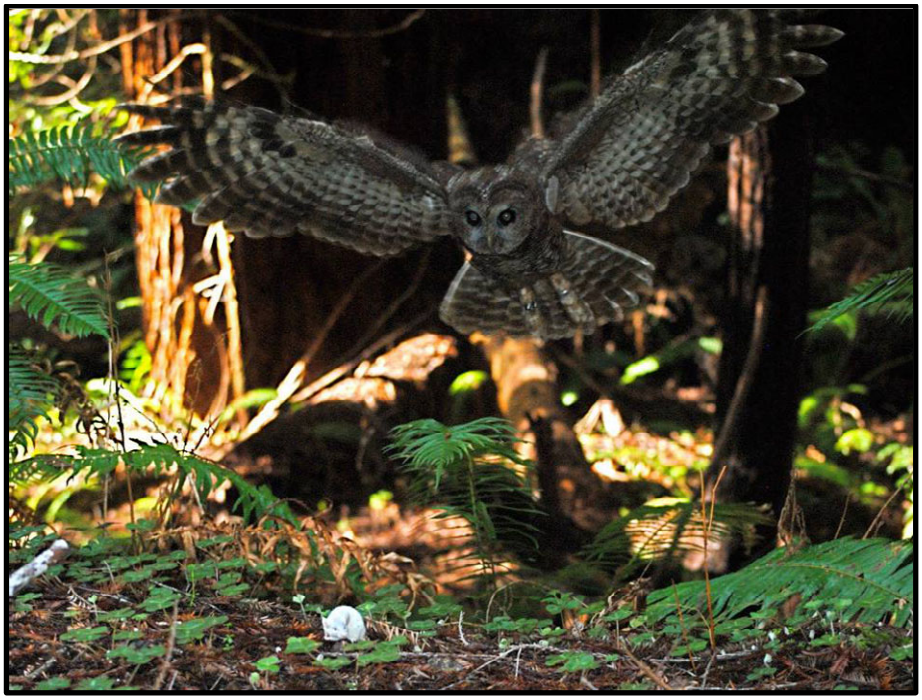
MENDOCINO • HUMBOLDT
Redwood Companies

Northern Spotted Owl Conservation and Management on Mendocino Redwood Company Forestlands and California Red-legged Frog Habitat Restoration Project Summary

January 31, 2024



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NORTHERN SPOTTED OWL INTRODUCTION

The Northern Spotted Owl (*Strix occidentalis caurina*; NSO) was listed as federally threatened in 1990 because of continued timber harvesting throughout its range, uncertainties about its population status, and the absence of any regulatory mechanisms to conserve and manage this species on working landscapes (USDI 1990). Today, despite an increased understanding of its biology and status, the NSO still remains a species of strong scientific interest in the Pacific Northwest (PNW) and is regulated for timber harvest activities on both private and public lands in northwestern California.

In the 33 years since it was listed as federally threatened, the NSO is now the most studied bird of prey in the PNW, and one of the most studied in the world. A substantial body of research indicates that the northern spotted owl's population status, habitat associations, natural and anthropogenic disturbance regimes, and preferred prey vary over its range (Forsman et al. 2011; USFWS 2011).

The coast redwood (*Sequoia sempervirens*) belt, ranging from coastal southwest Oregon south to Marin County of northwestern California, comprises only 9% of the northern spotted owl's range. This region contains relatively little old-growth forest due to historical timber harvesting (approximately 5% is located in state and federal reserves) yet has one of the highest densities of northern spotted owls when compared to its entire range (Diller and Thome 1999; California Natural Diversity Database 2013). On commercial forestlands within the redwood zone, spotted owls nest and roost in stands that are lower on the slope, contain residual trees (i.e., trees retained during previous harvest entries), and have higher amounts of forest edge in greater proportion to their availability on the landscape (Thome et al.1999; Folliard et al. 2000; MRC unpublished data).

Although these stands are relatively young when compared to old-growth forest, they often contain structural legacies, which may include individual large trees, snags, and trees with other features conducive for wildlife. This often cited "anomaly" can be attributed to coast redwood's association with a cool maritime climate as well as its ability to rapidly regenerate following timber harvest, form dense canopies, generate nest structures (debris accumulations and broken-top platforms), and support high densities of woodrats in early seral stands.

Regional differences in spotted owl territory densities and habitat associations are also driven by the composition and availability of prey species. Spotted owls in western Washington and northwestern Oregon predominantly prey on northern flying squirrels (*Glaucomys sabrinus*; Forsman et al. 2001,

2004), which feed on hypogeous fungi (e.g., truffles and false truffles that form fruiting bodies below the surface of the ground) commonly associated with mature and late-seral coniferous forests (Carey 1995). Hence, in these areas, spotted owl presence is associated with old-growth forest characteristics. In contrast, diets of spotted owls in southwestern Oregon and northwestern California are largely comprised of woodrats (*Neotoma* spp.), which are abundant in early seral stands containing a shrub component such as blueblossom (*Ceanothus thyrsiflorus*), manzanita (*Arctostaphylos* spp.) and tanoak (*Notholithocarpus densiflorus*; Carey et al. 1999; Hamm and Diller 2009).

Spotted owls in the northern part of their range tend to have larger territory sizes and are associated with mature and old-growth forests compared to their extreme southern range, where spotted owls have smaller territories and thrive on landscapes containing a heterogeneous mixture of mature and early seral habitat (Franklin et al. 2000). Therefore, northern spotted owl density and habitat use can be dependent on both the degree of habitat disturbance and how primary prey species respond to changes in vegetative composition and structure.

Meta-analysis of demographic data from 11 study areas indicates that the northern spotted owl has declined at an annual rate of 6-9% on 6 of the study areas and 2-5 % on the other 5 study areas from 1993 to 2018, and barred owl presence on NSO territories was the primary factor (Franklin et al. 2021).

Experimental removal of barred owls from treatment areas on Green Diamond Resource Company lands in northwestern California had a strong positive effect on both spotted owl survival and rate of population change, indicating that barred owl removal may be a viable management option to reverse spotted owl population declines (Hamm et al. 2015; Dugger et al. 2016). While the maintenance and growth of habitat supporting various spotted owl life-history functions still remain a key aspect to spotted owl conservation (Dugger et al. 2011), competition from the barred owl is now the single-most pressing threat to the continued existence of the northern spotted owl throughout its entire range (USFWS 2011).

Mendocino Redwood Company, LLC (MRC) forestlands have a long history of spotted owl surveys, research on local spotted owl ecology, and regulatory compliance for timber harvesting plans. Although MRC formed in 1998, the Louisiana-Pacific Corporation (LP)—MRC's predecessor—initiated and maintained a survey and monitoring program when the listing of the northern spotted owl appeared to be imminent in 1989. This program continued through to the transfer of title marking the inception of MRC. In total, MRC forestlands have amassed 35 years of spotted owl survey and population monitoring data, spanning 1989–2023. This large dataset provides insight into spotted owl occupancy and reproduction

dynamics during a period when this species has been continuously regulated for timber harvest in California. In addition, several research projects have also investigated spotted owl diet, home-range size, nest-site characteristics, and demography.

This document summarizes MRC's spotted owl territory distribution, survey methodology, occupancy, and reproductive trends over the past two decades. This report is also produced to satisfy the reporting requirements of U.S. Fish and Wildlife Service 10(a)(1)(A) Recovery Permit ES058630 for northern spotted owls and California red-legged frog (*Rana draytonii*).

