ROOST SITES OF THE BLACK-BACKED WOODPECKER IN BURNED FOREST

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ABSTRACT: The Black-backed Woodpecker (*Picoides arcticus*) is strongly associated with recently burned forest, which makes it vulnerable to salvage logging or other post-fire forest management that removes snags. As part of a larger radio-telemetry study of the species' resource use and habitat selection in a burned forest in California, we located radio-tagged Black-backed Woodpeckers at night to find and describe their roost sites. We found 14 unique roost locations during night-time searches for five individual birds. Description of the micro-site on the tree that the bird used was impossible at five roosts where we could not visually locate the bird in the dark. At the nine roosts confirmed visually, none of the birds roosted in excavated cavities. Rather, they roosted in sheltered spaces within burned-out hollows of trunks (5 instances), in the crook of a forked trunk (1 instance), wedged between adjacent trunks of two closely spaced trees (1 instance), in a deep, natural bark furrow (1 instance), and clinging to a trunk directly above a horizontal branch (1 instance). Eleven of the 14 roosts (79%) were in dead trees. Our results suggest that in burned forests the Black-backed Woodpecker may benefit if, during salvage logging, emphasis is placed on retaining snags with burned-out hollows, forked trunks, or other relatively unusual structures that may create crevices or other opportunities for shelter.

The Black-backed Woodpecker (*Picoides arcticus*) is strongly associated with recently burned forest, which makes it vulnerable to salvage logging or other post-fire forest management that removes snags (Bond et al. 2012). In California, the U.S. Forest Service has designated the Black-backed Woodpecker a "management indicator species" for burned forest across ten national forests (U.S. Forest Service 2007). At this writing, the U.S. Fish and Wildlife Service is also evaluating the California segment of the species for candidacy as threatened or endangered under the federal Endangered Species Act. Recent research into the Black-backed Woodpecker's occupancy patterns (Saracco et al. 2011), habitat selection for nesting (Seavy et al. 2012) and foraging (Hanson and North 2008), and home-range size and characteristics (Tingley et al. 2014) in burned forests of California have provided a wealth of information that land managers can use to consider habitat needs of the species when managing burned forests.

Night-time roost sites could be a habitat element limiting the suitability of otherwise appropriate burned forest as habitat for Black-backed Woodpeckers. Understanding the specific characteristics of sites the species selects for roosting could lead to more informed snag-retention guidelines to help ensure that retained habitat is as suitable for Black-backed Woodpeckers as possible.

Although many woodpeckers create their own roost sites by excavating cavities in live or dead trees (Winkler et al. 1995), the limited evidence available indicates this is not the case for the Black-backed Woodpecker, at least during the nesting season. Goggans et al. (1988) reported characteristics of roosts used by four radio-tagged Black-backed Woodpeckers breeding in unburned Oregon forests with a high rate of tree mortality induced by bark beetles. Of 20 roost sites found, none were in excavated cavities. Rather, the birds roosted in a variety of micro-sites, including trunk scars and concave western gall rust (*Endocronartium harknessii*) cankers, primarily on live trees. However, no information is available about the Black-backed Woodpecker's roost-site selection in burned forests. As part of a larger radio-telemetry study of the species' resource use and habitat selection in a burned forest in California (Tingley et al. 2014), we located radio-tagged Black-backed Woodpeckers at night to find and describe their roost sites.

METHODS

During the breeding season of 2013, we studied Black-backed Woodpeckers occupying the area burned by the Wheeler fire (alternatively referred to as the Antelope Complex fire) in the Plumas National Forest (Figure 1) in the northern Sierra Nevada, California. The Wheeler fire burned in 2007, affecting 9265 ha of mostly Sierran mixed conifer forest (California Department of Fish and Game 2005) on Forest Service land. Forest Service mapping based on Landsat Thematic Mapper data before and after the fire classified the burning of 52.6% of the area inside the fire perimeter as high severity, 28.3% as moderate severity, 13.4% as low severity, and 5.7% as unchanged. There was little post-fire logging on Forest Service land within our study area, but a few private inholdings within and adjacent to the study area were clear-cut after the fire, and post-fire wood-cutting for firewood by the public was pervasive along roads through much of the study area on Forest Service land. Much of the study area encompassed large, continuous stands of moderately or severely burned forest. The burned area extends from 1417 to 2138 m above sea level.

