there have been 21 activity sites that have been re-occupied by spotted owls after having been occupied by barred owls for a period of time:

- 7 (Dunlap Gulch)
- 9 (North Fork Elk River)
- 11 (Doe Creek)

- 28 (Strong's Creek)
- 41 (Road 24 Yager Creek)
- 99 (Chadd Creek)
- 126 (Lower Cloney Gulch)
- 153 (Upper Freshwater Creek)
- 166 (Hely Creek)
- 167 (Corbett Ranch)
- 260 (Gas Wells)
- 33 (Middle Cooper Mill Creek)
- 38 (Yager Creek)
- 287 (McCready Gulch/Freshwater)
- 320 (Bridge Creek)
- 163 (Yager Creek)
- 88 (Greenlaw Creek)
- 346 (Yager Creek)
- 293 (Clapp Gulch)
- 574 (Mt. Bemis-Grizzly Creek)
- 98 (Allen Creek).

See Map 2 for current and historic barred owl detections and nest sites located on HRC property.

WEST NILE VIRUS (WNV)

There is limited information on WNV to report for 2021. Based on preliminary data, there were no human disease cases reported in Humboldt County in 2021. However, WNV continues to have the potential to be a threat to the northern spotted owl range-wide, and specifically to the Klamath region population (Courtney et al. 2004).

WNV has been documented in other species in Humboldt County. Mosquitoes, the vector organism for WNV, are very prevalent in the area. WNV has the potential to disrupt HCP objectives regardless of the covered activities of the HCP; however, at the present time

there are no avian diseases that appear to be significantly affecting spotted owl populations (USFWS 2008).

Blakesley *et al.* (2004) In USFWS (2010) offered two different scenarios for the possible outcomes of an infection by WNV of spotted owl populations:

- Spotted owls could tolerate severe, short-term population reductions caused by the virus because populations are widely distributed and number in the several thousands (see above also), and
- The virus will cause unsustainable mortality because of the frequency and/or magnitude of infection, thereby resulting in long-term population declines and extirpation from parts of the current range.

SUDDEN OAK DEATH (SOD)

The infection of hardwood species, especially tanbark oak (*Notholithocarpus densiflora* var. *densiflora*), by the invasive plant pathogen *Phytophthora ramorum* (Pythiaceae) and subsequent deterioration of spotted owl habitat has been raised as a threat (Courtney et al. 2004, Courtney et al. 2008, USFWS 2008). The pathogen is not a fungus or a bacterium, but a member of a unique group of organisms called oomycetes (water molds). Oomycetes share some characteristics of fungi but are biologically different and more closely related to yeasts and brown algae.

The effects of this disease, known as Sudden Oak Death (SOD), could be especially harmful to spotted owl habitat in the Bear and Mattole watersheds on HRC lands where the hardwood component of habitat is most prevalent. Yearly weather patterns are thought to significantly influence the reproduction and spread of this disease.

SOD survey and monitoring results from 2008 to 2021 on HRC lands indicate evidence (positive stream samples and known infected trees) of the pathogen in the Canoe Creek, Decker Creek, Bull Creek, Thompson Creek, and Elk Creek planning watersheds as well as positive stream samples from the Lower Larabee planning watershed (the source of infection is likely off property to the east). All these sites are in the greater Upper Eel watershed unit. In 2018 UC Davis Ag-Extension staff recovered positive SOD samples from the Chadd Creek watershed (nested in the greater Lower Eel/Eel River Delta

watershed unit) but were unable to locate the source of the infection. There have also been positive stream samples taken from the Grizzly Creek and Stevens Creek planning watersheds in the greater Van Duzen watershed unit; the location and extent of the infection there is still under investigation. During the 2017 surveys stream samples taken from Yager Creek just below the confluence with Lawrence Creek in the greater Van Duzen watershed unit tested positive for the pathogen. Additional sample points on Yager Creek; upstream of the confluence were tested in 2018-2021 and results indicate that while Yager Creek is infected (source yet unknown) Lawrence Creek appears to be currently free of the SOD pathogen. In the northern portions of the HRC ownership stream samples recovered from Elk River, within the Lower Elk River planning watershed and greater Elk River watershed unit on the western edge of HRC lands, were negative for the SOD pathogen. Samples recovered from Freshwater Creek below the confluence with Graham Gulch in the Cloney Gulch planning watershed within the greater Freshwater Creek watershed unit also tested negative for the SOD pathogen in 2019.

HRC did not sample any streams in 2020, as the project was put on hold due to COVID-19 restrictions and lack of ability to process samples at the local lab. Southern and Central California areas were sampled by a number of regional agents and the results were mixed. Statewide vegetation sampling results indicate that SOD expanded in area and number of infected trees in 2020. The Statewide Estimated Rate of Infection rose from 6.1 to 7.4 percent. While California did have a relatively low rainfall accumulation in 2020, there was significant spread of the pathogen in the central portion of the state. Cool coastal counties had stable or decreasing amounts of infection (Santa Cruz, Monterrey, San Mateo north) while warmer, mesic areas (Carmel, Contra Costa, Northern Inland Sonoma County) experienced an increase in the number of infected trees and overall infested area. Very warm areas (South Alameda, Santa Clara, Lake County, Napa, Santa Rosa, San Francisco, and Oakland) also saw some decrease in infection. The increase in SOD infection in spite of the low rainfall may prove that the disease has become endemic to those areas (SOD Blitz 2020 Report).

Results of 2021 statewide vegetation sampling efforts show a decrease in estimated infection rate compared to last year, down to 3.3% from 7.4% in 2020. This is the lowest

rate since 2018. Counties in central California/bay area still show higher infection rates than do northern counties, especially east bay areas and Sonoma County which have estimated infection rates ranging from 4% to almost 19% (SOD Blitz 2021 Report). Tan oak and bay laurel continue to be the species most affected by the pathogen in wildland and wildland/urban settings.

HRC continued stream sampling in 2021 and collected samples from Bear Creek, Lawrence Creek, Yager Creek, Bear River, as we have in past years, but also collected from both Conklin Creek and McGuinness Creek (both in the Mattole planning watershed). All samples taken from HRC streams in 2021 were negative for the presence of *Phytophthora ramorum* except Yager Creek which is known to be infested.

FOLLOW-UP VISITS

Timely follow-up visits were conducted to the locale of night contacts to determine the status and location of the owls contacted. All core spotted owl sites, and all activity sites within the sample quadrats (“quadrat sites”) were visited to determine occupancy, reproductive status, and reproductive success (if applicable). Other sites were visited to determine occupancy prior to the August designation of Level 1 sites.

A total of 925 daytime status and follow-up visits were conducted in 2021, compared to 928 in 2020.

Surveys and daytime status visits were conducted in order to collect data to determine the HCP management objectives (HCP §6.2.1) for the core sites, as discussed above in the Study Area and Methods section.

MANAGEMENT OBJECTIVES 1 AND 4

Management objectives 1 and 4 of the HCP require the maintenance of a minimum of 108 activity sites in the HCP area over the life of the permit, and at least 108 total activity sites in the twenty-third year of the permit (2021). As noted above, the HCP management objectives apply to the 108 core sites, consisting of 80 Level 1 sites, and 28 Level 2 sites.

Therefore, with the 108 core activity sites, management objectives 1 and 4 have been met for 2021 (Table 2).

In 2021, 20 activity centers met the criteria for removal from the active GIS layer according to the Decision Tree for Removal of Activity Centers but have been retained (Appendix F).

Table 2. HCP northern spotted owl sites and occupancy status for 2021.

