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Black-backed Woodpecker (*Picoides arcticus*) Surveys on Sierra Nevada National Forests: 2008 Pilot Study

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Summary

The Black-backed Woodpecker (*Picoides articus*) was recently selected by USDA Forest Service Region 5 as a Management Indicator Species (MIS) for snags in burned forests across the ten Sierra Nevada national forests: Eldorado, Inyo, Lassen, Modoc, Plumas, Sequoia, Sierra, Stanislaus, Tahoe, and the Lake Tahoe Basin Management Unit. This 2008 pilot study was implemented to develop and test field methods and collect information that will be useful in developing a monitoring program for Black-backed Woodpecker on Sierra Nevada national forests.

Prior to the 2008 breeding season we developed a survey protocol based on passive point counts followed by playback of recorded Black-backed Woodpecker vocalizations at survey stations located 250 m apart within each fire area. During the 2008 breeding season we visited 19 of 20 fire areas randomly selected from among fires that burned across the ten Sierra Nevada national forests since 2000, and conducted surveys at 371 survey stations. We detected Black-backed Woodpeckers at 68 survey stations distributed among 10 of the 19 fire areas we visited.

The fire areas where we detected Black-backed Woodpeckers were well distributed across the Sierra Nevada national forests, and included both the second most northerly fire area we visited (Straylor Fire on Lassen NF) and the most southerly fire area (Vista Fire on Sequoia NF), as well as sites both west and east of the Sierra crest. We found Black-backed Woodpeckers in every major pre-fire habitat type we surveyed, including Eastside Pine, Jeffrey Pine, Jeffrey Pine/Red Fir, Sierra Mixed Conifer, and Subalpine Conifer. Occupied fire areas ranged from small (Vista Fire = 170 ha burned, Rock Creek Fire = 187 ha burned) to very large (Moonlight Fire = 26,159 ha burned). We found no evidence suggesting that fire areas that burned more recently were more likely to be occupied than older fire areas; indeed, of the four oldest sites we surveyed (seven years post-fire), three were occupied by Black-backed Woodpecker. Contrary to published descriptions of Black-backed Woodpecker habitat preferences, these findings suggest the species might possibly occupy burned forest stands at high densities well beyond seven years after fire.

We classified fire severity at each survey station, and then used those classifications to assess whether Black-backed Woodpeckers were more likely to be present at sites that had been subject to low-, medium-, or high-severity fire. We detected the species at 5 of the 64 stations (7.8%) in stands we classified as low-severity fire, 28 of the 163 stations in stands we classified as mid-severity fire (17.2%), and 35 of the 139 stations (25.2%) in stands we classified as high-severity fire, yielding a statistically significant preponderance of detections in stands subject to higher-severity fire.

Effects of post-fire salvage logging, and perhaps pre-fire forest management as well, may also be important in determining Black-backed Woodpecker occupancy. Our relatively small sample of fire areas was inadequate for addressing this question, particularly since some areas that had been partially salvage-logged were occupied, while others were not.

Although we did not quantitatively assess detection probability, our playback procedures appear to constitute a relatively effective method for determining Black-backed Woodpecker

presence/absence, as they elicited vigorous responses from the birds. Passive point counts, however, were clearly not an effective means of detecting Black-backed Woodpeckers, which can be much less conspicuous than some other woodpecker species in the Sierra Nevada. We detected Black-backed Woodpecker at 67 of our 371 playback surveys, but we definitively detected the species during only one of our 123 passive point counts. Of the 67 playback surveys during which we detected Black-backed Woodpecker, 11 of them were preceded by passive point counts. We did not detect Black-backed Woodpecker during passive point counts at any of these 11 stations where presence was subsequently confirmed by response to playback surveys. However, we recorded 'unidentified woodpecker' during 6 of these point counts. The 'unidentified woodpecker' determination was usually based on hearing drumming by unseen birds. Even though we often suspected the unseen birds were Black-backed Woodpeckers, we felt unable to definitely identify them without visual confirmation or hearing characteristic *pik* or *scream-rattle-snarl* vocalizations—circumstances that rarely arise with this species during passive point counts. Moreover, because Black-backed Woodpecker detections during passive point counts appear to frequently depend on *seeing* the birds, passive point counts may yield quite different detection probabilities in different habitats. Specifically, the birds may have higher detection probabilities in high-severity burned forest than in other habitats, because there is little or no live foliage to serve as barriers to visual detections. Such a problem should be much less pronounced, if present at all, when playback surveys are used, as playback elicits conspicuous behavior from the woodpeckers, presumably making them easily detectable in virtually any habitat conditions.

