

FIRST RECORD OF THE NORTHERN SPOTTED OWL NESTING IN FOREST BURNED AT THE HIGHEST LEVEL OF SEVERITY

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ABSTRACT: An instance of the Northern Spotted Owl (*Strix occidentalis caurina*) nesting successfully in severely burned forest indicates that under some circumstances, such habitat may indeed provide the species suitable habitat. Current forest-management approaches treat wildfire as the primary cause of habitat loss for both the Northern and California (*S. o. occidentalis*) Spotted Owls. Assumptions that severely burned forest does not provide any viable nesting or roosting habitat for these Spotted Owl subspecies has resulted in substantial post-fire logging and removal of burned trees throughout both owls' ranges. In addition, forest management intended to prevent severe fires may entail thinning of unburned Spotted Owl habitat to reduce tree density and potential fuel loads. In the Mendocino National Forest of western Glenn County, California, I followed a pair of Northern Spotted Owls nesting and roosting deep within a large patch of severely burned forest two years after a fire, in a stand with no post-fire salvage logging, pre-fire thinning, fuels reduction, or attempts at restoration. A pair of Spotted Owls had used this location consistently since 1990, and the territory remained occupied with owls roosting and nesting successfully in 2022, despite 73% of the territory burning at high severity in 2020.

Under the Federal Endangered Species Act, the United States Fish and Wildlife Service (USFWS) designated the Northern Spotted Owl (*Strix occidentalis caurina*) a threatened subspecies in 1990 (USFWS 1990). Despite 25 years of this designation the subspecies has continued to decline precipitously throughout its range. In 2020, the USFWS reexamined the Northern Spotted Owl's vulnerability to extinction and confirmed severe and significant downward population trends, with declines of 32–77% since the early 1990s (USFWS 2019). The USFWS (2020) concluded that an elevating the owl's status from "threatened" to "endangered" was "warranted but precluded," meaning that although the Northern Spotted Owl met the requirements to be designated "endangered," the agency lacked the resources to take action at that time. The USFWS (2019) recognized the primary threats to the Northern Spotted Owl as competition with the Barred Owl (*Strix varia*), past and present habitat loss from timber management, and stated that "the primary loss of habitat is due to wildfire." Although the USFWS (2019) briefly mentioned post-fire logging, the agency failed to consider loss of potential *Strix occidentalis* habitat caused by logging of severely burned forest because such burned forest is not recognized as suitable habitat for the Spotted Owl's nesting or roosting. Here I document the successful nesting and roosting by a pair of Northern Spotted Owls in a large severely burned patch of forest, which indicates not only that such burned areas need closer examination, as they may offer breeding Spotted Owls viable habitat, but that the practice of logging severely burned forest should be reevaluated.

The Spotted Owl is recognized as having high site fidelity to established territories that meet fundamental biological needs and may remain in a terri-

tory even after a fire (Lee and Bond 2015). Although the Spotted Owl activity center I monitored was not surveyed every year, records such as those available through the California Natural Diversity DataBase (CNDDDB: <https://wildlife.ca.gov/Data/CNDDDB/Spotted-Owl-Info>; accessed on 20 February 2024) attest to stable long-term occupancy of this site (confirmed occupancy: 1977, 1980, 1982, 1990, 1992, 2002, 2006, 2008, 2021, 2022; confirmed reproductive success: 1980, 1990, 1992, 2002, 2008, 2022). In 2020 this entire Northern Spotted Owl activity center was burned in the August Complex Fire at high severity, typically defined as 76–100% mortality of the basal area of trees (USDA 2021b). In 2022, two years following the August Complex Fire, I returned to this site and confirmed Northern Spotted Owls nesting and roosting more than 1.5 km from the edge, within the deep interior of a 4500-ha swath of severely burned forest where 100% of the trees within at least 50 m of the nest and roost trees were killed. This may be the first report of a Northern Spotted Owl nest located in a large severely burned patch of mixed conifer forest.

The recent increase of wildfire in the Spotted Owl's habitat raises the question of the relationship between fire and the owl's habitat use over both the short and long term (CDFW 2016, Lesmeister et al. 2018, USFWS 2019). This increase raises concern for loss of high-quality nesting and roosting habitat, the scarcity of which has historically limited the number of Spotted Owl territories. Although the increase of fire has created more opportunity for study of the relationship between the Spotted Owl and burned forest (Clark et al. 2013, Rockweit et al. 2017, Bond et al. 2022), there remains little conclusive information about effects of fire *only*, unencumbered by logging pre- or post-fire (Bond et al. 2022, Hanson et al. 2021).