Parameter Description	All Sites	Core Sites	Quadrat Sites
A) HCP Occupied Sites	108	108	24
B) Occupied by Pairs	56	56	14
C) Occupied by Male	32	32	7
D) Occupied by Female	8	8	2
E) Occupied by Bird of unknown sex	2	2	1
F) Unoccupied (sites retained)	132	36	21
G) Unoccupied (sites removed)	0	0	0
H) Total HCP Property Sites	240	144	45
Occupancy rate by pairs* (HCP §6.2.1.2 target = 80%)	N/A	52%	58%

*Occupancy rate by pairs is determined by taking the number of sites occupied by pairs (B) and dividing it by the number of occupied sites: (A).

Core Sites include all Level 1 and Level 2 Sites.

The total number of HCP activity sites has remained relatively constant over the HCP years (Range 149-240, mean 195) (Figure 2). Only 149 activity sites were reported in the first year of HCP implementation (1999) when not all the HCP covered lands were surveyed. In 2000, several activity sites were included that were not occupied, were the result of take avoidance management prior to the HCP and were subsequently removed from the inventory for 2001. It should be noted that not all Level 3 sites are surveyed for occupancy or non-occupancy every year, depending on which quadrats are being surveyed, although we make the effort to visit each site at least once each season.

In 2021 there was one new activity center located in addition to one re-occupied site and one site that moved back onto HRC property. It is possible that the gradual increasing trend in spotted owl activity centers from 2008 – 2021 has been due to the movement of spotted owls as a result of increasing barred owl numbers, as well as the resulting barred owl influence on spotted owl activity centers.

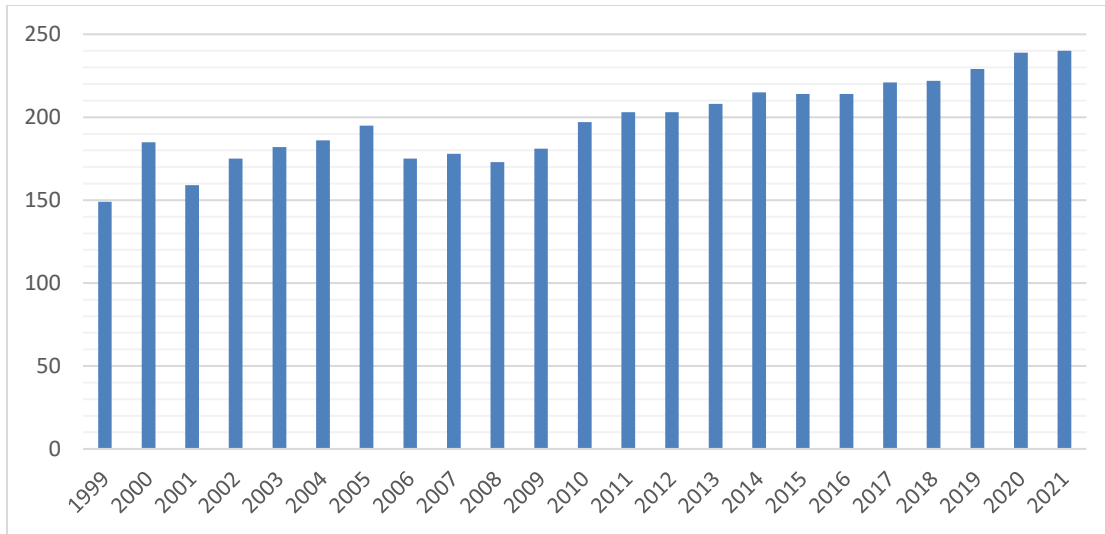


Figure 2. Total NSO Activity Sites by HCP Year.

MANAGEMENT OBJECTIVE 2

Management objective 2 calls for maintenance of spotted owl pairs on an average of 80% of the core sites in the HCP area. During HCP development, 80% was selected as a target by taking the average number of occupied sites that contained pairs during the period of 1991 to 1998. As per HCP §6.2.3 # 6, the values pertaining to management objectives 2 and 3 are to be averaged over running five-year periods (see below). Site occupancy surveys verified pairs at 56 of the core 108 sites during the 2021 season (Table 2), giving an occupancy rate by pairs of 52% (0.518). The five-year running average for the pair occupancy rate is 61% (Table 3).

To address the agreed-upon reporting components of the quadrat sampling approach, we also calculated the pair occupancy rate for all sites monitored in the quadrats, for comparison to results of the core sites. The pair occupancy rate for the 24 (occupied) activity sites within quadrats was 58%. For the quadrat sites, the five-year running average for the pair occupancy rate is 46% (Tables 2 and 4).

MANAGEMENT OBJECTIVE 3

Management objective 3 requires the maintenance of a five-year running average reproductive rate of at least 0.61 fledged young per pair for the core sites (for those pairs monitored to determine reproductive output). For establishment of a target reproductive

rate during HCP development, 0.61 was selected as a target by taking the average number of young fledged per pair during the period of 1994 to 1998. However, only pairs that were determined to be nesting, or confirmed by protocol visits to be non-nesting, were used in the calculation. Spotted owl pairs with “status unknown” are now also used in the equation.

During the 2021 breeding season, 56 pairs (of the 108 core sites) were monitored for nesting activity and reproductive output. Nesting activity was verified for 29 of the 56 pairs. A total of 35 young fledged, resulting in a reproductive rate of 0.63 for the year. Although this rate is almost twice that of last year’s, this results in a five-year running average reproductive rate of 0.43 (Table 3), which does not meet the target for management objective 3.

Table 3. Northern Spotted Owl Yearly Summary 2021.

Activity Center Status Definitions and Management Objectives	Activity Center Status	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Single Unk Sex	U	4	8	8	1	1	3	3	2	7	3	6	1	4	4	4	4	1	7	4	7	13	9	2
Single Male	M	29	31	14	4	11	6	9	7	11	9	10	7	9	9	6	7	9	16	12	17	31	30	32
Single Female	F	6	3	4	8	11	5	5	9	12	10	5	7	6	13	11	6	7	10	9	8	8	9	8
Pair Status Unknown	PU	66	43	39	38	42	38	38	45	47	21	30	44	51	49	52	50	42	26	36	41	25	45	24
Non-nesting Pairs	PNN	11	14	12	18	20	13	7	7	14	6	3	5	8	6	17	8	10	24	21	4	8	3	3
Nesting Pair (failed)	PNF	0	5	8	2	9	5	5	3	2	9	2	1	9	6	3	7	7	6	6	7	7	2	7
Nesting Pair (PN)	PN	2	0	1	5	1	0	1	3	0	6	3	6	0	1	1	0	0	0	0	0	0	0	0
Nesting Pair (PN1J)	PN1J	10	10	22	16	7	16	21	16	6	5	13	21	7	9	4	7	15	9	9	12	8	5	9
Nesting Pair (PN2J)	PN2J	21	46	47	22	6	22	19	16	9	38	36	16	14	11	10	19	17	10	8	12	8	6	13
Nesting Pair (PN3J)	PN3J	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
Total Nesting Pairs*		33	56	71	43	14	38	41	35	15	50	52	43	21	21	15	33	39	25	23	31	23	14	29
Total AC monitored *(after 2003 only 108 "core sites" are monitored for reproductive and pair rate)	Total # Sites	149	160	156	114	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108	108
Total Owls	Total # Owls	311	380	405	275	212	262	258	246	210	278	280	254	232	221	219	244	248	212	210	220	188	192	189
Pairs	Total # Pairs	110	118	130	101	85	94	91	90	78	86	87	93	89	82	87	91	91	75	80	76	56	62	56
Juveniles	Total # Fledglings	52	102	119	60	19	60	59	48	24	84	85	53	35	31	24	45	49	29	25	36	24	20	35
Pair Occupancy Rate	Pair Occupancy Rate	73.8%	73.8%	83.3%	88.6%	78.7%	87.0%	84.3%	83.3%	72.2%	79.6%	80.6%	86.1%	82.4%	75.9%	80.6%	84.3%	84.3%	69.4%	74.1%	70.4%	51.9%	57.4%	51.9%
Reproductive Rate	Reproductive Rate	0.61	0.86	0.92	0.59	0.22	0.64	0.65	0.53	0.31	0.98	0.98	0.57	0.39	0.38	0.28	0.49	0.54	0.39	0.31	0.47	0.43	0.32	0.63
Rolling Average Pair Occupancy Rate (5 Yr)	Rolling Average Occupancy Rate (5 Yr)	73.8%	73.8%	83.3%	88.6%	79.6%	82.3%	84.4%	84.4%	81.1%	81.3%	80.0%	80.4%	80.2%	80.9%	81.1%	81.9%	81.5%	78.9%	78.5%	76.5%	70.0%	64.6%	61.1%
Rolling Average Reproductive Rate (5 Yr)	Rolling Average Reproductive Rate (5 Yr)	0.61	0.86	0.92	0.59	0.64	0.65	0.60	0.53	0.47	0.62	0.69	0.67	0.64	0.66	0.52	0.42	0.42	0.41	0.40	0.44	0.43	0.38	0.43