OWNERSHIP

Mendocino Redwood Company forestlands consist of 232,000 acres of coast redwood (*Sequoia sempervirens*) and mixed coniferous forests in Mendocino (223,000 acres) and Sonoma (9,000 acres) counties and are primarily managed for commercial timber (Figure 1). These forests are dominated by three tree species (percent by volume): coast redwood (45%), Douglas-fir (*Pseudotsuga mensziesii*; 37%), and tanoak (*Notholithocarpus densiflora*; 15%). The remaining 3% of the tree species includes hardwoods such as madrone (*Arbutus menzesii*), red alder (*Alnus rubra*), California bay (*Umbellularia californica*), big leaf maple (*Acer macrophyllum*), true oaks (*Quercus* spp.); and shade-tolerant conifer such as grand fir (*Abies grandis*) and western hemlock (*Tsuga heterophylla*). Vegetation patterns vary across the landscape and are the result of an interaction between precipitation gradients, soil type, fire history, past agricultural use, and timber harvest.

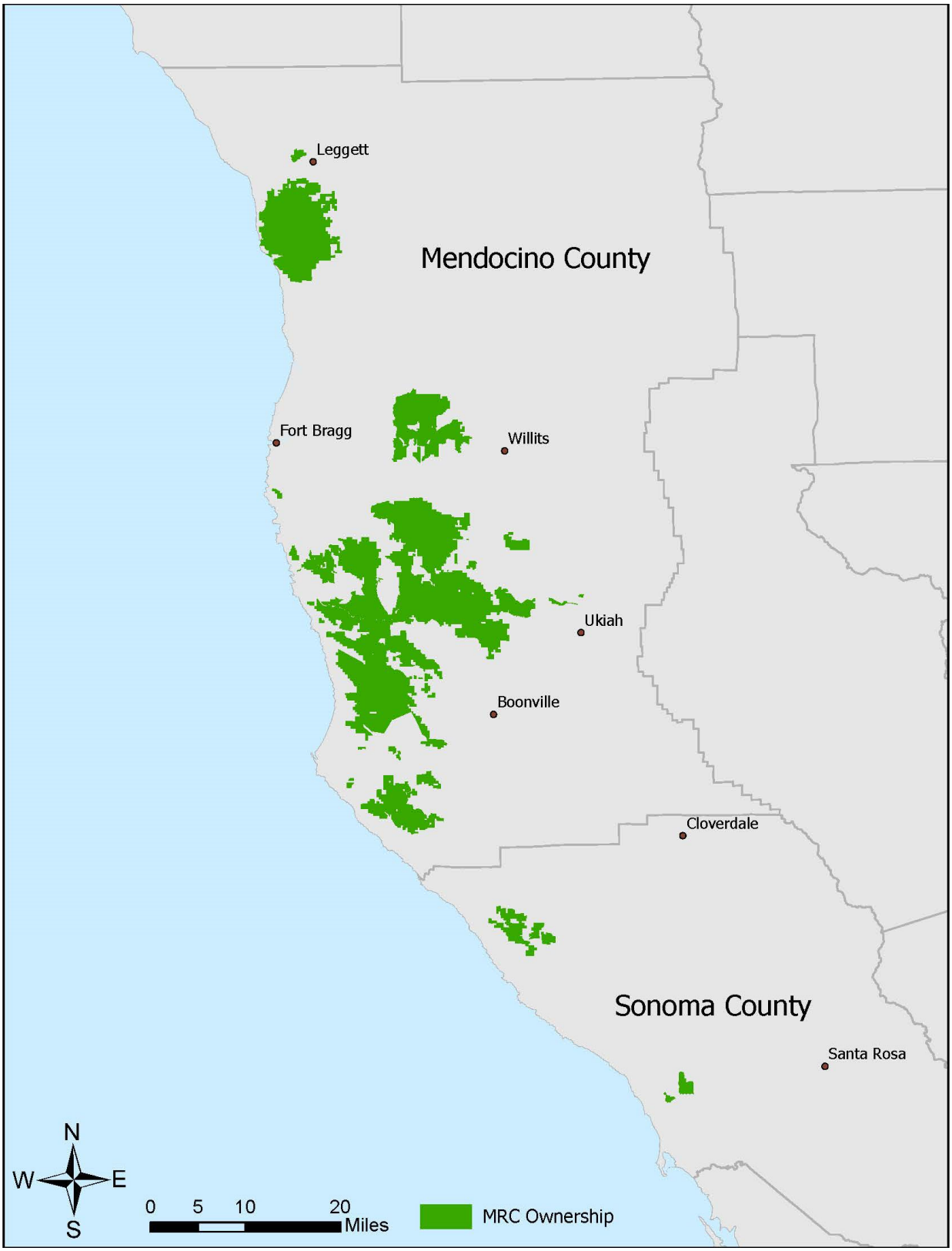

Figure 1. Map showing Mendocino Redwood Company Ownership in coastal Mendocino and Sonoma counties.

SILVICULTURAL HISTORY

Forest structure patterns on the landscape have been heavily influenced by commercial timber harvests over the past 120 years. These timberlands have experienced at least two harvest entries and have been shaped by a regimen of clear-cutting and repeated burning that removed most of the old-growth forest and large merchantable trees.

In the two decades prior to MRC forming, LP managed these forestlands using a combination of even- and uneven-aged silvicultures. A majority of the harvests consisted of shelterwood removal (50-60%), followed by clear-cut (15-25%) and selection (15-25%). The significant amount of overstory removal, combined with a failure to manage for adequate conifer regeneration following harvest entries, resulted in large heterogeneous patches of advanced regeneration dominated by pioneering tanoak that has become today's forest—one which consists of more tanoak than pre-settlement times.

In an effort to restore the species balance on its landscape, MRC is actively working to transition tanoak dominated stands (that were formerly conifer) back to conifer by managing these pioneering hardwoods and replanting areas with conifer (primarily redwood) following restoration harvests. At the same time, tanoak is a species long recognized as having cultural and ecological significance in forest ecosystems throughout its range. Areas where tanoak is actively being managed also contain retention areas where tanoaks are maintained for their ecological value such as mast crop, ectomycorrhizal fungal associations, and structural features (nests, platforms, and tree cavities) important to numerous wildlife species. The company has also committed to making a transition to selection-based harvesting systems focusing on single tree and group selection methods, along with thinning of some stand types, as well as growing more conifer and larger trees throughout its ownership. This transition will not only ensure a sustainable supply of future wood products, but also improve ecological function for terrestrial and aquatic species over time.

NORTHERN SPOTTED OWL DISTRIBUTION

MRC lands support approximately 181 NSO territories (Figure 2; California Natural Diversity Database 2023). Because the ownership is divided into large discontinuous blocks, there is a high amount of property edge that also supports a significant number of nearby, off-property territories whose home-

ranges overlap with MRC's ownership. When MRC lands are buffered by 1000 feet, the number of territories increases to a total of 220. Given that spotted owl home-range size and shape may conform to topographic features and habitat distribution, it is likely that MRC lands provide roosting and foraging habitats for even more territories residing farther off-property.