Most studies reporting fire to have negative effects on the Spotted Owl have not been able to distinguish between the effects of fire itself versus those of post-fire logging (Hanson et al. 2021). The few studies that have separated the two effects have shown that the effects of fires of mixed levels of severity are neutral or positive, while those of post-fire logging are consistently negative (Lee 2020, Hanson et al. 2021). The Northern Spotted Owl's use of severely burned forest has not been investigated, yet in the absence of published evidence such forest has been broadly assumed to be unsuitable for nesting or roosting habitat. Implicit in this assumption is the inference that the owl nests and roosts only in habitat traditionally considered suitable.

The Northern Spotted Owl's traditional nesting and roosting habitats in unburned forests of northwestern California are well documented, being characterized by structural complexity, decadent features, old conifers of large diameter, high basal area of live trees, trees of mixed ages, a multi-storied canopy, a high percentage of canopy cover, and coarse downed woody debris (Blakesley et al. 1992, Folliard et al. 2000, LaHaye and Gutiérrez 1999). With little information on how Spotted Owls respond to wildfire, these characteristics of unburned forest have been assumed to be the same requirements the owl needs to nest and roost in burned forests, fostering the idea that forests burned at high severity are unsuitable habitat (USFWS 2019). However, widespread assumptions that *Strix occidentalis* does not use burned habitats are inconclusive and untested because of widespread logging of severely burned forests, including those encompassing Northern Spotted Owl territories

(Bond et al. 2022). As reported by many (Brown 2008, Lee et al. 2013, Hanson et al. 2018) and statistically supported by other research (Bond et al. 2009, Clark 2007, Clark et al. 2011, 2013), *Strix occidentalis* avoids areas logged after fire. Whether Spotted Owls may nest or roost within severely burned areas that have not been logged after the fire, however, has not been investigated.

Many studies of the California Spotted Owl's relationship with wildfire have been similarly faced with the challenge of isolating the effects of wildfire from those of other factors. California Spotted Owl studies able to distinguish between these factors have found fire to be either neutral or slightly positive for territorial occupancy and survival (Bond et al. 2002, Roberts et al. 2011, Lee et al. 2012, Lee and Bond 2015, Hanson et al. 2018, Schofield et al. 2020). Studies that failed to document post-fire logging and distinguish between behavioral responses to post-fire logging versus severe fire (Comfort et al. 2016, Jones et al. 2016, 2020, Rockweit et al. 2017) may also have failed to recognize the ecological role such burned forests may play in the Spotted Owl's biology.

METHODS

Study Area

The Mendocino National Forest is located in northwestern California on the inland eastern spur of the northern California's Coast Range. It is about 320 km north of San Francisco and 195 km northwest of Sacramento. My observations took place at elevations from 1425 to 1460 m in Glenn County, on a west-facing slope within a patch burned at high severity in the 417,898-ha August Complex Fire of 2020. The fire burned hot through this entire area, including a 40-ha "late-successional reserve" composed of mature mixed coniferous forest. The reserve was surrounded by early- to mid-successional forest heavily logged in the mid-1980s, when approximately 85 ha of forest was removed. Draining into Butte Creek on a moderate slope are multiple year-round and ephemeral waterways.

Spotted Owl Surveys

In May and June 2002, my Spotted Owl surveys followed the protocol specified by the USFWS (1992), whereas those in May and June 2022 adhered to the updated "Protocol for Surveying Proposed Management Activities that May Impact Northern Spotted Owls" (USFWS 2012). All observations and data for each field visit were recorded and compiled on individual field outing forms with attached United States Geologic Survey (USGS) topographic 7.5-minute quadrangle maps, showing coordinates obtained from a hand-held Garmin GPS unit (global positioning system).

RESULTS

In 2002, I was one of a two-person team documenting a pair of Northern Spotted Owls with two successfully fledged young in the Mendocino National Forest. The habitat within the core area (within 1126 m of the nest) consisted of traditional nesting/roosting habitat in late-successional forest.

In 2022, after the area burned in the August Complex Fire of 2020, I located

a Northern Spotted Owl nest ~325 m downslope and west of the nest used in 2002 and identified several of the male's day-roost sites. The Northern Spotted Owl nest and roosts were >1300 m from the perimeter of a ~4500-ha patch burned at high severity (Figures 1–4). The nest contained three nestlings, of which two successfully fledged (Figure 2). It was situated in a cavity within a Douglas fir (*Pseudotsuga menziesii*) tree (diameter at breast height 105.5 cm) that was fire-scorched and moribund (Figure 1). The nest tree and some others in the same stand were not immediately killed by the fire but subsequently died between 2021 and 2022, as dead needles remained on branches. The nest tree stood approximately 30 m tall, with the south-facing nest cavity approximately two-thirds up the trunk, midway up a ~30° west-facing slope. The nearest live tree was ≥50 m north of the nest along a large perennial creek. In addition, I observed the male roosting by day on two separate days in burned snags ~38 m southwest and ~33 m southeast of the nest (Figure 3). Concentrated accumulations of recent whitewash and pellets indicating routine owl use lay around the trunks of many other burned trees within 40 m of the nest tree and throughout the burned stand. Chew marks observed on feather shafts found on the ground ~30 m south of the nest tree implied mammalian predation of the third chick.