*since 2003 only 108 core sites have been monitored for reproductive and pair rates.

Table 4. Northern Spotted Owl Yearly Quadrat Summary 2021.

Owl Status	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Single Unk Sex	1	2	2	1	2	3	0	0	2	2	6	0	2	1	3	0	2	4	5	3	2	6	1
Single Male	7	4	4	3	4	4	3	5	4	3	5	9	5	3	3	5	7	2	4	3	7	6	7
Single Female	1	0	2	1	3	1	0	3	1	3	1	2	4	7	7	3	4	3	2	5	1	1	2
Pair Status Unknown	12	12	8	6	13	13	7	15	11	3	9	4	22	9	18	13	9	12	7	11	12	8	7
Non-nesting Pairs	1	3	2	1	6	3	0	1	2	3	1	0	3	1	3	3	1	4	0	2	3	0	1
Nesting Pair (failed)	0	0	0	0	2	2	1	0	0	2	1	0	1	1	1	4	0	3	1	3	3	1	1
Nesting Pairs	12	10	18	10	7	12	9	4	2	17	19	9	3	5	0	11	6	5	5	5	6	5	6
Total Number of Activity Sites	34	31	36	22	37	38	20	28	22	33	42	24	40	27	35	39	29	30	34	29	34	27	24
Total Number of Owls	76	75	91	55	74	87	49	51	40	89	106	47	75	52	57	89	54	58	41	50	66	51	46
Total Number of Pairs	25	25	28	17	28	30	17	20	15	25	30	13	29	16	22	31	16	21	12	18	24	14	14
Total Number of Juveniles	17	19	27	16	9	19	12	3	3	31	34	10	6	9	0	19	9	7	6	3	8	10	8
Pair Occupancy Rate	73.5%	80.6%	77.8%	77.3%	75.7%	78.9%	85.0%	71.4%	68.2%	75.8%	71.4%	54.2%	72.5%	59.3%	62.9%	79.5%	55.2%	70.0%	35.3%	62.1%	70.6%	51.9%	58.3%
Reproductive Rate	0.68	0.76	0.96	0.94	0.32	0.63	0.71	0.15	0.20	1.24	1.13	0.77	0.21	0.56	0.00	0.61	0.56	0.33	0.50	0.17	0.33	0.71	0.57
Rolling Pair Occupancy Rate (5 YR)	73.5%	80.6%	77.8%	77.3%	77.0%	78.1%	78.9%	77.7%	75.8%	75.9%	74.4%	68.2%	68.4%	66.6%	64.0%	65.7%	65.9%	65.4%	60.6%	60.4%	58.6%	58.0%	55.6%
Rolling Pair Reproductive Rate (5YR)	0.68	0.76	0.96	0.94	0.73	0.72	0.71	0.55	0.40	0.59	0.69	0.70	0.71	0.78	0.53	0.43	0.39	0.41	0.40	0.44	0.38	0.41	0.46

In 2004 the Service clarified that the rolling averages, or running means, for pair occupancy and reproductive rates should be calculated by calculating a mean for each individual year, then calculating a mean of means, where $n = 5$ (Long 2004). This method is used for Tables 3 and 4.

For the quadrat sites, including all the Level 1-3 sites in the quadrat monitoring units, and using the number of pairs monitored for reproduction ($n = 14$), the 2021 reproductive rate was 0.57 (Table 4). The five-year running average for reproductive rate among quadrat sites is 0.46 (Table 4). The core site average reproductive rate is typically greater than the quadrat site rate, as would be expected given the selection of the core sites based on assumed habitat quality and history of successful reproduction, and this was the case again in 2021.

The NSOSRP recommended monitoring both the core sites and quadrat sites for occupancy and reproduction and comparing the results to other study sites within the region. Because the HRC core sites and quadrat sites are managed in ways that are specific to the HCP, a comparison of trends in occupancy and reproduction with other study sites that are managed under different strategies (e.g., intensive timber harvest, moderate harvest, little to no harvest) can provide insight as to how the HCP is working and possibly what other factors may be affecting the spotted owl population (e.g., barred owls, climate). The available information indicates that trends for both the core and quadrat sites continue to track the results of other study areas over time (Figure 4).

Per HCP § 6.2.3, #3, management objectives may be modified if new information becomes available following review of the NSOSRP recommendations and approval by the USFWS and CDFW.

ACTIVITY SITE LEVELS OF PROTECTION

HCP §6.2.2 # 4, Conservation Measures, requires that owl activity sites on the covered lands be assigned to one of three protection levels. Accordingly, in September of 2020, 80 activity sites were designated as Level 1 sites. HRC requested an extension of the 1 June requirement for Level 1 selection due to the continuing difficulty of surveying all the available sites by that date. The difficulty has increased in recent years due to the presence of barred owls in the study area.

USFWS and CDFW again granted HRC's request to extend the selection to 31 August to allow more time to visit the owl sites and provide greater flexibility in selection.

Selection of Level 1 sites was guided by the parameters described in HCP §6.2.2.4: 1) having the requisite habitat levels within a 0.7- and 1.3-mile radius of the activity center; and 2) having supported spotted owls in the previous year (2020), and also in the year selected (2021). There was one activity center that was not active in 2020 but was elevated to Level One protection in 2021 with agency approval (CDFW# 21-R1-CTP39-NSO).

In addition, as part of the minor modifications approved in 2002, further language regarding Level 1 sites was added to management objective 2:

Maintain spotted owl pairs on an average of 80 percent (over a five-year period) of the minimum of 108 activity sites on the ownership (as shown in Table 7, for 2002 this minimum number shall be 115 activity sites, then 108 for 2003 and all subsequent years). At least 80 of these sites shall be Level One sites, and the balance shall be Level Two sites. PALCO intends to maintain these selected Level One and Level Two sites as the core sites for a period of from three to five years, or as long as possible, given other circumstances that may arise, and may preclude their maintenance as such. PALCO intends to select core sites that are historically stable, reproductively successful, and that have minimal disturbance, given that they occur in a managed landscape. (Emphasis added).

In keeping with the requirements of HCP §6.2.2 # 4 and # 5, if less than 500 acres of suitable habitat exists within 0.7 miles, or less than 1,336 acres of suitable habitat exists within 1.3 miles, the acreage of habitat cannot be reduced.

HRC is currently maintaining 116 Level One sites (83 Level One sites with an HRA and 33 replacement Level One sites, per the HRA language).

See the appendices for details and information on habitat acreage relative to Level 1 sites, THP activity, and quadrats (Appendices A-C).