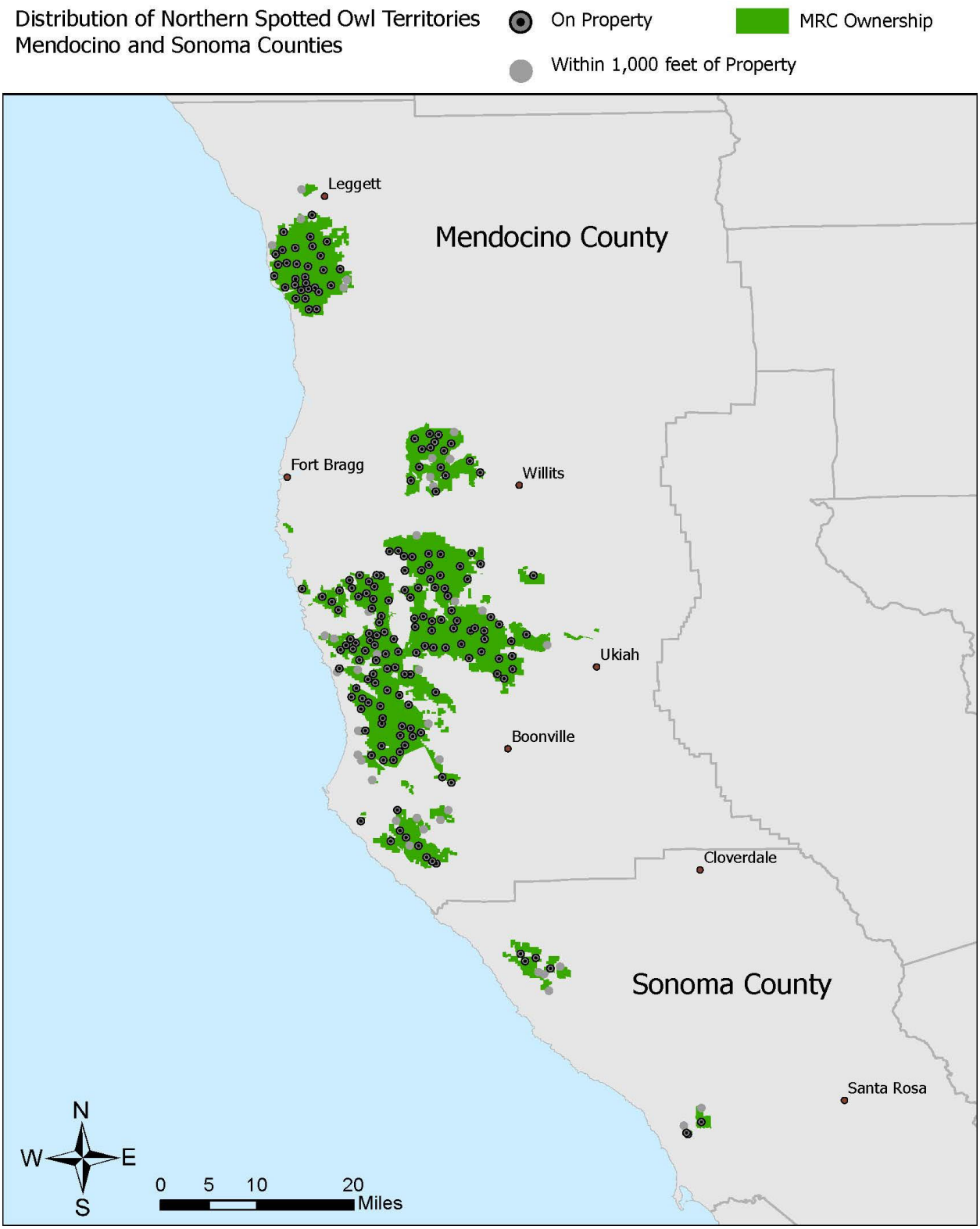

Figure 2. Distribution of northern spotted owl territories in coastal Mendocino and northern Sonoma counties.

SPOTTED OWL SURVEY PROTOCOL

MRC followed a modified version of the 1992 United States Fish and Wildlife Service (USFWS) endorsed protocol (USFWS 1992) until 2018 which relied on a combination of night surveys around project areas and day surveys (monitoring visits) at known owl territories. Night surveys typically followed a two-year, three-visit protocol; however, in some instances a one-year, six-visit protocol may have been used. When either the one- or two-year protocol was completed, then a minimum of three night surveys were required within 0.7 miles of a project during March (or the breeding season), and all historic owl territories within 0.5 miles of the project were visited prior to the commencement of operations during the early part of the breeding season (February 1–May 15).

Starting in 2018 MRC began following the most current USFWS-endorsed protocol (USFWS 2012) which mandates a two-year, six-visit night survey and at least one visit to every territory within 0.7 miles of the project area. After the completed 2-year protocol survey, three-visit night surveys and at least one visit to every territory within 0.25 miles of the project area is required before operations can proceed.

SPOTTED OWL SURVEY EFFORT

Consideration of survey effort is an important factor when monitoring populations over successive years because it may influence detectability of the target species, and hence, overall variation in observed occupancy patterns. Failing to account for survey effort may result in survey bias (e.g., over- or under-represent true occupancy), which can erroneously lead one to conclude that a population is stable when it is not, or vice-versa.

Spotted owl survey effort consists of two elements: 1) the number of visits to a survey station at night or to a spotted owl territory during the day; and 2) the spatial area of survey coverage as represented by the number of unique locations where surveys occurred. Outside of preventing “take,” surveys are used to locate spotted owls at historic sites, determine if any have changed location, and if there are any new territories. Surveys associated with projects also overlap with owl territories that are regularly monitored. Night surveys offer a fallback method to locate birds that were not found in historically occupied areas during daytime site visits, which not only aids in tracking territory movements over time but may also help identify alternate nest/roost areas on the landscape.

Over the past 23 years, night-survey effort varied with the number of THPs, road restoration projects, and other disturbance activities planned (Figure 3). A notable low point in survey effort occurred in 2009 due to the sudden downsizing of MRC due to the nation-wide recession which reduced the overall ability of wildlife staff to maintain night and day surveys at previous levels (Figures 3 and 4).

Monitoring is primarily associated with daytime site visits to known territories. Over time, however, it was found that balancing day visits with night surveys can improve owl detection, particularly for owls that have moved. Night surveys provide greater area-wide acoustic survey coverage at a time when owls are generally more responsive, while day surveys provide fine-scale information on site use (e.g., roost/nest sites, whitewash, pellets, etc.) and owl identity (via band resights).