The severity of the fire in these owls' home range, based on the USGS's Monitoring Trends in Burn Severity Project (www.mtbs.gov; accessed on 13 March 2024), is shown in Figures 4a and 4b. Within the home range (radius 2092 m), the severity of the fire was 73% high, 20% moderate, 6% low, and 1% unburned.

DISCUSSION

For the California Spotted Owl, Lee and Bond (2015) found an 87% probability of a pair occupying a previously identified territory even when 100% of the 121-ha activity center had been burned severely. Though I found no previous records of Spotted Owls nesting in such burned forest, my results here add to those of Lee and Bond (2015) regarding the California Spotted Owl. Mine may be the first documentation of the Northern Spotted Owl nesting within severely burned forest, but the findings of Lee and Bond (2015) with the California Spotted Owl imply that nesting under such conditions is unlikely an isolated event. The lack of previous documentation of Northern Spotted Owl nests inside large patches of forest burned at high severity may reflect the very high proportion of such areas that are logged shortly after wildfires (Bond et al. 2022), as well as the long-standing assumption by land managers and Spotted Owl survey crews that severely burned forest is not suitable for Spotted Owl nesting or occupancy (USFWS 2019). This assumption may lead to nest-site surveys within the few large severely burned patches that are not largely clearcut soon after the fire being inadequate or lacking (Bond et al. 2022).

The 2022 Northern Spotted Owl nest that I documented in the area burned in the August Complex Fire had three nestlings, of which two fledged successfully (Figure 2). Spotted Owls typically rear one or two young and have been rarely known to fledge three in any given season (Bond et al. 2013). Thus a brood of three offspring suggests that this severely burned forest provided

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FIGURE 1. Northern Spotted Owl cavity nest in mixed conifer forest severely burned in the 2020 August Complex Fire, Mendocino National Forest, 1 June 2022.

Photo by Maya Khosla



FIGURE 2. Adult Northern Spotted Owl with two fledglings in mixed conifer forest severely burned in the 2020 August Complex Fire, Mendocino National Forest, 3 July 2022.

Photo by Tonja Chi



FIGURE 3. A northeast-facing view of two roost trees (indicated by yellow arrows) of a male Northern Spotted Owl in mixed conifer forest severely burned in the 2020 August Complex Fire, Mendocino National Forest, 19 May 2022.

Photo by Tonja Chi

prey sufficient to support a brood of at least typical size (Bond et al. 2013). Lee (2020) found that Spotted Owl productivity increased as the proportion of the pair's territory burned severely increased. Examples of increased prey abundance resulting in increased brood sizes and larger clutches are common in other raptor species, for example, the Great Horned Owl (*Bubo virginianus*;

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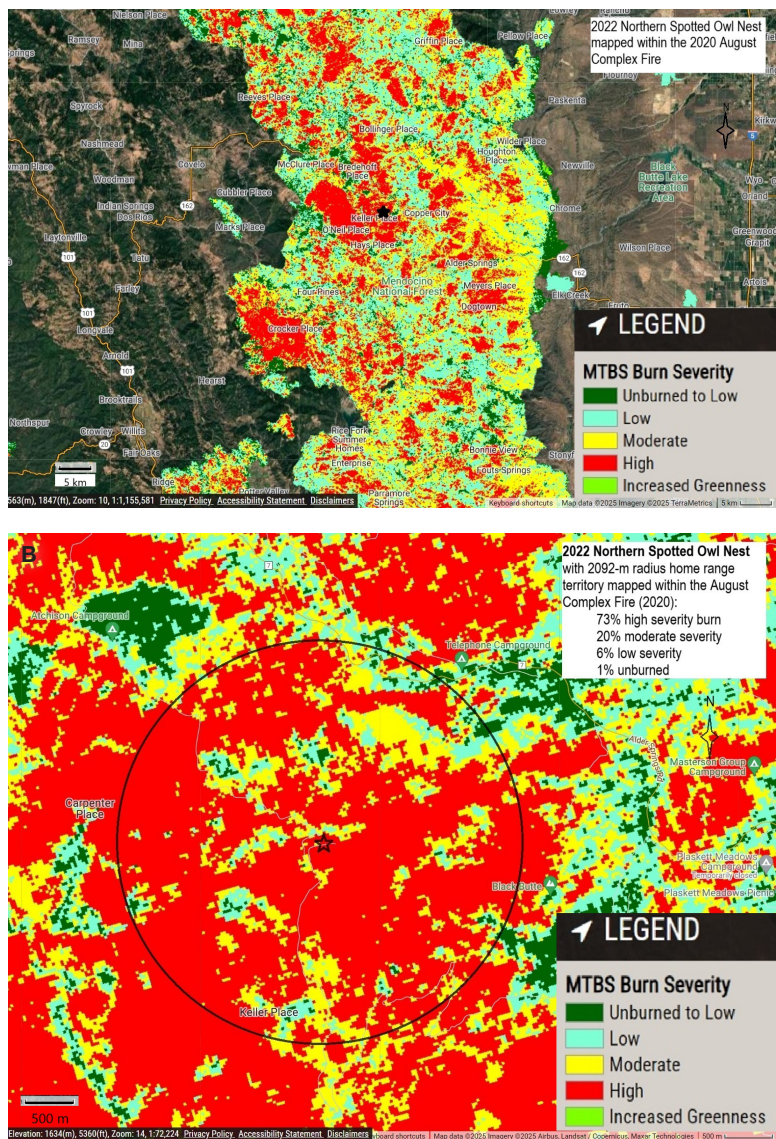