While playback surveys appeared to be a relatively effective means of determining presence/absence, we found that they were not very effective as a means for *counting* Black-backed Woodpeckers. We frequently elicited responses from Black-backed Woodpeckers at multiple adjacent survey stations. Although we tried to note the direction from which responding birds approached, and the direction they flew when they departed, we nevertheless found it very difficult to determine with confidence whether we were detecting new individuals, or whether the same birds that responded to playback at a previous point had followed us to subsequent points. We therefore do not suggest that each survey station where we detected one or more Black-backed Woodpeckers represents a unique Black-backed Woodpecker territory; rather, all we can say is that each of those points lies within a Black-backed Woodpecker territory. In some cases we were able to confirm there that more than one pair of Black-backed Woodpeckers were present in a fire area (because we could see or hear three or more adult birds at the same time), but in general we are unable to estimate how many pairs were present in each of the occupied fire areas. If adopted for longer-term monitoring, playback surveys likely will not provide a good means of counting Black-backed Woodpeckers; a much more tractable (and still worthwhile) survey goal would be to estimate and track the *area of occupied habitat* each year.

Even though passive point counts proved to be a poor method for surveying Black-backed Woodpecker, the point counts provided an inexpensive opportunity to collect information on additional bird species occupying the fire areas we surveyed, including several species known to have strong associations with burned forest in the Sierra Nevada. In addition to Black-backed Woodpecker, our 123 passive point counts detected 74 other bird species occupying the fire areas. The most frequently detected species was Fox Sparrow (82 detections), but 23 species

were detected at least 20 times. Several of the frequently detected species, including Western Wood-Pewee, Olive-sided Flycatcher, and Mountain Bluebird, are known to have strong associations with burned forest in the Sierra Nevada.

Based on our results during the 2008 field season, we provide 12 recommendations (see body of the report for more detailed versions of the recommendations) for Black-backed Woodpecker monitoring on the Sierra Nevada national forests:

1) Develop the monitoring program around a sampling frame that includes all fire areas in the ten national forests that:

> *i) burned sometime during the ten years prior to the survey year.*
> *ii) burned areas dominated (pre-fire) by mid- or high-elevation conifer forest.*
> *iii) burned at least 50 ha of national forest land at moderate or high severity.*
> *iv) have not been clearcut subsequent to the fire.*

2) Solicit participation from national parks within the Sierra Nevada region.

3) Conduct annual surveys at selected sites, perhaps re-surveying all occupied sites in the following year, and replacing unoccupied sites with newly selected sites.

4) Conduct surveys between mid- May and mid-July.

5) Begin each field season with a weeklong, intensive training program to standardize data collection procedures and promote safe and productive field operations.

6) At each selected site, establish survey stations 250 m apart, at the vertices of a regularly spaced grid, opportunistically along roads and trails, or using a combination of both.

7) Conduct surveys at each survey station using the 5-min playback methodology implemented during the 2008 survey (See Methods).

8) If qualified observers are available, precede as many of the playback surveys as is logistically feasible with passive point counts, to collect information about other bird species using burned forest stands.

9) Collect on-the-ground habitat information at each survey point, including an assessment of snag density in a vegetation plot centered on the survey station.

10) Develop and follow a clear data management plan.

11) Conduct a short-term (one breeding season should be sufficient) radio-telemetry study to estimate home range size of Black-backed Woodpeckers in the Sierra Nevada.