In late April of 2013, we began searching for Black-backed Woodpeckers at the study site, using a combination of broadcast surveys (loosely following the survey methods described in Saracco et al. 2011) and passive observation. Once we located birds, we caught them in mist nets and attached model BD-2 radio transmitters supplied by Holohil Systems, Ltd., to the dorsal surface of one of the inner rectrices. Transmitters were custom-modified by the manufacturer with a hole drilled into the large end, through which we could feed monofilament. Transmitters, including batteries, weighed approximately 2.0 g. We used ethyl cyanoacrylate (available commercially as Superglue) to glue transmitters to a feather shaft and then further attached them with two loops of monofilament tied around the feather shaft.

Some of the woodpeckers we radio-tagged occupied home ranges in very steep terrain or in areas otherwise difficult or unsafe to traverse at night. To identify roost sites, we therefore selected five focal individuals from a subset of the larger group of woodpeckers we radio-tagged, on the basis of their feasibility of being radio-tracked at night, given the accessibility and terrain of their home ranges.

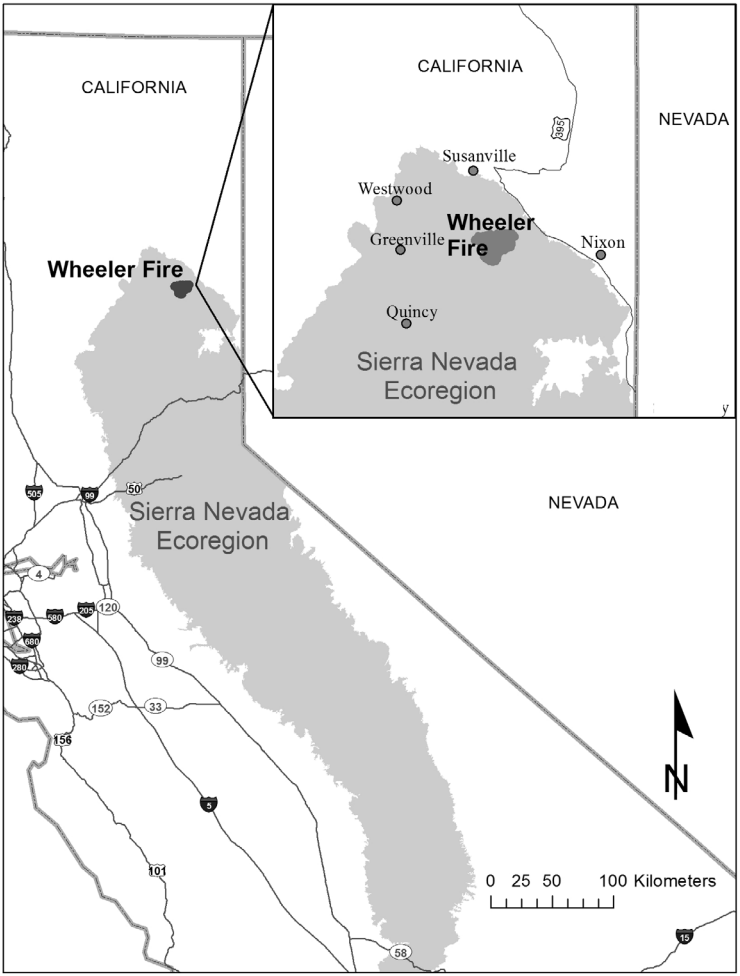

Figure 1. Location of the Wheeler fire, where we located roosts of radio-tagged Black-backed Woodpeckers during the breeding season of 2013.

We attempted to locate the focal birds about every ten days, or opportunistically when our crew was able to visit the study site at night. In the Black-backed Woodpecker, males roost primarily in the nest cavity until late in the nestling period (Short 1974). After confirming this by finding one of our radio-tagged males roosting in the nest with nestlings, we searched for roosts of males only after their nestlings had fledged. We looked for roosts of radio-tagged females both before and after nestlings fledged.