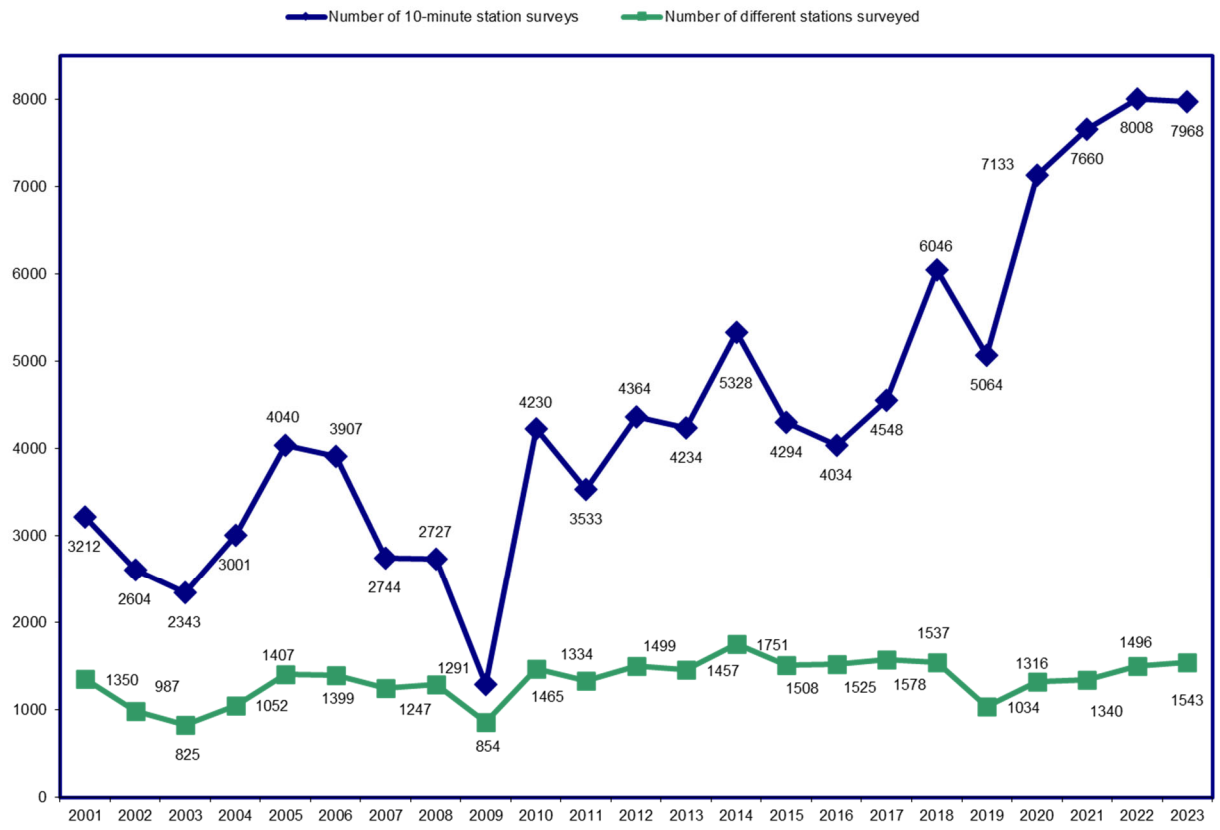

Figure 3. Survey effort by year showing the total number of protocol station surveys (blue squares) and the total number of unique stations surveyed (green diamonds).

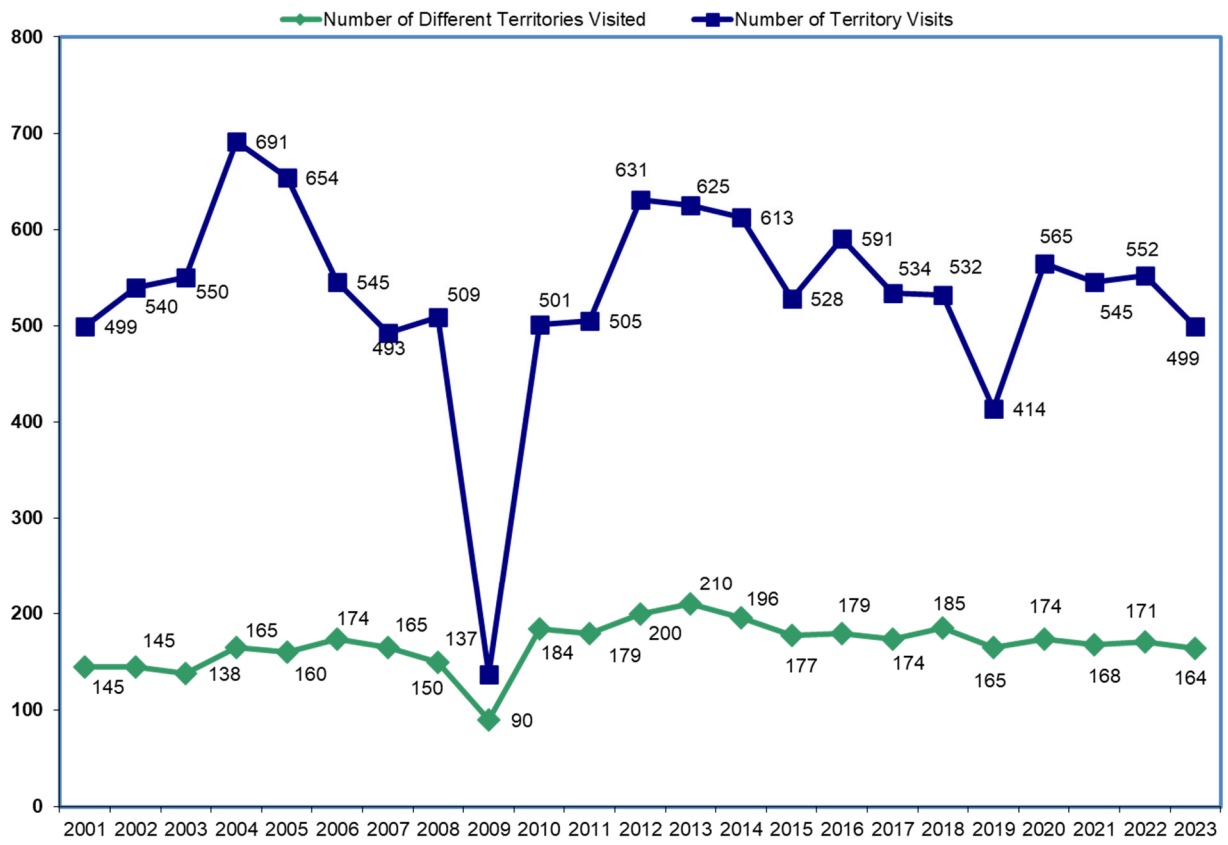

Figure 4. Monitoring effort by year showing the total number of daytime visits to known spotted owl territories (blue squares) and the total number of unique territories visited (green diamonds).

OCCUPANCY TRENDS

Spotted owl population numbers are typically dynamic, and thus, may fluctuate annually. Determining a population trend requires a long-term view (at least 10 years) and a consistent survey effort across the landscape. Inferring trends from a limited number of years is difficult because multiple causal factors often interact differently over short time scales and may result in drastically different population responses annually. Outside of detailed field experiments and measurement of environmental factors, discussion of trends and causal mechanisms underlying the ensuing spotted owl empirical counts are best framed as hypotheses.

Annual empirical counts of spotted owls show a dynamically stable population trend from 2001-2016, with several dips and spikes in annual numbers of total occupied sites, pairs, and singles (Figure 5). Although the total number of birds was influenced by annual fluctuations in the number of pairs and

single birds found during a season, territory occupancy remained relatively constant, then experienced a decline from 2017 to 2023 (Figure 5). This pattern is a concern because survey effort, especially nocturnal surveys, has been increasing during this period.