Level 2 protection measures were afforded to 28 sites in 2021 (HCP §6.2.2.5). Level 2 sites receive 1,000-foot buffers during the breeding season. After the breeding season, or if a non-nesting status is determined, harvest may occur around a Level 2 activity site, as long as an 18-

acre core area (the equivalent area of a 500-foot radius circle), with at least a 400-foot radius consisting of the best available habitat, is retained.

As with the Level 1 sites, as part of the minor modifications approved in 2002, further language regarding Level 2 sites was added to HCP §6.2.2 # 5, bullet # 4:

By 1 September of each year, PALCO shall designate the necessary number of Level Two sites, to make up the minimum number of activity sites as shown in Table 7.

Accordingly, in late August we designated 28 Level 2 sites, which combined with the 80 Level One sites already designated made up the 108 core sites for 2021.

Level 3 protection was afforded the balance of the activity sites on the HCP covered lands in 2020 (HCP §6.2.2 # 6). Level 3 sites are those sites not needed to meet management objectives 1 or 4 (108 minimum activity sites). As with Level 2 sites, Level 3 sites receive 1,000-foot buffers during the breeding season.

Language was also added (in 2002) to HCP §6.2.2 # 6 regarding Level 3 sites:

During the breeding season, for activity sites which have been determined to be occupied by a non-nesting pair or single NSO, 18 acres around the activity site shall be maintained as suitable nesting habitat, if present. The protected 18 acres may conform to natural landscape features, as designated by PALCO's wildlife biologist or a designee, and the buffer protecting the activity site must have at least a 400 foot radius. At PALCO's discretion harvesting may occur during the breeding season, in the area adjoining the 18-acre habitat retention area.

Thus, if a non-nesting status is determined, harvest may occur around a Level 3 activity site, so long as an 18-acre core area (the equivalent area of a 500-foot radius circle), with at least a 400-foot radius is retained. After the breeding season, harvest of the Level 3 sites may occur. If the activity site is harvested, any known nest trees are to be retained.

Habitat Conditions

The amount and type of spotted owl habitat as per HCP §6.2, Table 6 is reported annually (Table 5). Habitat information from the HRC Geographic Information System (GIS) is a “snapshot in time” of habitat conditions. For consistency and coordination with other forest inventory requirements the snapshot is currently taken on or around 1 January each year (Map 3). Thus, the

information contained in this section of the report represents habitat conditions from approximately 1 January 2021 to 1 January 2022.

As discussed in previous NSO annual reports, annual reports from 1999-2009 utilized forest stand information from 1999 and previous years to generate Wildlife Habitat Relationship (WHR) types and thus nesting, roosting, and foraging (NRF) types based on HCP Table 6. Beginning in 2010 HRC embarked on a re-inventory project of the entire 209,000 acres of HRC lands. For the 2010 through 2012 habitat reports we included the most current forest inventory information resulting from 2002-2006 cruise information, harvest updates for each year from 2000 forward, and cruise information available to date from the re-inventory work. This information was the most current and reliable “stand” information and best reflected conditions on the ground, although field evaluations were occasionally needed to verify stand types.

WHR habitat typing for 2021 reflects the changes in the preharvest status of the property from the outset of the year/end of 2020 by incorporating the change in habitat due to confirmed harvested areas from 2021 THPs. “No harvest” and “no operations” areas were excluded from the harvest history clip. Since the new inventory data are not yet available, no growth was added for 2021.

Historically, HRC has used the California Growth and Yield Modeling cooperative’s FORSEE software to process field inventory data. HRC has used output from FORSEE (modeled crown widths and WHR habitat species calls) together with the methodology described by PALCO’s 1999 HCP to assign WHR size classes and the associated nesting, roosting, and foraging classifications to each stand polygon. HRC is currently finalizing a complete re-inventory of the ownership, scheduled for completion in 2022, and will be moving to the Forest Biometric Research Institute’s Forest Projection System growth model (FPS) as that project is completed. Therefore, it is likely that habitat numbers will differ in our 2021 report.

The current inventory information has been applied to both the property-wide analysis of habitat (Table 5, Figure 3) and the 0.7- and 1.3-mile habitat radii pertaining to the Level 1 activity sites (Appendix C). A change in habitat trends corresponding with change in ownership, silviculture, and harvest level can be seen beginning around 2009. The steady, anticipated trend of reduction in nesting habitat, resulting in part due to the even-age silviculture preferred by the previous

landowner, has leveled out in recent years. Similarly, the observed recent decline in the previously increasing number of acres of non-habitat is also consistent with the change to uneven-age management, with a concurrent increase in foraging habitat post-harvest.

Similar to previous annual reports, an analysis of patch sizes of suitable nesting habitat has been conducted on both the 18-acre and 80-acre polygon size and included with this report (Table 5). The inventory changes discussed above also resulted in a change in the number of habitat patches. The acres of habitat in the Grizzly Creek Complex and Owl Creek MMCA are shown separately due to the unique nature of these parcels. No new inventory information has been applied to these parcels, although it is reasonable to assume that young stands in these reserves are growing and potentially increasing in habitat value for spotted owls.

Table 5. Acres of Habitat and Nesting Habitat Patches.

Year	Nesting (Acres)	Roosting (Acres)	Foraging (Acres)	Non Habitat (Acres)	18+ Acre Patches (Nesting)	80+ Acre Patches (Nesting)
1999	87,416	35,343	40,780	45,142	199	64
2000	82,205	36,670	40,753	49,053	204	68
2001	76,799	37,416	40,608	53,858	214	62
2002	70,309	38,209	39,642	60,521	226	72
2003	65,984	38,289	39,538	64,870	231	79
2004	63,153	38,641	40,103	66,784	238	83
2005	60,927	39,557	40,307	70,442	241	93
2006	58,453	39,043	39,533	74,204	244	92
2007	56,386	37,390	39,010	78,431	250	87
2008	55,412	37,747	39,890	77,886	251	88
2009	54,402	59,036	28,094	68,130	348	101
2010	60,348	46,372	36,236	66,300	332	105
2011	55,758	56,063	43,589	53,869	366	118
2012	61,817	60,424	43,330	43,708	311	102
2013	57,171	52,842	68,177	31,073	421	128
2014	54,909	55,514	68,177	30,625	424	125
2015	53,106	58,642	68,302	29,227	426	123
2016	51,429	57,133	71,382	29,399	422	120
2017	50,491	60,427	71,980	26,445	431	127
2018	51,767	57,775	76,276	23,632	418	117
2019	49,141	60,982	73,989	25,244	423	118
2020	46,479	61,187	76,077	25,664	420	115
2021	45,955	60,999	76,900	25,724	426	113
Grizzly_Owl	1,921	208	325	413	5	4