12) Analyze monitoring data and report findings annually, and use findings to develop scientifically informed Black-backed Woodpecker management recommendations.

Introduction

The Black-backed Woodpecker (*Picoides articus*) was recently selected by USDA Forest Service Region 5 as a Management Indicator Species (MIS) for snags in burned forests across the ten Sierra Nevada national forests: Eldorado, Inyo, Lassen, Modoc, Plumas, Sequoia, Sierra, Stanislaus, Tahoe, and the Lake Tahoe Basin Management Unit (USDA Forest Service 2007a, 2007b). The MIS approach identifies species whose population changes are believed to indicate the effects of management activities (USDA Forest Service 2007a). The habitat needs of MIS are to be considered in the establishment of forest plan objectives for important wildlife and fish habitat, and as forest plans are implemented through individual projects, Forest Service managers are to assess their effects on MIS habitat (USDA Forest Service 2007a). Additionally, population monitoring of MIS is used to monitor the outcomes of forest plan implementation, since it is impossible to monitor the status or population trend of all species (USDA Forest Service 2007a). Population monitoring is thus an integral component of the MIS approach.

Black-backed Woodpeckers on the Sierra Nevada national forests are not well-monitored by existing multi-species, regional monitoring programs. Two large-scale, annual bird monitoring programs, the Breeding Bird Survey (BBS; Sauer et al. 2008)) and the Monitoring Avian Productivity and Survivorship Program (MAPS; DeSante et al. 2008), detect Black-backed Woodpecker throughout the region in small numbers, but due in part to the ephemeral nature of the species' preferred habitat, neither program yields data that are adequate for regional MIS monitoring. Although Black-backed Woodpecker was detected on 13 Sierra Nevada BBS routes on or adjacent to Sierra Nevada national forests between 1991 and 2006 (Sauer et al. 2008), the data are too sparse for estimating the species' regional population trend (Sauer et al. 2008). Black-backed Woodpeckers were captured at five of 29 MAPS stations that operated in the Sierra Nevada physiographic province (including national parks and private lands), but only rarely; overall just 0.023 adults and 0.005 young were captured per 600 net-hours in the region (Siegel and Kaschube 2007). These data are insufficient for estimating population trends and adult survival rates, or for calculating meaningful productivity indices.

Most of what is known about Black-backed Woodpecker ecology and population dynamics comes from areas of their range outside of the Sierra Nevada. In general terms, the species occurs across coniferous forests of North America (Fig. 1a). More specifically, Black-backed Woodpeckers can be found from western Alaska to northern Saskatchewan and central Labrador, south to southeastern British Columbia, central California, northwestern Wyoming, southwestern South Dakota, central Saskatchewan, northern Minnesota, southeastern Ontario, and northern New England (NatureServe 2007; Fig 1a). Outside of the breeding season, individuals may move to areas south of the breeding range, with occasional large irruptions (Dixon et al. 2000). In California, Black-backed Woodpecker occurs from the Siskiyou Mountains, Mount Shasta, and Warner Mountains south through the Cascade Range and the Sierra Nevada to Tulare County (California Department of Fish and Game 2005; Fig. 1b). California Department of Fish and Game (2005) suggest that throughout the Sierra Nevada some Black-backed Woodpeckers move downslope during winter, but other published sources suggest Black-backed Woodpecker is generally a non-migratory resident species lacking in predictable seasonal movements (Farris 2001).