Working in pairs or small groups, our crew used the homing method (Mech 1983, White and Garrott 1990) to find roosting birds at night. Searching

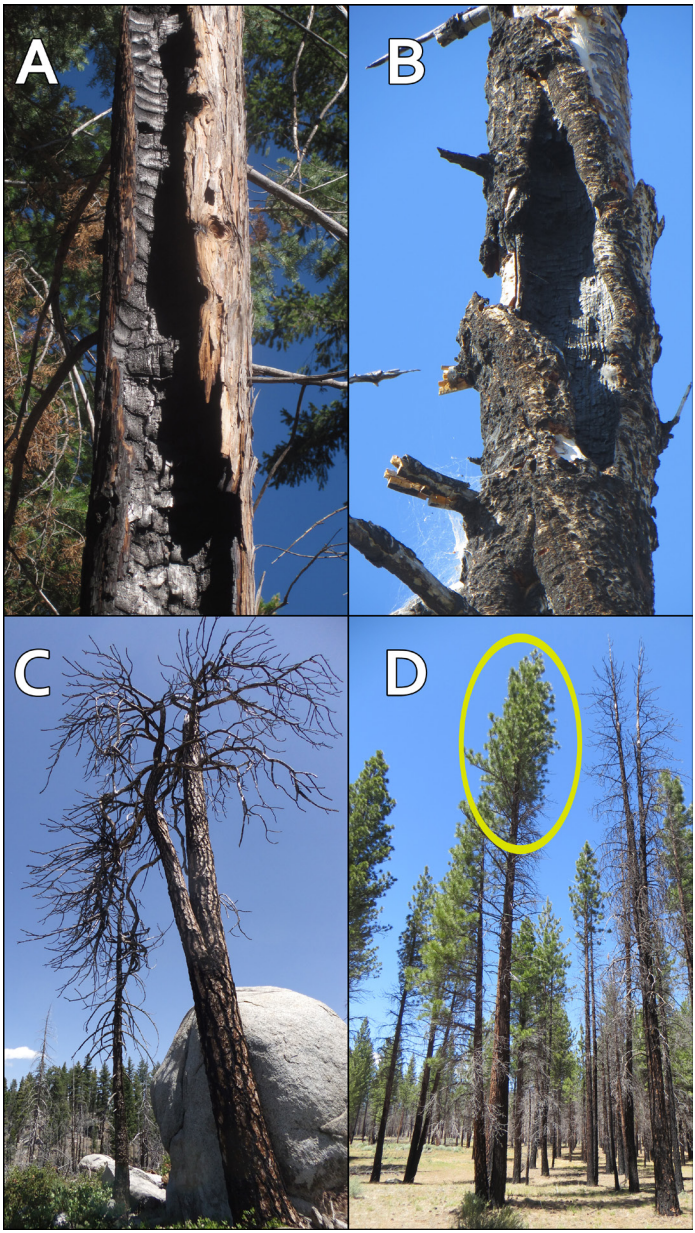

Figure 2. Examples of locations of night-time roosts in burned-out hollows of trunks (A and B), in the crook of a forked trunk (C), and obscured within thick live foliage indicated by the oval (D).

began only after at least three stars were visible in the night sky, usually near the tagged bird's nest. Locating roosts generally required between 15 and 90 minutes of homing. In many cases we were able to visually confirm the roosting bird's location with a flashlight, but sometimes the birds were obscured by vegetation or were otherwise impossible to see. We recorded the roost's coordinates and marked the site with flagging, then returned during daylight to record the roost's substrate and details of the surrounding habitat.