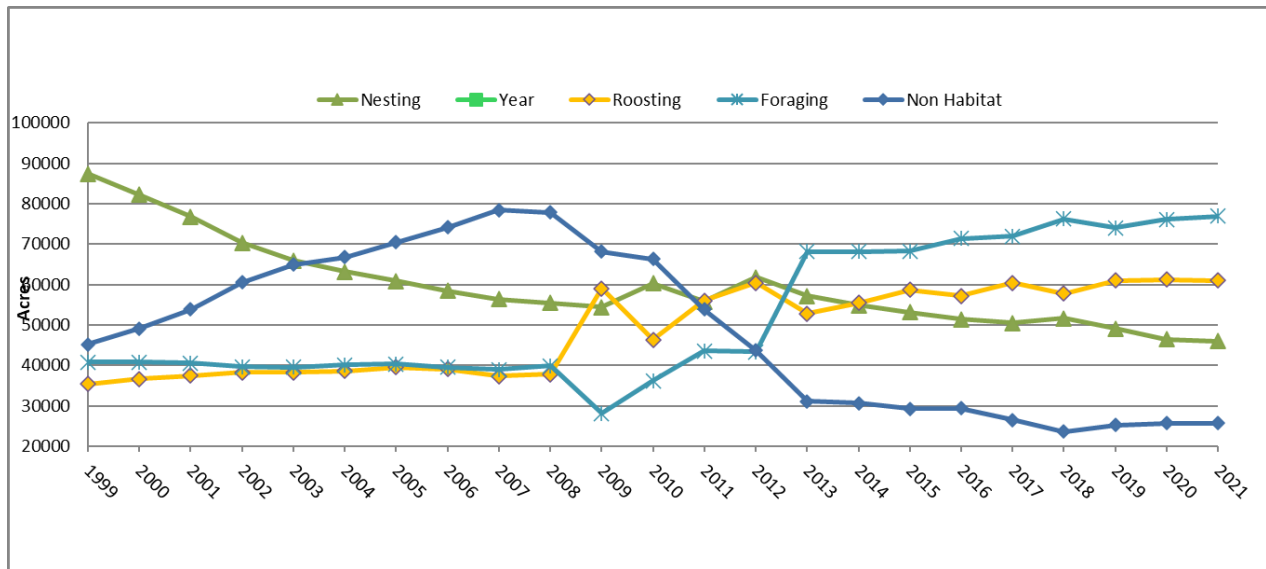


Figure 3. Northern spotted owl habitat types on HRC lands 1999-2021.

To put habitat growth and harvest on HRC lands in the context of regional habitat conditions within the range of the northern spotted owl, we have previously reviewed the Final and Revised Final Recovery Plans for the Northern Spotted Owl (USFWS 2008, 2011b). The USFWS (2008) reported on the loss of spotted owl habitat range-wide related to timber harvest and natural events. Specifically related to timber harvest, they cautioned readers that harvest estimates can only be used to infer rates of forest removal and may or may not translate directly to a rate of suitable habitat loss, since not all forest may equate to suitable spotted owl habitat.

Relative to the loss of suitable habitat due to **timber harvest**, USFWS (2008, 2011b) noted that there are only a few available reports on the topic, and summarized them as follows:

Cohen et al. (2002) cited in Bigley and Franklin (2004) reported “a steep decline in harvest rates between the late 1980’s and early 1990’s on State and Federal and private industrial forestlands.” Habitat trends reported by the Service (USFWS 2004) indicated an overall decline of about 2% in the amount of suitable habitat on Federal lands as a result of management activities from 1994 to 2003. This rate is lower than the 2.5% per decade estimate of habitat loss resulting from management activities that was predicted in the Northwest Forest Plan (USDA and USDI 1994). Cohen et al. (2002) reported that from the early 1970’s through the mid-1990’s the harvest rates on private industrial forest lands were consistently about twice the average harvest rate on public lands.

Raphael (2006) estimated that since 1994, losses of NSO habitat from non-federal timber harvest have exceeded losses from Federal land, with a range-wide loss of approximately 8.0% (12% in Washington, 10.7% in Oregon, and 2.2% in California). Raphael (2006) also conducted an analysis looking only at regeneration harvest. This analysis estimates that nearly 3,000 acres of higher suitability spotted owl habitat was harvested on Federal reserved lands, and about 26,000 acres on non-reserved lands, between 1994 and 2004. This harvest represents less than 1% of the approximately 10 million acres of high suitability habitat thought to exist on both Federal and non-federal land in 1994.

Davis and Dugger (2011) estimated the amount of spotted owl nesting and roosting habitat lost due to harvest from the start of the Northwest Forest Plan (1994/1996) to 2006/2007 on non-federal lands in California to be about 90,200 acres (5.8% of total). However, Davis and Lint (2005) found that forest fragmentation in California *decreased* from the 1930's and 1940's to the current time, possibly due to fire suppression.

Regarding habitat loss from **natural events** the USFWS (2008) reported that the loss of spotted owl habitat from natural events during the 10-year period from 1994 to 2003 was 224,041 acres, or about a 3% decline in available habitat range-wide (USFWS 2004). The majority of the habitat loss was due to wildfire (75%) with insects and disease making up the remainder (25%). Approximately 7,500 acres (0.4%) in California were estimated to have been lost due to fire, insects and disease from (1994/1996) to 2006/2007 (Davis and Dugger 2011).

During the devastating fires of 2019-2020 in California, approximately 1.47 million acres burned in the range of the NSO (Stanish, pers. comm.). Approximately 378 NSO activity centers were within a fire perimeter. This number does not include those ACs that are outside of, but within the home range of a given fire perimeter. It was estimated that would add another 200 ACs, resulting in a total of approximately 10% of NSO ACs having been affected by fire.

BANDING PROGRAM

Banding of spotted owls as part of our overall program is a long-term research and management tool to help monitor the spotted owl population on the HRC ownership. The primary purposes of

the banding and re-sighting project include defining stable activity sites (site fidelity and displacement); detection of changes in occupancy over time (turnover and replacement); documentation of movements of sites and nest areas; and assessment of habitat quality based on site occupancy and reproductive history.

We again request that the USFWS and CDFW consider this report, with associated Map 1, to satisfy the requirements of banding, recovery, Memoranda of Understanding, and Scientific Collecting Permits.

In 2021, there were 61 total band resights (Appendix H). Of the 108 core sites, 13 pairs were positively identified at occupied sites. Since 2003 a total of 437 spotted owls have been banded, consisting of 379 adults and 57 juveniles.

Data from HRC banded northern spotted owls with at least seven years of data (131 banded adults from 60 sites during the years 2000-2006) showed that spotted owl survival remained stable over that time period (Bigger et al. 2008). Continuing to collect and analyze banding and re-sight information is a key component of this program.

REGIONAL TRENDS

Following both the 2003 and 2007 survey seasons, PALCO, the NSOSRP, and the Agencies convened and discussed the HCP management objectives, potential reasons why they may not be met, and potential corrective measures to implement if necessary. On both occasions the NSOSRP recommended that HCP results be compared to those of other study areas in the region. Figure 4 below illustrates the regional northern spotted owl reproductive rates for several study areas of Northern California (Early, Fullerton, Higley, Carlson, pers. comm. 2021).

As demonstrated in the figure, results for both the core and quadrat sites on HRC track the results of other study areas over the HCP period, with the exception of the Willow Creek Study Area (WCSA) for which positive or negative changes sometimes seem to “lag” a year or two behind other study areas. As with other studies in the region (Anthony, et al 2004, Franklin 1997, Franklin 2000) data indicates that reproductive results are strongly correlated to regional trends in climate (Franklin, et al. 2000, HRC, unpublished data). Glenn (2009) found that climate accounted for 78-84% of the temporal variation in population change in the Oregon coast range,

and climate and barred owls together accounted for approximately 100% of the changes in spotted owl survival. Thus, there are good and bad reproductive years that appear to track precipitation early in the breeding season, and more recently, the barred owl influence on spotted owl reproduction.

Four of the five cooperators reported positive reproductive results for 2021. Typically, lower than average rainfall events of late spring results in higher-than-average reproduction. In 2021 there was a very dry spring which may have positively impacted spotted owl nesting activities.