Although Black-backed Woodpecker can be found in unburned forest stands throughout its range, the species appears to be most abundant in stands of recently fire-killed snags (Hutto 1995, Kotliar et al. 2002, Smucker et al. 2005). Black-backed Woodpeckers foraging in burned forests appear to feed primarily on wood-boring beetle larvae (Villard and Beninger 1993, Murphy and Lehnhausen 1998, Powell 2000), although some studies have also reported or inferred foraging on bark beetle larvae (Lester 1980, Goggans et al. 1988). Although bark beetles and wood-boring beetles share important life-history characteristics (both spend a prolonged portion of their life-cycle as larvae inside dead or dying trees) they also exhibit differences that may be important in their ecological interactions with Black-backed Woodpeckers. Bark beetles are small (generally <6 mm in length), numerous, often able to attack live trees, and generally remain as larvae in bark less than a year before emerging as adults (Powell 2000). In contrast, wood-boring beetles have much larger larvae (up to 50 mm long), are less numerous, and can remain as larvae in dead wood for up to three years (Powell 2000). Additionally, most wood-boring beetles are unable to attack living trees, and concentrate heavily in fire-killed wood, which some genera have been shown to find by sensing smoke or heat (reviewed in Powell 2000). Black-backed Woodpecker preference for wood-boring beetles could thus either drive or result from the species' proclivity to forage and nest in or near forest stands that have recently burned.

Although Black-backed Woodpecker shows a strong association with burned stands of conifer forest, the species does not appear to be closely tied to any particular tree species. Studies from different parts of its range report preferential foraging on Lodgepole Pine (*Pinus contorta*; Bull et al. 1986, Goggans et al. 1989), spruce (*Picea* sp.; Villard 1994, Murphy and Lehnhausen 1998), White Pine (*Pinus strobus*; Villard and Beninger 1993), and in California, Red Fir (*Abies magnifica*; Raphael and White 1984).

Pilot Study Objectives

This 2008 pilot study was implemented to develop and test field methods and collect information that will be useful in developing a monitoring program for Black-backed Woodpecker on Sierra Nevada national forests. Specific objectives for the pilot study were:

1) Summarize and interpret existing anecdotal information about Black-backed Woodpecker distribution in the Sierra Nevada.

2) Use existing anecdotal information in (1) to develop a sampling scheme for Black-backed woodpecker surveys during the 2008 breeding season.

3) Develop and field-test survey procedures.

4) Collect preliminary information on Black-backed Woodpecker distribution on Sierra Nevada national forests.

5) Produce recommendations for the design of a Black-backed Woodpecker monitoring program on Sierra Nevada national forests.

We emphasize that this project was not intended to constitute the first year of a long-term monitoring program for Black-backed Woodpecker, but rather was a small-scale pilot study (funding to support a 2-person crew for about one month of fieldwork, plus necessary time for study design and preparation, data analysis, and reporting) to help ensure that such a program, when developed, would be based on scientifically sound preliminary information.

Methods

Summarizing and interpreting existing anecdotal information about Black-backed Woodpecker distribution in the Sierra Nevada

Our initial plan for selecting study areas to survey during the 2008 pilot field season was to collect and assess existing anecdotal information about recent Black-backed Woodpecker detections on the Sierra Nevada national forests. We hoped that by plotting locations of recently reported detections over a map of recent fires throughout the Sierra Nevada, we would be able to identify fire areas where we would have a high probability of finding Black-backed Woodpeckers in 2008.

We collected records of recent Black-backed Woodpecker detections in two ways:

1) We queried the online eBird database (eBird 2008) for all Black-backed Woodpecker records collected within the Sierra Nevada study area since 2000. There were 145 such records, over half of which were collected over multiple years by staff of PRBO Conservation Science, as part of their avian monitoring efforts on the Lassen and Plumas National Forests (Burnett et al. 2008). The remaining records were mostly collected by recreational birders, and were form throughout the Sierra Nevada.

2) We also used a listserv (sierra-nevadabirds@yahoogroups.com) that provides a forum for discussion of birds and birding in the Sierra Nevada to solicit additional detection records that might not have been submitted to eBird. Our request for information on Black-backed Woodpecker detections yielded dozens of leads, and we discovered dozens more by combing through the listserv archives.

Unfortunately both these sources of information proved not to be useful for the task of identifying recent fire areas likely to be occupied by Black-backed Woodpecker, as very few of the detections corresponded with recent fire areas. Many of the reports were redundant, or at least reported the same general vicinity in multiple years, and while the PRBO data were well-distributed across the landscape of Lassen and Plumas National Forests, many of the remaining detections were clustered around campgrounds, ski area parking lots, and other frequently visited locales.