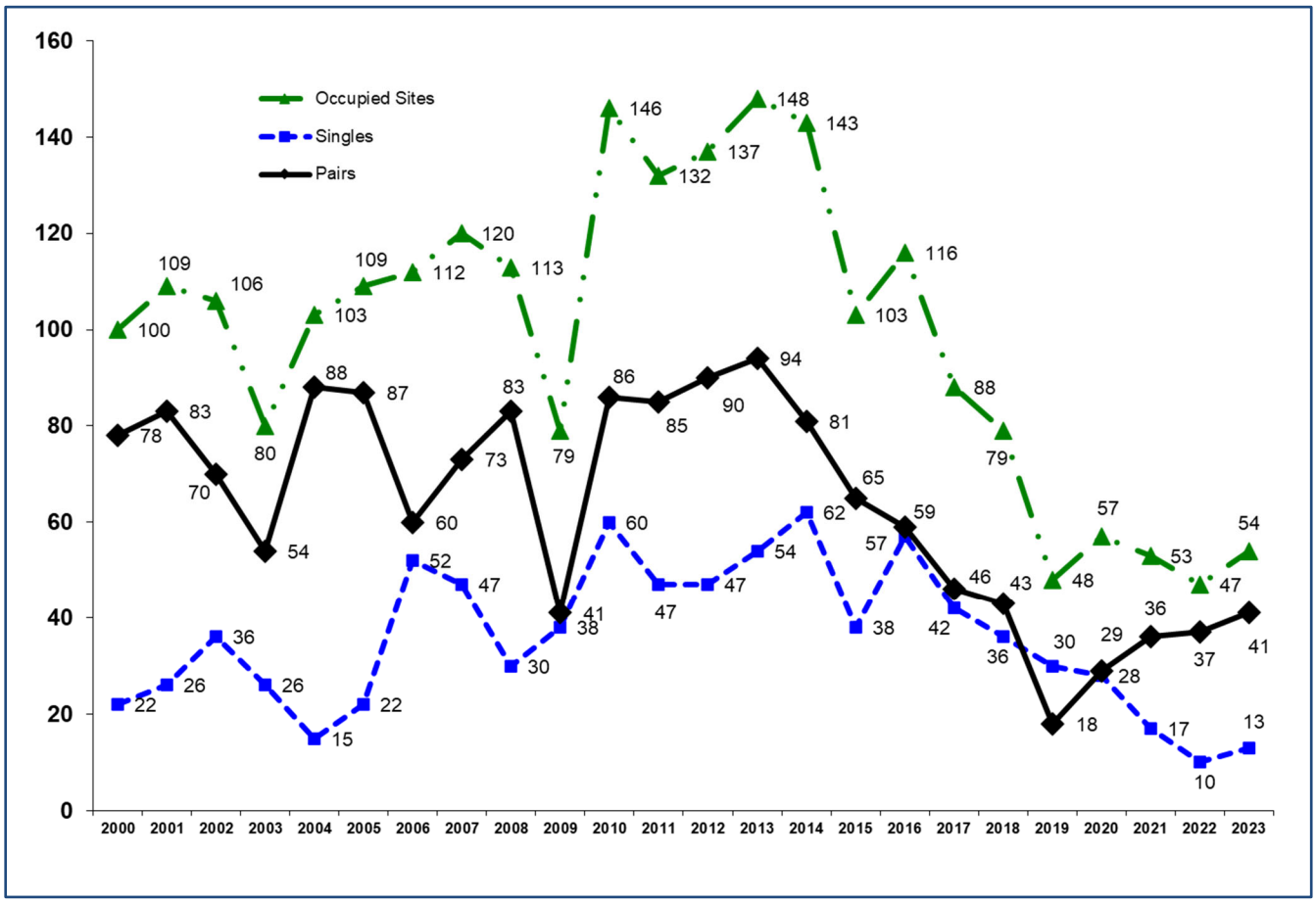

Figure 5. Number of northern spotted owl singles, pairs, and occupied sites by year for Mendocino Redwood Company timberlands, 2000–2023.

Disentangling the potential influence of survey effort on the above results requires scaling the data by considering the total number of sites surveyed or the spatial area covered by surveys. A naïve estimate of occupancy was calculated as a proportion of the total number of spotted owl sites occupied by either a single bird or pair (Figure 6). The proportion of sites occupied varied annually, exhibited similar dips as the empirical counts, and averaged 68% from 2000-2016 (Figure 6). The proportion of occupied sites from 2017 – 2023 averaged 34% because the total number of spotted owl territories surveyed was high while the number of territories with detected occupancy was low. One possible reason for this

phenomenon may be related to the barred owl (*Strix varia*), whose increasing presence on the landscape has displaced many spotted owls from historically occupied areas to new locations. In many instances, the "displacement" effect has resulted in the creation of new territories and the simultaneous retention of old spotted owl territories (now occupied by barred owls), thereby artificially inflating the number of territories on the landscape and driving down this proportion. Regardless, spotted owl numbers were lower than previous years, and the underlying causes of this apparent reduction in occupancy can only be judged in light of additional population information collected in the future.

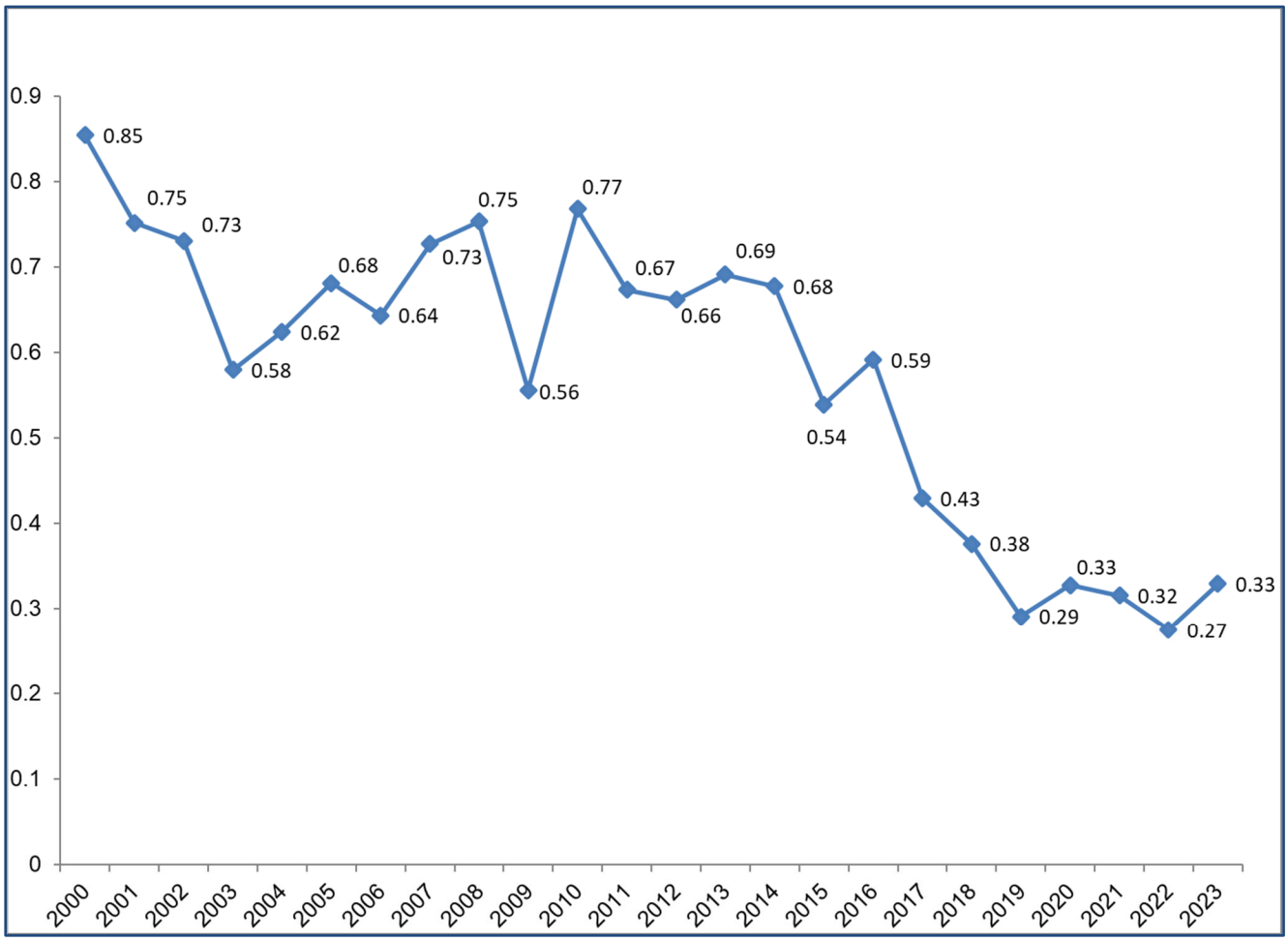

Figure 6. Proportion of occupied northern spotted owl territories on MRC lands, 2000–2023.

REPRODUCTIVE TRENDS

Reproductive success is an important metric because owls that successfully reproduce have a higher chance of contributing offspring—and genes—to future generations of spotted owls. Successful

reproduction is also necessary for generating a surplus pool of non-territorial birds (i.e., "floaters") available for recruitment when there is territory vacancy. Spotted owl reproduction is sporadic and closely linked to local weather and regional climate patterns, but may also be influenced by habitat, spotted owl breeding experience, prey availability, the presence of barred owls, disease, chemical exposure, and other environmental factors.