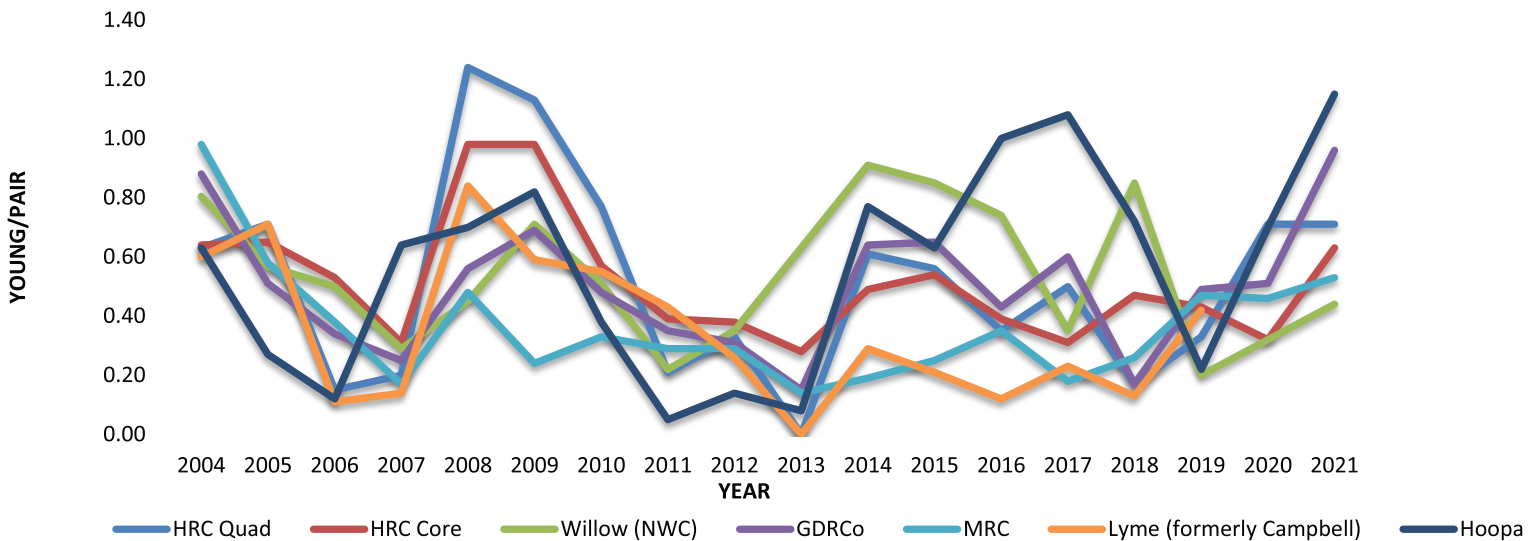


Figure 4. Comparison of Regional Reproductive Rates 2004-2021.

RECOMMENDATIONS

SURVEYS

Current plans call for continued surveys in 2022 for THPs and for monitoring with the quadrat sampling strategy. In 2022, quadrats 1, 5, 15, and 16 are scheduled for monitoring (Freshwater Creek, Corbett area in the Van Duzen river drainage, McCann and South Rainbow, respectively). These quadrats were initially surveyed in 2007, 2012 and again in 2017, and it will be interesting to compare them with the 2022 surveys, distribution of activity centers, reproduction, and

location and activity level of barred owls. Timely follow-up visits (i.e., within 72 hours, weather permitting) will be conducted to all nighttime contacts. Following the season, the data gathered will be used to evaluate the efficacy of the HCP management objectives and conservation measures for the core sites in addition to the quadrat sites.

BANDING

In 2022 we intend to continue to work with the Service, Department, and adjacent study areas to make our banding efforts as efficient and effective as possible, keeping in mind the goals of the effort. As always, during any of our capture and banding efforts, we will continue to be cautious in our efforts, keeping the care and safety of the birds first in mind.

BARRED OWLS

HRC continues to have significant concerns that the barred owl invasion will continue to cause declines in site occupancy and reproduction of our spotted owl population. In addition, HRC continues to be interested in the results of barred owl removal projects as recommended by the Service (USFWS 2008) and will continue to monitor the results of ongoing studies as they are available.

SCIENTIFIC PANEL/MANAGEMENT OBJECTIVES

The HCP Northern Spotted Owl Conservation Plan §6.2.2, Conservation Measures, Item 1 refers to the NSO Scientific Review Panel (NSOSRP) and discusses the establishment and roles of the NSOSRP. The NSOSRP generally met every year for the first 5-6 years of implementation and provided review of monitoring results and recommendations for future monitoring and analyses.

Not meeting the HCP management objectives for pair occupancy and/or reproductive rate triggers the adaptive management measures of HCP § 6.2.3, #6, and a discussion between HRC, USFWS, CDFW, and the Panel shall occur to review potential reasons why the objective is not being met, and potential corrective measures to implement.

As stated earlier, during the period of 2014 - 2021 the rolling five-year average reproductive rate for monitored pairs of northern spotted owls in our study area has not met the HCP objective of 0.61 fledglings per pair. The rolling average reproductive rates for 2014- 2021 are, 0.42, 0.42,

0.41, 0.40, 0.44, 0.43, 0.38, and 0.43 respectively, and follow a period of five consecutive years (2008-2012) when the rolling average reproductive rate *did* meet the management objective. This seemingly new range of values may represent a level of spotted owl coexistence with barred owls, or a brief leveling off period that will be followed by another decline.

During the 23 years of HCP implementation (1999-2021) the management objective for the rolling average reproductive rate was not met during the 2006 and 2007 seasons (0.53 and 0.47 respectively). And, similar to the 2013-2021 period, followed seven consecutive years when the rolling average was greater than 0.61, or not significantly different from 0.61 (e.g., 0.59, 2002).

Following the 2007 season the HRC, USFWS, CDFW, and Panel convened via conference call to discuss the reproductive results. Consideration was given to whether there was a clear cause-and-effect relationship between management activities, or if results were within the range of annual variation.

At that time, the forestlands were still owned by the Pacific Lumber Company and managed using primarily even-age (clear cut) management at a rate of harvest of approximately 150 mmbf/year, including harvest of old growth trees. The barred owl invasion of north coastal California had not yet been fully realized as a potential reason for a reduced reproductive rate.

Although there were no clear reasons for a reduced reproductive rate, for discussion on the conference call a Habitat Retention Area (HRA) strategy was proposed as a potential corrective measure, with the objective of retaining a polygon of the best habitat surrounding the most stable and reproductive spotted owl nest sites, rather than using the 500' and 1,000' radii as the standard habitat retention model. The Service, Department, Panel and HRC agreed on the strategy, and it was implemented beginning in 2009 (CDFG and USFWS 2009).

In 2008 the Humboldt Redwood Company (HRC) was formed out of the Pacific Lumber Company bankruptcy proceedings and significant management changes followed, including in harvest techniques, rate of harvest, and retention of old growth components. Management of the Humboldt County forestlands was changed to reflect that of HRC's sister company, Mendocino Redwood Company (MRC), including the use of uneven-age (selection, group selection) harvest, a reduction in harvest level, and retention of all old growth trees meeting the company policy.

In 2008 and 2009 the annual reproductive rate was relatively high (0.98 both years) but has since declined from 2010-2021, and as the high rates have fallen out of the rolling average calculation and been replaced by lower rates, the rolling average has also declined to the point where it is below the management objective. So, although management on the forestlands has changed in a manner that results in harvest of less spotted owl habitat (i.e., Figure 3), and retains more late successional habitat components on the landscape, the reproductive rate is in a current decline, nonetheless.

Similar to other study sites in the region, HRC has tracked the presence of barred owls in our study area. There has been an overall increase over time in barred owl detections within 0.5-mile of spotted owl activity sites (Figure 1). Studies previously referenced have indicated that barred owl presence within spotted owl territories can disrupt spotted owl occupancy and reproduction.