RESULTS

We found 14 unique roost locations (other than nests) during 20 nighttime searches for the five birds (Table 1). In six cases (30%), we found birds roosting at sites where we had found them roosting on previous nights. In all cases, we ascertained the tree in which the bird was roosting by radio-tracking, but description of the micro-site on the tree that the bird used was impossible at five roosts (36%) where observers could not visually locate the bird in the dark. At the nine roosts (64%) that were confirmed visually, none of the birds roosted in excavated cavities. Rather, we found them roosting in sheltered spaces within burned-out hollows of trunks (5 instances; Figure 2), in the crook of a forked trunk (1 instance; Figure 2), wedged between

Table 1 Characteristics of Black-backed Woodpecker Roost Sites Found in the Area Burned in the Wheeler Fire

Bird	Roost micro-site	Tree species	Live or Dead	Fire severity[a]	Dates used[b]
BX-13	Forked trunk	Yellow Pine	Dead	H	10 Jun
BX-13	Burned-out hollow in trunk	Fir	Dead	M	18 Jun
BX-13	Unseen	White Fir	Dead	H	26 Jun
BX-13	Deep bark furrow	Incense Cedar	Dead	M	3, 10, 18 Jul
CR-13	On trunk above a branch	White Fir	Dead	H	11 Jun
CR-13	Burned-out hollow in trunk	Fir	Dead	H	21, 26 Jun, 3, 10, 18 Jul
EM-13	Wedged between two trunks	Oak	Dead	M	**30 Apr**
RR-13	Burned-out hollow in trunk	Yellow Pine	Dead	H	**8**, 26 Jun
RR-13	Unseen	Jeffrey Pine	Live	M	19 Jun
RR-13	Burned out hollow in trunk	Fir	Dead	H	10 Jul
RR-13	Burned out hollow in trunk	Fir	Dead	H	18 Jul
SD-13	Unseen	Ponderosa Pine	Live	M	**14 May**
SD-13	Unseen	Yellow Pine	Dead	M	**21 Jun**
SD-13	Unseen	Yellow Pine	Live	M	26 Jun

[a]Severity of the fire as unburned, low, moderate (M), or high (H) within 50 m of the roost, as assessed in the field.

[b]All dates were during 2013. **Bold** type, the bird's young had not yet fledged from the nest; regular type, the bird's young had already fledged.

adjacent trunks of two closely spaced trees (1 instance), in a deep, natural bark furrow (1 instance), and clinging to a trunk directly above a horizontal branch (1 instance). At the five locations where the roosting bird was not located visually, inspection of the roost tree during the day did not reveal any excavated cavities that could have been used for roosting.

The 14 roosts varied greatly (Figure 3) in distance from the roosting bird's nest, with an average distance of 428 m (SD = 241 m). We recorded both the minimum (110 m) and maximum (874 m) distance from the nest tree when the roosting bird still had nestlings in its nest. All 14 of the roost sites were within stands that had burned at moderate or high severity (Table 1). Three of the 14 roost sites were in live trees, whereas the remaining 11 (79%) were in fire-killed snags (Table 1). Tree species used for roosting included Ponderosa (*Pinus ponderosa*) and Jeffrey Pine (*P. jeffreyi*), White Fir (*Abies concolor*), unidentified fir (which could be White Fir or Red Fir [*A. magnifica*]), and unidentified oak (Table 1). The trees averaged 37.0 (SD = 16.1) cm in diameter at breast height (dbh) and 12.3 (SD = 5.5) m tall (Figure 3). Most of the roost sites had few or no live trees within 10 m of the roost tree (range 0–17 live trees with dbh >10 cm), whereas the abundance of dead trees within the 10-m radius varied greatly (Figure 3; range 1–89 dead trees with dbh >10 cm).