Similar to previous studies, we found that precipitation in the early nesting period (March-April) is an informative model explaining the negative relationship with reproductive output (Figure 7; Franklin et al. 2000; Glenn et al. 2009). And while the significance of this statistical relationship has declined in recent years, there are also additional variables not considered here that may explain the current unprecedented decline in spotted owl reproductive success over the past five seasons.

Potential stressors impacting the spotted owl population include the presence of barred owls, the use of toxic pesticides in trespass marijuana gardens, and long-term drought over the past decade. The extended drought may have a negative effect on small mammal populations, which could in turn affect not only spotted owls but other top predators that rely on this prey base. A similar pattern of declining reproduction in spotted owls has been observed on multiple ownerships in Humboldt, Mendocino and Sonoma counties over the past five years. This pattern appears to be independent of site-specific management activities.

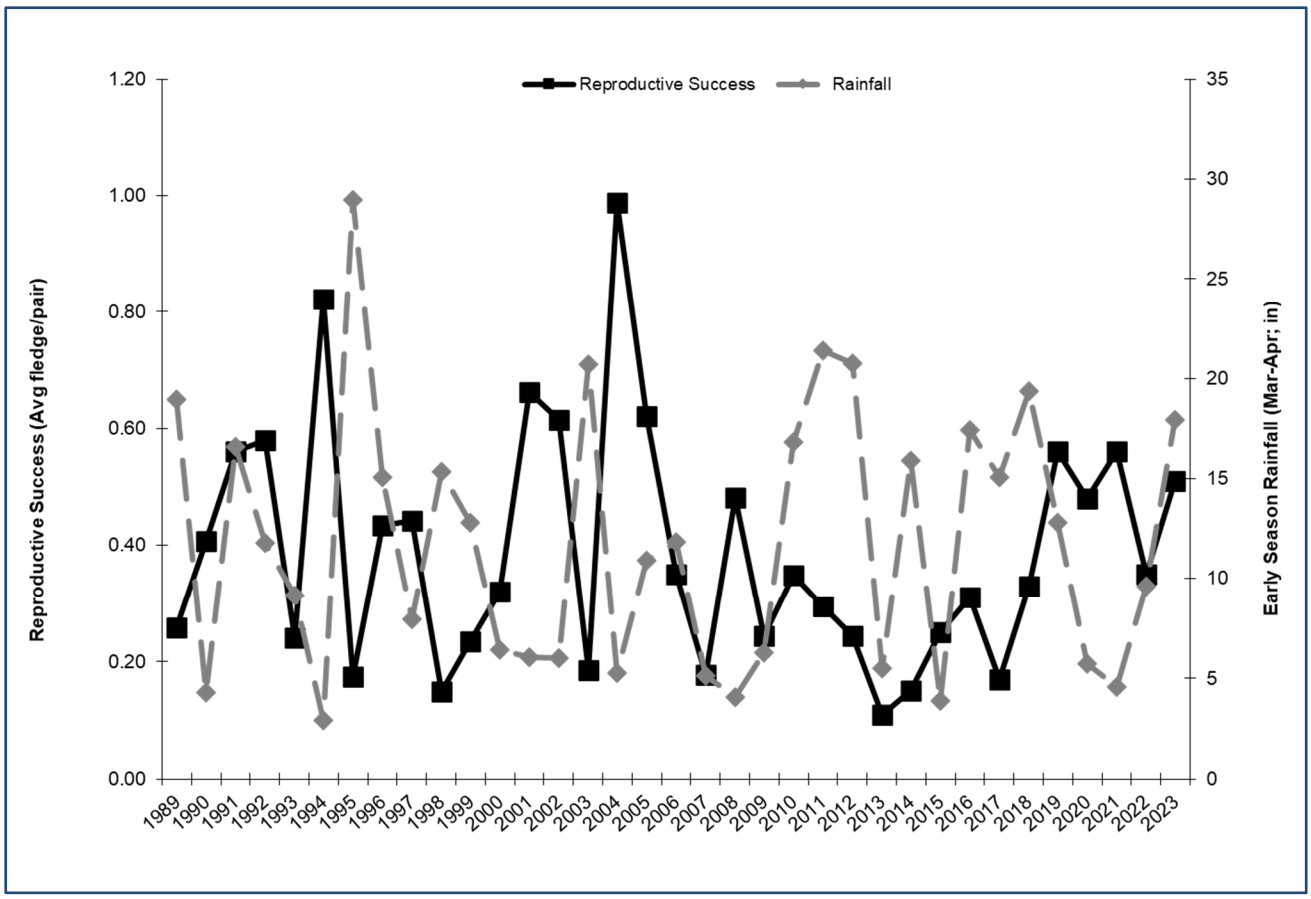

Figure 7. Annual reproductive success (number of fledglings/pair) of spotted owls and early season rainfall (inches) by year for Mendocino Redwood Company timberlands, 1989–2023.

SPOTTED OWL BANDING

Demographic analysis of mark-recapture data, derived from owl banding, is useful for estimating rates of population change, survival, fecundity, turnover, and dispersal. Generating these data usually take a substantial investment of time and effort. For spotted owls, the minimum amount time necessary to generate a demographic dataset is 10 years, but the data must be of a certain quality to estimate specific parameters. The main goal of our banding program at this time is to help track the movement of individuals over the landscape and the territories in which they occupy.

Spotted owl banding started in 1990 and has continued for the past 32 years with the exception of 1999 (Figure 8). Banded birds consisted of 581 adults, 87 subadults, 342 juveniles, and 5 unknown age. Sex ratios of adult and subadult owls were nearly 1:1, with 322 males and 328 females. Band resights totaled 887 for the 32-year dataset (Table 1). In 2023 there were 6 female, 10 male, 1 unknown sex subadult and

13 juvenile NSO's banded. Since MRC was established, a total of 605 birds have been banded and 491 band resights have been made.