During the HCP's early years, the Panel recommended comparing the HRC HCP results to other study sites within the region. Because the HRC owl sites are managed in ways that are specific to the HCP, a comparison of trends in occupancy and reproduction with other study sites that are managed under different strategies (e.g., intensive timber harvest, moderate harvest, little to no harvest) can provide insight as to how the HCP is working and possibly what other factors may be affecting the spotted owl population (e.g., barred owls, climate). The available information indicates that trends for both the core and quadrat sites continue to track the results of other study areas over time (Figure 4).

As per HCP requirements, HRC and the Wildlife Agencies convened the NSOSRP in November of 2020 (Gutiérrez, et al. 2020). The NSOSRP concluded that the likely cause of lower population performance, especially over the past 5 years, is competition with invasive barred owls (*Strix varia*) but other factors could also have caused poor population performance by spotted owls. As a result, the NSOSRP recommended an experimental barred owl removal program consisting of removing as many barred owls as possible from the HCP area, while at the same time conducting retrospective studies assessing the effects of barred owls and other factors that might also cause such declines. HRC and the Wildlife Agencies have had ongoing discussions regarding potential adaptive management changes to the HCP in consideration of the Panel's recommendations.

Most study areas in the region reported normal to above average breeding activity and reproductive rates in 2021,. It should also be noted that increases in spotted owl occupancy and reproduction on the Hoopa and Green Diamond study areas have been at least in part attributed to lethal barred owl removal from spotted owl territories. While 2021 results were up slightly from 2019 (0.43, 0.63 respectively), 2017 was the lowest rate for the last five years for HRC as the reproductive rate was 0.31, and along with the 2016 rate of 0.39, represents a similar trend of below average rates (for our study area) for the past six years along with 2013 rate of 0.28 that occurred in the last ten years.

In light of the fact that management of the HRC forestlands has had a reduced impact on habitat since the change in ownership in 2008, the evidence from other study areas within the range of the northern spotted owl that barred owls can have a significant impact on occupancy and reproduction of spotted owls, and the fact that HRC activity centers have been colonized by barred owls, it seems to be clear that barred owls are now negatively impacting spotted owl occupancy and reproduction on HRC lands and are likely to be the primary cause of failure to meet HCP management objectives.

REFERENCES

- Anthony, R.G., Eric D. Forsman, Alan B. Franklin, David R. Anderson, Kenneth P. Burnham, Gary C. White, Carl J. Schwarz, Jim Nichols, Jim E. Hines, Gail S. Olson, Steven H. Ackers, Steve Andrews, Brian L. Biswell, Peter C. Carlson, Lowell V. Diller, Katie M. Dugger, Katherine E. Fehring, Tracy L. Fleming, Richard P. Gerhardt, Scott A. Gremel, R.J. Gutiérrez, Patti J. Happe, Dale R. Herter, J. Mark Higley, Rob. B. Horn, Larry L. Irwin, Peter J. Loschl, Janice A. Reid, and Stan G. Sovern. 2004. Status and Trends in Demography of Northern Spotted Owls, 1985-2003. Report for the Interagency Regional Monitoring Program. 179 pp.
- Bigger, D., K. Sullivan, and S. Chinnici. 2008. Modeling reproductive performance of northern spotted owls relative to climate and forest habitat in coastal California. Presentation at the Annual Meeting of The Wildlife Society, Miami, Florida.
- Bigley, R. and J. Franklin. 2004. Habitat trends. Chapter 6 in S. Courtney (editor), Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute, Portland, Oregon.
- Blakesley, J.A., W. LaHaye, J.M.M. Marzluff, B.R. Noon, and S. Courtney. 2004. Demography. Chapter 8 in S. Courtney, editor. Scientific evaluation of the status of the northern spotted owl. Sustainable Ecosystems Institute, Portland, Oregon.
- California Department of Fish and Game. 2009. Concurrence on Habitat Retention Area Strategy for Level One Northern Spotted Owl Activity Centers, Humboldt Redwood Company Habitat Conservation Plan Section 6.2.2.4 Bullet # 6. Letter from CDFG to Humboldt Redwood Company, March 3, 2009.
- California Department of Fish and Wildlife (CDFW). 2020. #20-R1-CTP84-NSO. Email from Susan Sniado, Senior Environmental Scientist, to Sal Chinnici and Brad Mauney (HRC). Level 1 Selection Additional Information. 28 October, 2020.
- Carlson, P. 2021. Personal communication between Peter Carlson, Research Associate, Colorado State University, and Brad Mauney, Lead Wildlife Biologist at HRC.
- Cohen, W.B., T.A. Spies, R.J. Alig, D.R. Oetter, T.K. Maiersperger, and M. Fiorella. 2002. Characterizing 23 years (1972-1995) of stand replacement disturbance in western Oregon forests with Landsat Imagery. *Ecosystems* 5:122-137.
- Courtney, Steven P., Jennifer A. Blakesley, Richard E. Bigley, Martin L. Cody, Jack P. Dumbacher, Robert C. Fleischer, Alan B. Franklin, Jerry F. Franklin, Rocky J. Gutiérrez, John M. Marzluff, and Lisa Sztukowski. 2004. Scientific Evaluation of the Status of the Northern Spotted Owl. Report to the U.S. Fish and Wildlife Service in Support of the 5-Year Status Review Process.
- Courtney, S.P., A.B. Carey, M.L. Cody, K. Engel, K.E. Fehring, J.F. Franklin, M.R. Fuller, R.J. Gutiérrez, J.F. Lehmkuhl, M.A. Hemstrom, P.F. Hessburg, S.L. Stephens, L.A. Sztukowski, L. Young. 2008. Scientific Review of the Draft Northern Spotted Owl Recovery Plan and Reviewer Comments. Sustainable Ecosystems Institute. Portland, OR. 159 pp.
- Davis, R.J., and K.M. Dugger. 2011. Northwest forest plan-the first 15 years (1994-2008): status and trends of Northern Spotted Owl Populations and Habitat. General Technical Report PNW- GTR-850. Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service, Portland, Oregon.
- Davis, R., and J. Lint. 2005. Habitat status and trends. Pages 21–82 in J. Lint, technical coordinator. Northwest Forest Plan—the first 10 years (1994–2003): status and trends of northern spotted owl populations and habitat. General Technical Report PNW-GTR-648, Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service, Portland, Oregon.