FIGURE 4. Location of Northern Spotted Owl nest (black star), plotted on a map of levels of fire severity in areas burned in the August Complex Fire of 2020. Fire-severity data obtained from the Monitoring Trends in Burn Severity Project of the USGS (2024). (A) The southern half of the 2020 August Complex Fire, Mendocino National Forest. (B) Closer view, showing a radius of 2092 m around the nest, defining the pair's home range or activity center (indicated black circle).

Reynolds et al. 2021), Eurasian Eagle Owl (*Bubo bubo*; Hadad et al. 2024), Tengmalm's or Boreal Owl (*Aegolius funereus*; Korpimäki 1990), and Eurasian Kestrel (*Falco tinnunculus*; Korpimäki and Wiehn 1998).

My surveys in 2022 were a response to the Mendocino National Forest's proposal, in the wake of the August Complex Fire, to salvage-log 306 ha (Plaskett-Keller Phase I Project) around the Northern Spotted Owl nest I found active. This proposal would have resulted in the removal of one quarter of the burned forest within 2.1 km of the nest or one quarter of the 1372-ha territory. The project's environmental assessment (USDA 2021a) also specified logging much of the severely burned forest in two other Northern Spotted Owl activity centers. The following excerpt from the proposal is a common example of the assumptions have been frequently applied to severely burned forest: "All three of these [activity centers] have the most habitat loss from fire. Nesting and roosting habitat has been greatly diminished, and new nests are not expected to occur in these activity centers" (USDA 2021a). The Northern Spotted Owls I observed were roosting (Figures 2 and 3) and nesting (Figure 1) in a long-established territory deep within the perimeter of the August Complex Fire in which tree mortality two years after the fire was 100% (Figure 4a).

SUMMARY

A successful Northern Spotted Owl nest located in a patch of severely burned forest suggests an unrecognized value to such burned forest—it may be not only beneficial but essential to Spotted Owls after a wildfire. Currently, this habitat is regularly undervalued, overlooked, and routinely removed, be the forest federally, state, or privately owned (Bond et al. 2022). This finding of a successful Spotted Owl nest within a large patch of severely burned forest introduces a new dialog to evaluation of the species' use of burned landscapes. It emphasizes the need for further research into such use, as well as a need for establishment of new protections of such sites from post-fire logging. It appears that the high-quality conditions for nesting and roosting observed at this site in 2002 (unmanaged from 2002 to 2022) persisted in a different form after the territory burned in 2020.

Most public lands on which the Spotted Owl has been studied have a long history of management and timber harvest, with national parks being the exception. This emphasis on logged forest has likely led to the habitat at a large percentage of study sites being complex and heterogeneous, a baseline variable not considered when different regions are compared. Schofield et al. (2020), who studied the Spotted Owl in areas burned at mixed levels of severity within national parks protected from logging, compared their results to those of other studies conducted in wildfire-burned and managed forests. They surmised that pre-fire forest structure was likely paramount to the legacy of post-fire habitat conditions the owls need. My findings, in a stand of high-quality habitat pre-fire, demonstrate that severely burned forest can not only provide nesting and roosting habitat for Northern Spotted Owl but may supply an enhanced food abundance, allowing for an increase in fecundity, as indicated by Lee (2020). This finding suggests not only the need to increase protection of severely burned forest but also protection of the

habitat's structural complexity pre-fire, essential for resilience in maintaining habitat value for *Strix occidentalis* post-fire. It further highlights pre- and post-fire forest conditions as aspects of *Strix occidentalis* territories that must be protected to slow the continuing loss and degradation of Northern Spotted Owl habitat, identified as a top contributing factor to the Northern Spotted Owl's population decline range wide (USFWS 2019).

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