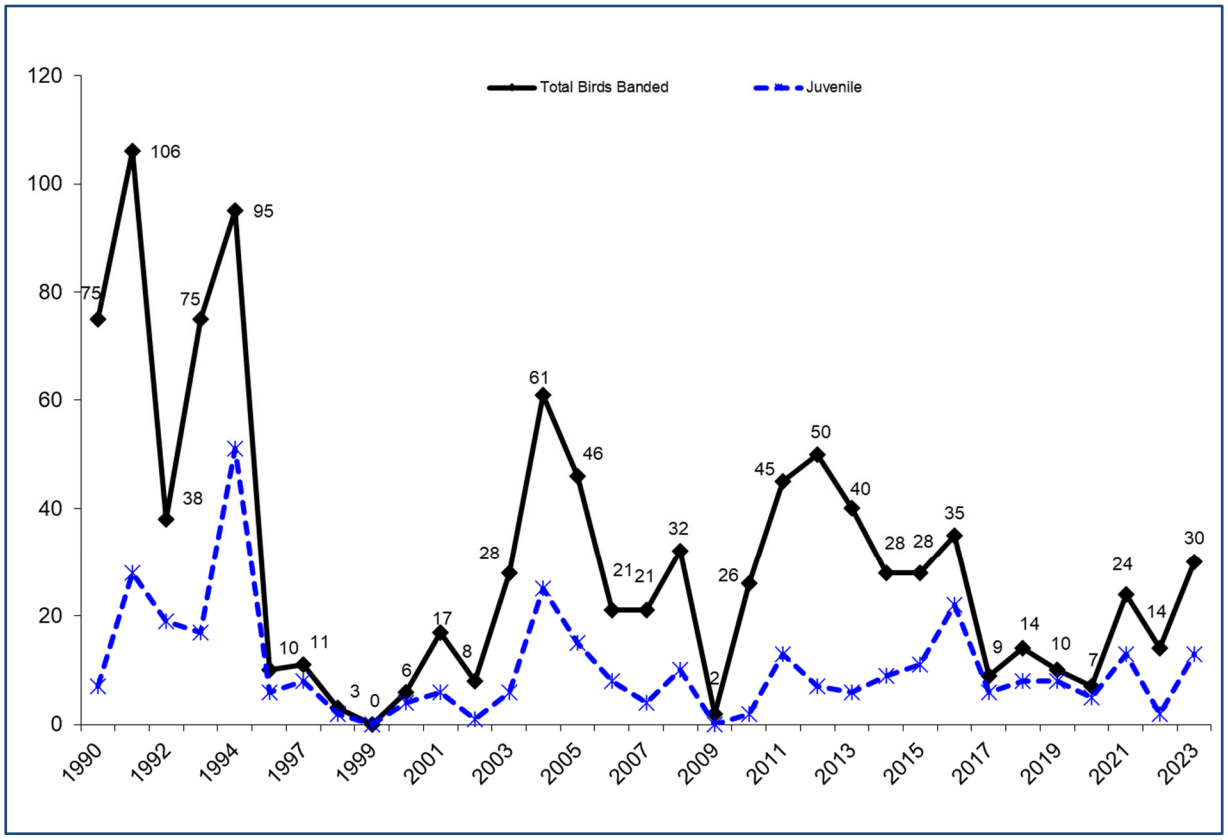

Figure 8: The total number of owls banded annually by life stage, 1990–2023.

Table 1: NSO banding and resight totals for MRC Property, 1990–2023

	Adults	**Subadults**	**Juveniles**	**Unknown**	**Total**
Male	265	57	-	4	326
Female	305	23	-	1	329
Unknown	11	7	342	-	360
Band Totals	**581**	**87**	**342**	**5**	**1015**
Resight Totals					**887**

THREATS TO THE NSO POPULATION

BARRED OWLS

Over the past 32 years, the barred owl population has increased substantially and is now displacing the spotted owl throughout the PNW (Kelly et al. 2003; Pearson and Livezey 2007). Barred owl presence may negatively affect spotted owl social behavior, detectability, occupancy, reproduction, and even survival (Kelly et al. 2003; Olson et al. 2005; Crozier et al. 2006; Forsman et al. 2011; Wiens et al. 2011; Dugger et al. 2016, Franklin et al. 2021). As previously mentioned, evidence indicates that the barred owl is primarily responsible for declining spotted owl populations in Washington, Oregon, and California (Anthony et al. 2006; Forsman et al. 2011; Dugger et al. 2016, Franklin et al. 2021). In British Columbia, the northern spotted owl was briefly extirpated from the northern-most part of its range by the barred owl but is now being reintroduced to the wild through a captive breeding program (USFWS 2011).

Barred owl presence was initially confirmed in Mendocino County in 1989 when area-wide surveys for spotted owls began. However, barred owls may have been present as early as 1978 (Dark et al. 1998; California Natural Diversity Database 2013). They have significantly increased during the past ten years on commercial forestlands in northwestern California, especially in coastal areas (Douglas 2015). In Mendocino County, barred owls were initially detected on California State Park lands and other reserve areas, then later on commercial timberlands (California Natural Diversity Database 2015).

Since 2010 an average of 27 known spotted owl territories have had detections of barred owls within 0.5 mile of the activity center (Figure 9). The total number of spotted owl territories on and adjacent (within 1000 feet) to MRC land with barred owl detections within 0.5 mile has increased to 121 over the past 14 years, which represents 55% of the spotted owl territories. Only a subset of these spotted owl sites had consistent barred owl detections over multiple years. In many areas, barred owls were transitory and never detected again; while in other areas they established territories, formed pairs, and repeatedly bred and fledged young. Spotted owls were not only increasingly difficult to locate in areas where barred owls were repeatedly detected over successive years but were also prone to traveling long distances within the season, possibly to avoid interactions with this larger, more aggressive species. Barred owls have successfully fledged young at several sites over the past 14 years, however, the numbers associated with barred owl detections and reproduction are likely underestimates given that spotted owl calls were primarily used during surveys.

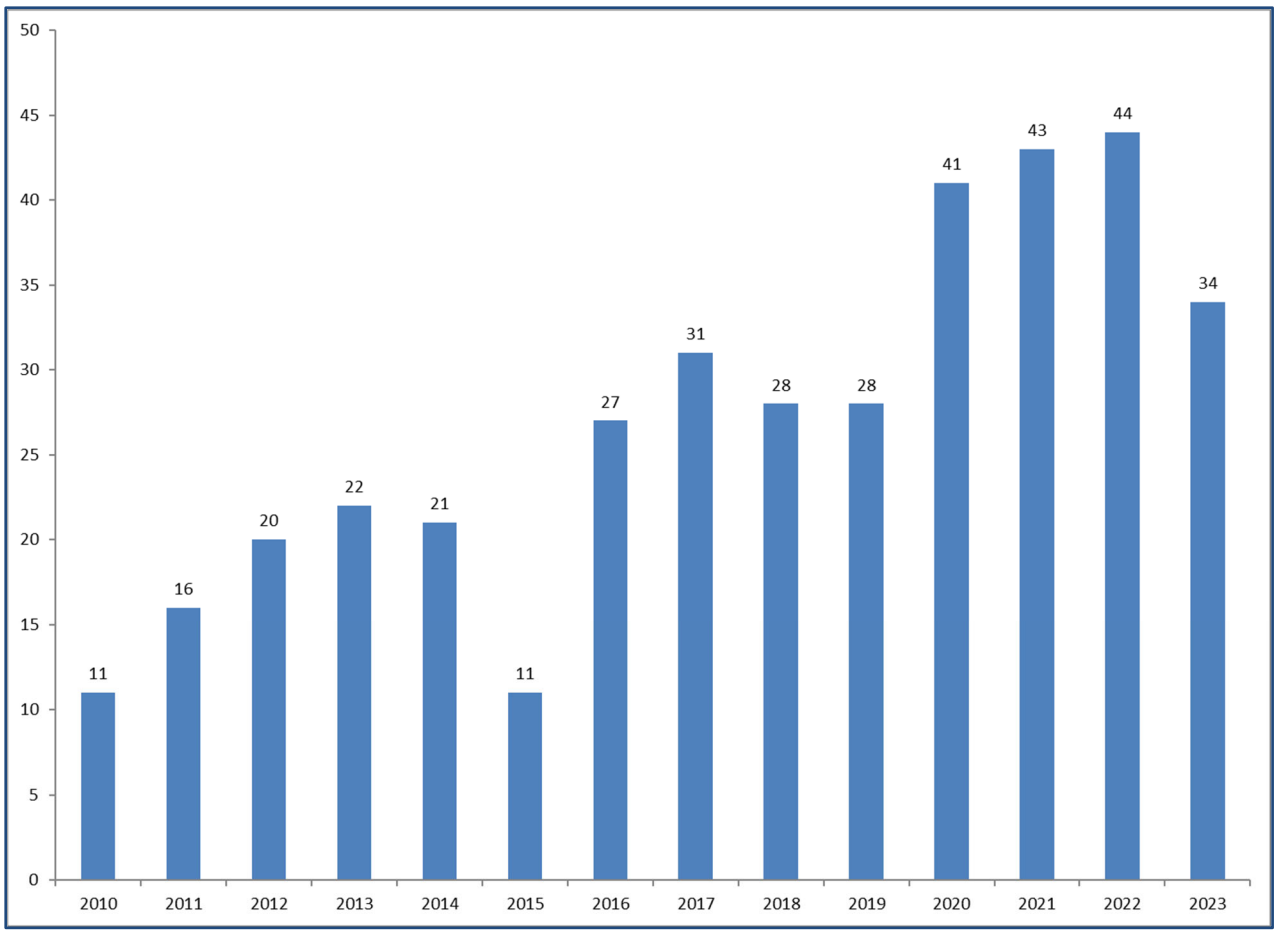

Figure 9. The number of northern spotted owl territories with barred detections within 0.5 mile by year.