- Diller, L.V., K.A. Hamm, D.A. Early, D.W. Lamphear, K.M. Duggar, C.B. Yackulic, C.J. Schwarz, P.C. Carlson, and T.L. McDonald. Demographic Response of Northern Spotted Owls to Barred Owl Removal. *Journal of Wildlife Management*; DOI: 10.1002/jwmg.1046.
- Dugger, K.M., E.D. Forsman, A.B. Franklin, R.J. Davis, G.C. White, C.J. Schwarz, K.P. Burnham, J.D. Nichols, J.E. Hines, C.B. Yackulic, P.F. Doherty, Jr., L.Bailey, D.A. Clark, S.H. Ackers, L.S. Andrews, B. Augustine, B.L. Biswell, J. Blakesley, P.C. Carlson, M.J. Clement, L.V. Diller, E. M. Glenn, A. Green, S.A. Gremel, D.R. Herter, J.M. Higley, J. Hobson, R.B. Horn, K.P. Huyvaert, C. McCafferty, T. McDonald, K. McDonnell, G.S. Olson, J.A. Reid, J. Rockweit, V. Ruiz, J. Saenz, and S.G. Sovern. 2016. The effects of habitat, climate, and Barred Owls on long-term demography of Northern Spotted Owls. *The Condor: Ornithological Applications* 118: 57-116.
- Early, D. 2021. Personal communication between Desiree Early, Senior Terrestrial Biologist at Green Diamond Resource Company and Brad Mauney, Lead Wildlife Biologist at HRC.
- Franklin, A. 1997. Factors Affecting Temporal and Spatial Variation in Northern Spotted Owl Populations in Northwest California. PhD. Dissertation, Colorado State University, Fort Collins, Colorado. 185 pp.
- Franklin, A.B., D.R. Anderson, R.J. Gutiérrez, and K.P. Burnham. 2000. Climate, habitat quality, and fitness in northern spotted owl populations in northwestern California. *Ecological Monographs* 70:539-590.
- Fullerton, S. 2021. Personal communication between Scott Fullerton, Wildlife Biologist for Lyme Timberland Management, and Brad Mauney, Lead Wildlife Biologist at HRC.
- Garbelotto, M. 2020. "SOD BLITZes 2020: Results and New SOD Management Recommendations". Department of ESPM, U.C. Berkeley, College of Natural Resources Forest Pathology and Mycology Lab. https://nature.berkeley.edu/matteolab/?page_id=5438
- Garbelotto, M. 2021. "SOD BLITZes 2021: Results and New SOD Management Recommendations". Department of ESPM, U.C. Berkeley, College of Natural Resources Forest Pathology and Mycology Lab. https://nature.berkeley.edu/matteolab/?page_id=6406
- Glenn, E.M. 2009. Local weather, regional climate, and population dynamics of northern spotted owls in Washington and Oregon. Dissertation, Oregon State University, Corvallis.
- Green Diamond Resource Company. 2014. HCP Annual Report. Available on the website greendiamond.com.
- Gutiérrez, R. J., M. Cody, S. Courtney, and A. B. Franklin. 2007. The invasion of barred owls and its potential effect on the spotted owl: a conservation conundrum. *Biological Invasions* 9:181-196.
- Gutiérrez, R.J., A.B. Franklin, M.Z. Peery, and J.D. Wiens. 2020. Recommendations for assessing reasons for declining pair occupancy and reproductive output by Spotted owls on Humboldt Redwood Company land: Report of the Northern Spotted Owl Scientific Review Panel. 9 December 2020. 10 pp.
- Higley, J.M. 2021. Personal communication between J. Mark Higley, Senior Biologist for Hoopa Tribal Forestry, and Brad Mauney, Lead Wildlife Biologist at HRC.
- Irwin, L., D. Rock, and S. Rock. 2015. Resource Partitioning in California Coast Redwood Forests: Hope for Spotted Owls? Final Report. National Council for Air and Stream Improvement. 48 pp.

- Long, M. 2004. Letter from Michael Long, U.S. Fish and Wildlife Service to J. Barrett, Scotia Pacific Lumber LLC. April, 21, 2004. Review of the 2003 Northern Spotted Owl Annual Report of The Pacific Lumber Company (AFWO File Number 1-14-TA-2004-2190). 2 pp.
- Raphael, M.G. 2006. Conservation of listed species: the northern spotted owl and marbled murrelet. Chapter 7 in R.W. Haynes, B.T. Borman, D.C. Lee, and J.R. Martin (technical editors), Northwest Forest Plan – the first 10 years (1994-2003): synthesis of monitoring, and research results. Gen. Tech. Rep. PNW-GTR. USDA Forest Service, Pacific Northwest Research Station, Portland, Oregon.
- The Pacific Lumber Company. 1999. Habitat Conservation Plan for the Properties of The Pacific Lumber Company, Scotia Pacific Holding Co., and Salmon Creek Corporation.
- U.S. Department of Agriculture and U.S. Department of the Interior. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl; standards and guidelines for management of habitat for late-successional and old growth forest related species within the range of the northern spotted owl USDA Forest Service, Portland, Oregon, and USDI Bureau of Land Management, Portland, Oregon.
- U.S. Department of the Interior, Fish and Wildlife Service. 2004. Estimate Trends in Suitable Habitat for the Northern Spotted Owl (*Strix occidentalis caurina*) on Federal Lands from 1994 to 2003. For Use By: Sustainable Ecosystems Institute for the Northern Spotted Owl 5-Year Review. U.S.D.I. Fish and Wildlife Service.
- U.S. Fish and Wildlife Service. 1992. Protocol for surveying proposed management activities that may impact northern spotted owls. March 7, 1991 (Revised March 17, 1992).
- U.S. Fish and Wildlife Service and National Marine Fisheries Service. 1999. Biological and Conference Opinions Regarding Issuance of an Incidental Take Permit to the Pacific Lumber Company, Scotia Pacific Company LLC, and Salmon Creek Corporation. 469 pp. and Appendices.
- U.S. Fish and Wildlife Service. 2008. Final Recovery Plan for the Northern Spotted Owl, *Strix occidentalis caurina*. U.S. Fish and Wildlife Service, Portland, Oregon. xii + 142 pp.
- U.S. Fish and Wildlife Service. 2009. Response to Proposal for a Habitat Retention Areas Strategy for Level 1 Northern Spotted Owls. Letter from USFWS to Humboldt Redwood Company, February 25, 2009.
- U.S. Fish and Wildlife Service. 2010. Draft revised recovery plan for the northern spotted owl, *Strix occidentalis caurina*. U.S. Fish and Wildlife Service, Portland, Oregon. xii + 163 pp.
- U.S. Fish and Wildlife Service. 2011a. Revised Survey Protocol for the Northern Spotted Owl, (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon.
- U.S. Fish and Wildlife Service. 2011b. Revised Recovery Plan for the Northern Spotted Owl, (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon. Xvi + 258 pp.
- U.S. Fish and Wildlife Service. 2011. 2011 Revision of the Northern Spotted Owl Take Avoidance Analysis and Guidance for California Coast Forest District. U.S. Fish and Wildlife Service, Arcata, CA. 12 pp.
- Wiens, David J., Katie M. Dugger, Damon Lesmeister, Krista E. Dilione, David C. Simon, and Robin Bown. 2017. Status of Spotted Owls, Barred Owls, and Removal Experiments in Oregon and Washington. Abstract of presentation at The Western Section of the Wildlife Society Conference. Santa Rosa, CA.

- Wiens, J.D., Dugger, K.M., Lesmeister, D.B., Dilione, K.E., and Simon, D.C.. 2018. Effects of experimental removal of Barred Owls on population demography of Northern Spotted Owls in Washington and Oregon-2017 progress report: U.S. Geologic Survey Open-File Report 2018-1086, 23 p., <https://doi.org/10.3133/ofr20181086>.
- Wiens, J.D., Dugger, K.M., Lesmeister, D.B., Dilione, K.E., and Simon, D.C. 2019. Effects of Barred Owl (*Strix varia*) removal on population demography of Northern Spotted Owls (*Strix occidentalis caurina*) in Washington and Oregon, 2015–18: U.S. Geological Survey Open-File Report 2019-1074, 17 p., <https://doi.org/10.3133/ofr20191074>.
- Wiens, J.D., Dugger, K.M., Lesmeister, D.B., Dilione, K.E., and Simon, D.C. 2020. Effects of Barred Owl (*Strix varia*) removal on population demography of Northern Spotted Owls (*Strix occidentalis caurina*) in Washington and Oregon, 2019 annual report: U.S. Geological Survey Open-File Report 2020-1089, 19 p., <https://doi.org/10.3133/ofr20201089>.
- Wiens, J.D., Katie M. Dugger, J. Mark Higley, Damon B. Lesmeister, Alan B. Franklin, Keith A. Hamm, Gary C. White, Krista E. Dilione, David C. Simon, Robin R. Bown, Peter C. Carlson, Charles B. Yackulic, James D. Nichols, James E. Hines, Raymond J. Davis, David W. Lamphear, Christopher McCafferty, Trent L. McDonald, and Stan G. Sovern. 2021, Invader removal triggers competitive release in a threatened avian predator. PNAS 2021 Vol. 118 No. 31. 9 p. <https://doi.org/10.1073/pnas.2102859118>