Sample Design

Because anecdotal detection records did not provided a good rationale for selecting fire areas to survey in 2008, we instead selected a random sample of recent fire areas from throughout the Sierra Nevada national forests. We used the GIS data layer CA_R5_FireHistory07_1 (obtained

from http://www.fs.fed.us/r5/rsl/clearinghouse/gis-download), which indicates boundaries of fires (and maps burn severity levels) that burned between 1984 and 2007 on Region 5 forests. We began winnowing down the 188 fires in the database by eliminating from consideration those that burned prior to the year 2000, as existing information suggest Black-backed Woodpeckers generally become rare in colonized burned areas 5-7 years after a fire (Kotliar et al. 2002, Saab et al. 2004). For the remaining fires, we clipped the perimeters to national forest boundaries, and then for each individual fire, calculated the total area mapped as having burned at any intensity (low, medium, or high, but excluding unburned areas within the larger fire perimeter). Although we had no information about the minimum size of a burned forest stand necessary to attract Black-backed Woodpeckers, we wanted to ensure that any fire area we visited would be large enough to accommodate at least a few survey stations spaced 250-m apart. We therefore eliminated fire areas that comprised less than 12 ha.

From the remaining 68 fire areas, we selected 20 to be surveyed in 2008. First, however, we needed to do what we could to confirm that each of the selected fire areas actually contained appropriate Black-backed Woodpecker habitat—stands of burned, coniferous forest. We used a variety of information sources including Google Earth imagery and consultation with Forest Service biologists to make this assessment for each of the 20 selected fire areas. Four of the fire areas we selected (the Goldledge and Borel Fires on Sequoia NF, the Woodlot Fire on Stanislaus NF, and the Fuller Fire on Inyo NF) proved to be comprised entirely of inappropriate habitat—mainly burned grasslands or chaparral. We eliminated them from our survey list and replaced them with additional randomly selected fire areas. A fifth fire (the Silver Fire on Sierra NF) was discarded and replaced because a) it was substantially smaller than all the other fires selected (just 46 ha), b) it consisted almost entirely of low-severity burned area, and c) it was in a remote wilderness location and would require an inordinate amount of our limited field time to access.

Survey Procedures

The fire areas we selected varied greatly in size, from 99 ha to 26,159 ha (Table 1). We generally had only a single morning for a two-person crew to conduct surveys at each fire area. We were able to completely saturate the smaller fire areas with survey effort by placing survey stations approximately 250 m apart, at the vertices of a systematic grid. Some of the larger fire areas, however, would have required much greater survey effort, in some cases ten days or more, to be thoroughly covered in this manner. To maximize the number of stations we could survey at such sites, we dispensed with the systematic grid of points, and instead established survey stations every 250 m along existing trails or roads that passed through the fire areas. We found that we could travel along roads and trails much more quickly than through off-trail areas, and therefore survey more points during a morning. In some cases we were able to conduct surveys along all trails and roads in the fire area, and even augment those points with additional, systematically placed, off-trail points. However at the largest fire areas we had to select a subset of available roads and trails to survey. We generally selected lengths of roads or trails that passed through the most severely burned areas available. To save time we did not ensure that points were exactly 250 m apart, but instead just approximated the 250-m distance between successive points with pacing, and then collected UTM coordinates at each survey station using Garmin eTrex GPS units.

At each survey point, data collection procedures were patterned loosely after Smucker et al. (undated). We conducted a 5-min playback survey to elicit responses from Black-backed Woodpeckers. We used FoxPro ZR2 digital game callers (Fig. 2) to broadcast electronic recordings of Black-backed Woodpecker vocalizations and drumming. The electronic recording we broadcast was obtained from The Macaulay Library of Natural Sounds, Cornell Laboratory of Ornithology (G.A. Keller, recordist), and included the *scream-rattle-snarl* vocalization, *pik* calls, and territorial drumming.