TRESPASS MARIJUANA GARDENS

Pesticide (e.g., rodenticides, insecticides, molluscicides, etc.) use in trespass marijuana gardens continues to be a significant concern because of their ability to directly kill wildlife and proliferate throughout the food chain (Gabriel et al. 2012, 2013, 2015; Thompson et al. 2013). The frequency and spatial extent of toxicants used in marijuana gardens are largely unknown because there is no forensic monitoring of these compounds on MRC forestlands. Current knowledge of illegal pesticide use has been gained by a series of anecdotes from foresters and biologists working on forestlands over the years. In many instances, these individuals have directly observed the presence of specific toxicants in marijuana gardens along with dead wildlife (fox, blue jays and rats). In 2011, a necropsy conducted on a dead spotted owl found by an adjacent landowner revealed the owl had detectable amounts of anti-coagulant rodenticide in its system.

Toxic exposure of wildlife to pesticides found in trespass marijuana gardens have been increasing over the past decade and have been attributed to direct and indirect mortalities of Pacific fisher (*Pekania penannti*; Gabriel et al. 2015). These events have generated concern about exposure of other species, such as the northern spotted owl, which is a focal point for conservation efforts by numerous forestland owners.

NSO SUMMARY

Mendocino Redwood Company forestlands have a 35-year history of spotted owl surveys, including detailed population monitoring, research, and conservation. Surveys were conducted to locate and protect spotted owl activity centers from timber operations and other disturbance activities, and to monitor owl occupancy and reproduction over time to assess population health. Results from MRC's long-term monitoring program show that spotted owl occupancy has been dynamically stable during most of the past; however, in recent years several observations have generated concern about the future trajectory of the spotted owl population in the region: 1) spotted owl territory occupancy has been low for the past six consecutive years; 2) barred owl detections and spatial distribution have increased substantially during this time; and 3) spotted owl pairs have declined over the past six seasons.

Temporal trends in declining spotted owl populations are coincident with the barred owl invasion that has been moving southward along the Pacific Coast for the past three decades. Despite this apparent correlation, confirming a population decline will require additional years of monitoring data to determine if the pattern observed on MRC lands represents the beginning phase of a trend or is simply natural variation. And while the barred owl remains a significant threat to the spotted owl, other local and regional environmental factors must also be evaluated for their influence on spotted owl population dynamics. These include weather and climate patterns, health and status of primary prey populations, presence of toxicants in the environment, disease, and changes in habitat (not only nesting/roosting but also primary prey habitat). Mendocino Redwood Company will continue to work with industry and agency biologists, foresters, private consulting biologists, state parks, and other landowners to monitor spotted owl population trends and to develop effective conservation measures for this species on forestlands throughout northwestern California.

CALIFORNIA RED-LEGGED FROG HABITAT RESTORATION PROJECT

There are two recognized species of red-legged frogs found on Mendocino Redwood Company (MRC) ownership: California red-legged frog (*Rana draytonii*) and northern red-legged frog (*Rana aurora*). Northern red-legged frogs occur from Big River in Mendocino County, California north along the Pacific coast to Sullivan Bay, British Columbia (Stebbins 1985, Shaffer et al. 2004). The historical range of the federally threatened California red-legged frog include Pacific slope drainages from Mendocino County, California inland to the vicinity of Redding in Shasta County and south to Baja California, Mexico. Currently, California red-legged frogs are primarily found in small coastal drainages from Mills Creek in Mendocino County south to Santa Barbara County. The narrow integration zone of the two species is located from Big River south to Mills Creek in Mendocino County (Jennings and Hayes 1994, Shaffer et al. 2004).

Surveys to determine the distribution of California and Northern red-legged frogs on MRC began in 2004. Searches were conducted at potential breeding sites using techniques aimed at detecting evidence of reproduction (larvae or egg mass presence). The perimeter of the potential breeding site was walked, turning over movable objects and looking into the water for conspicuous egg masses often times using binoculars. Dip nets and seines were used to capture larval red-legged frogs and other amphibian species from the potential breeding site. Small vessels (kayaks, rafts, etc) were used to survey the entire wetted area of larger potential breeding sites.

A total of seven documented breeding sites within the range of California red-legged frog were discovered on MRC ownership during the distribution surveys, primarily found in manmade pond sites. One of the man-made ponds (West Fashauer Pond) with high reproductive activity is located in the Lower Greenwood Creek Planning Watershed in Mendocino County. Annual egg mass surveys at the West Fashauer Pond were limited to one visit per season in certain years, and the site is large and difficult to survey completely, so the numbers shown in Table 2 are likely only a fraction of the actual annual productivity of the site. Female California red-legged frogs only lay one egg mass per season (Storer, 1925), so these egg mass surveys can serve as a metric for estimating population abundance and the reproductive potential of these populations (Wilcox et al., 2017).

Table 2. Egg mass survey results from 2004-2018, demonstrating the previously high productivity of this site.

Year	California Red-legged Frog Egg Mass Counts
2004	25
2005	18
2006	16
2007	18
2008	20
2009	25
2010	30
2011	45
2012	41
2013	39
2014	12
2015	30
2016	19
2017	25
2018	5

In 2019 it was discovered that the West Fashauer Pond had been overtaken by the aquatic invasive plant *Azolla filiculoides* (Azolla) mosquito fern. Azolla is a freshwater floating fern that can be found in suburban and rural ponds. It prefers warm, calm waters, full sun, and is one of the fastest growing plants on the planet; it can double its biomass in two to three days. High levels of Azolla in ponds can cause anoxic conditions, effectively killing life within the pond, eliminating food sources for frogs, and making habitat conditions unsuitable for egg-laying and larvae survival. The presence of Azolla at the West Fashauer Pond significantly reduced the ability to accurately survey for California red-legged frog reproduction (Figure 10).

Figure 10. Aerial image of West Fashauer Pond with entire wetted surface area overtaken by invasive Azolla prior to removal project implementation, 2023.

The United States Fish and Wildlife Service (USFWS) was contacted in 2022 in an effort to develop a strategy and secure possible funding for removal of Azolla from the site in an attempt to restore the pond to its previous condition. After review of the proposed project by the USFWS, MRC was awarded Federal Recovery funding to implement the removal of Azolla to encourage California red-legged frogs to begin breeding at the site and aid in the conservation of the species. Implementation of the project occurred in September 2023 lasting four days, removal of Azolla employed the use of a Caterpillar 308 Excavator, 30-foot beach seine, kayaks and floating landscape rakes.

Figure 11. Aerial image of West Fashauer Pond with visible wetted surface after completion of the Azolla removal project, 2023.

A total of nine sub-adult California red-legged frogs were captured with dip nets and safely relocated to nearby locations of the pond where the Azolla removal activity was infeasible to occur due to the steepness of the banks and the inability to mobilize the cattails. At the end of the project approximately 90% of the Azolla had been removed which in surface area measured approximately 0.7 acres, at an average thickness of 0.5 feet this equates to approximately 560 cubic yards (Figure 11).

Effort to control the growth of Azolla (if feasible) and monitoring of California red-legged frogs reproduction at the site are anticipated to continue.

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