DISCUSSION

Our study provides the first information on the Black-backed Woodpecker's roost sites in burned forest. In unburned forest with a high proportion

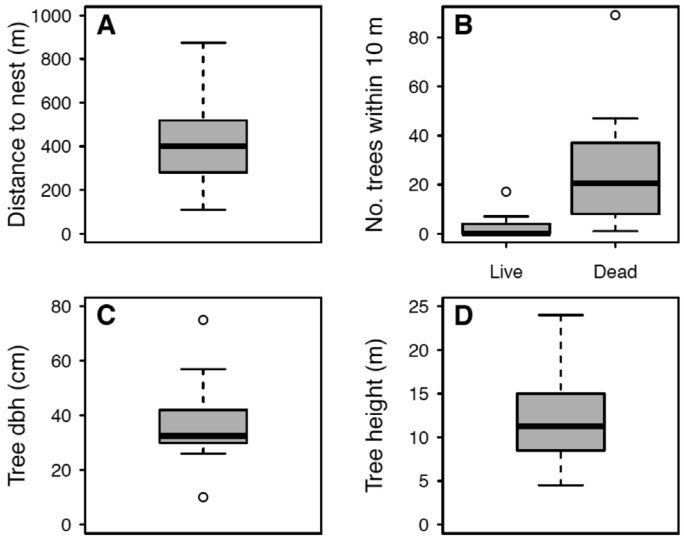

Figure 3. Box plots of distance to nest (A), number of live and dead trees within 10 m (B), tree diameter at breast height (C), and tree height (D) for 14 roost sites. Heavy bar, mean; shading, one standard deviation; whiskers, range excluding outliers; circles, outliers.

of trees killed by bark beetles, Goggans et al. (1989) reported Black-backed Woodpeckers roosting primarily in live trees (87% of sites), whereas 79% of our observations (11 of 14) were of birds roosting in dead trees. Neither study, however, found woodpeckers roosting in excavated cavities (except within the nest during incubation and brooding). Rather, at least during the nesting season, Black-backed Woodpeckers roost in semi-sheltered, unexcavated micro-sites, such as burned-out hollows in fire-killed trees, tight spaces between forked trunks, and, in at least one instance in our study, a portion of a trunk covered with dense, live foliage. In several cases, the creation of burned-out hollows in fir trunks used for roosting appeared to have been facilitated by previous nonlethal attacks by the Fir Engraver Beetle (*Scolytus ventralis*), a bark beetle that attacks stressed fir trees (D. Cluck, U.S. Forest Service Forest Health Protection program, pers. comm.). Unlike those of many other bark beetles, attacks of the Fir Engraver Beetle may kill only a patch of tissue on the bole (Berryman and Ferrell 1988). Particularly at drier sites, trees may be slow to compartmentalize wounds, leaving dry sapwood exposed and allowing decay-promoting fungi to enter. Several of the hollows we observed appeared to have been created where old partially exposed wounds from beetle attack allowed fire to burn into the bole.

Several of our findings pertaining to roost sites may have implications for retention of burned forest intended to benefit Black-backed Woodpeckers. After the Wheeler fire, Black-backed Woodpeckers roosted in relatively large trees (mean dbh = 37 cm), implying that retained forest stands with larger trees are more likely to provide adequate opportunities for roosting. All 14 of the roost sites we found were in stands that had burned at moderate or high severity, even though some of the birds had extensive lightly burned areas (and in the case of one individual, unburned areas) available within their home ranges.

In California, Black-backed Woodpeckers' home ranges can be quite large, encompassing hundreds of hectares (Tingley et al. 2014). We found Black-backed Woodpeckers—including individuals still tending nests from which the young had not yet fledged—roosting between 110 and 874 m (mean = 428 m) from their nest. The relatively long distances we found between nests and roost sites underscore the need for land managers to adopt a landscape perspective with respect to the Black-backed Woodpecker and retain large blocks of burned forest (Bond et al. 2012).

Perhaps most importantly, fire-killed trees with burned-out hollows, forked trunks, or other relatively unusual structures were most consistently selected for roosting. Forest-management guidelines often emphasize the importance of retaining "defect" trees during selective logging of unburned forest (Mazurek and Zielinski 2004, North et al. 2009) because such trees may be especially valuable to wildlife and are currently scarce in Sierra Nevada forests (McKelvey and Johnson 1992). Our results suggest that in burned forests Black-backed Woodpeckers may likewise benefit from retention of "defect" snags—snags with burned-out hollows, forked trunks, or other unusual structures that may create crevices or other opportunities for shelter—during salvage logging. Additional research is needed to determine which other species of wildlife might also benefit from such efforts.

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