We began the 5-min playback survey (Fig. 3) at each point by broadcasting the recording of Black-backed Woodpecker vocalizations and drumming for approximately 45 seconds, and then quietly listening and watching for Black-backed Woodpeckers until three minutes had elapsed (including the 45-second broadcast period). At three minutes into the survey we again broadcasted the 45-second recording, and then quietly listened and watched until a total of 5 minutes had elapsed since the beginning of the survey. When Black-backed Woodpeckers were detected, we recorded their initial distance and bearing from the observer, whether species identification was confirmed visually, the age (adult or juvenile) and sex (male, female, or unknown) of each bird, and whether the individual performed territorial drumming or vocalized. Black-backed Woodpecker surveys generally began within 10 min of official local sunrise. We stopped conducting passive point counts by 3.5 h after sunrise (sometimes sooner) because singing rates (and therefore detectability) of many species decline in the late-morning hours, but continued playback surveys for up to an additional hour.

At approximately half of the survey stations (generally every second station), we *preceded* the broadcast survey with a 5-min passive point count to count all birds of any species, using methods described in Siegel et al. (2007a and 2007b). The purpose of the passive point counts was twofold:

1. By conducting passive point counts and playback surveys at the same survey stations, we hoped to assess whether the playback methodology was necessary (over and above passive point counts) for effectively surveying Black-backed Woodpecker in the Sierra Nevada.

2. As long as we were deploying qualified observers to conduct bird surveys in fire areas throughout the Sierra Nevada, we thought it worthwhile to also collect information on other bird species, to the extent that doing so would not compromise our Black-backed Woodpecker survey objectives.

In practice we found that conducting passive point counts at every survey station was overly time-consuming, and would substantially reduce the number of survey stations we could visit in a morning. As a compromise solution, we conducted passive point counts at approximately every second survey station. After collecting UTM coordinates, the observers recorded the starting time and then began the five-minute point count. All birds observed in the first three minutes were recorded separately from those observed in the last two minutes, in order to allow comparison with Breeding Bird Survey results, which are based on three-minute counts. Observers estimated the horizontal distance, to the nearest meter, to each bird detected. Estimating distance to each bird allows for modeling of detectability as a function of distance

from the observer, and thus permits estimation of absolute abundance or density, taking into account birds that were likely present but not detected (Buckland et al 2001). The observers also recorded whether the bird ever produced its territorial song during the point count.

At each Black-backed Woodpecker survey station we also collected cursory habitat data. In addition to recording UTM coordinates, we classified the habitat within a 50-m radius of the survey station according to California Wildlife Habitat Relationships (CWHR) habitat classification system, as described in California Department of Fish and Game (2005). We recorded the dominant pre-fire habitat type, and used CWHR-defined categories to classify the dominant tree size (including snags) and amount of remaining live canopy cover. Finally, we provided an on-the-ground assessment of local fire severity.

Data management and analysis

After the field season all data were entered into a custom-designed Microsoft Access database. Data were checked for errors and corrected where necessary, using an array of automated and manual procedures.

Because of the relatively modest quantity of data collected during this pilot study, the potential for complex data analysis was limited. While the results presented in this report are primarily descriptive, we expect that future Black-backed Woodpecker monitoring efforts will accumulate substantial data over multiple years, allowing for sophisticated multivariate modeling of the habitat and landscape factors that drive the likelihood of a particular site being occupied by the species. Such modeling can incorporate data from our own on-the-ground habitat assessments at survey stations, as well as from remote-sensed data layers analyzed with program FRAGSTATS (McGarigal et al. 2002), and will likely be conducted in an information-theoretic framework (Burnham and Anderson 2002).

Results

Scope of Survey Work Accomplished

We visited 19 of the 20 selected fire areas between June 4 and July 25 (Fig. 4). We attempted to visit the 20th site, the Codfish Fire on Tahoe NF, but found that the only practical access to it required crossing private property which was posted with threatening signs ("Trespassers will be shot. Survivors will be shot again."). Of the 19 fire areas visited, two sites—the Poe Fire on Lassen NF and the Saint Pauli Fire on Eldorado NF—contained virtually none of the target habitat (burned conifer forest) for which Black-backed Woodpecker was selected. In the case of the Saint Pauli Fire the pre-fire forest cover appears to have been very sparse, such that the post-fire habitat includes virtually no live trees and only a few isolated snags. The Poe Fire area appears to have been heavily forested prior to the fire, but the area has been mostly clear-cut since the fire, such that only a few isolated clusters of snags remain. These conditions were in contrast to numerous other fire areas we visited where substantial post-fire logging had occurred, but potentially suitable habitat nevertheless remained across part or all of the fire area. We did not conduct any playback surveys or point counts at either of the two fire areas where we found no suitable Black-backed Woodpecker habitat.

We conducted 5-min playback surveys at 371 stations distributed across the 17 fire areas that contained apparently suitable Black-Backed Woodpecker habitat (Table 1). We also conducted a combined total of 123 passive point counts at the first twelve fire areas where we established playback survey stations (Table 2). After mid-July we felt that for most bird species seasonal nesting phenology was too far advanced for collecting meaningful data with passive point counts—too few birds were still singing frequently. We therefore did not conduct passive point counts at the fire areas that we surveyed after July 9.

Black-backed Woodpecker Detections

We detected Black-backed Woodpeckers at 68 survey stations distributed across ten of the 19 fire areas we visited (Table 1, Fig. 4). Occupied sites were well distributed across the Sierra Nevada national forests, and included both the second most northerly fire area we visited (Straylor Fire on Lassen NF) and the most southerly fire area (Vista Fire on Sequoia NF), as well as sites both west and east of the Sierra crest. We found Black-backed Woodpeckers in every major pre-fire CWHR habitat type we surveyed, including Eastside Pine, Jeffrey Pine, Jeffrey Pine/Red Fir, Sierra Mixed Conifer, and Subalpine Conifer (Table 1). Occupied fire areas ranged from small (Vista Fire = 170 ha burned, Rock Creek Fire = 187 ha burned) to very large (Moonlight Fire = 26,159 ha burned) (Table 1).

Although our sample size (and hence, statistical power) was admittedly small, we found no evidence for a relationship between years elapsed since fire and the likelihood of a site being occupied (Fig. 5). The fire areas we surveyed ranged from 1 year post-fire to 7 years post-fire. Both of the 1-year post-fire sites we surveyed were occupied by Black-backed Woodpecker, as were 2 of 3 two-year post-fire sites, 1 of 1 four-year post-fire sites, 2 of 3 five-year post-fire sites, 0 of 4 six-year post-fire sites, and 3 of 4 seven-year post-fire sites (Fig. 5).

We used our on-the-ground assessments of fire severity at each survey station to assess whether Black-backed Woodpeckers were more likely to be present at sites that were subject to low-, medium-, or high-severity fire. Pooling data from all 17 fire areas where we conducted playback surveys, we detected Black-backed Woodpecker at 5 of the 64 stations (7.8%) in stands we classified as low-severity fire, 28 of the 163 stations in stands we classified as mid-severity fire (17.2%), and 35 of the 139 stations (25.2%) in stands we classified as high-severity fire (Fig. 6). This association between Black-backed Woodpecker detections and fire severity was statistically significant (*chi-square* = 7.45, $p < 0.05$), indicating the woodpeckers prefer, or perhaps are more detectable in (see below), areas of higher-severity fire.

Black-backed Woodpecker Detectability

We detected Black-backed Woodpecker at 67 of our 371 playback surveys, but we definitively detected the species during only one of our 123 passive point counts. Of the 67 playback surveys during which we detected Black-backed Woodpecker, 11 of them were preceded by playback surveys (even though we conducted passive point counts at nearly half of all survey stations during most of the survey season, a disproportionate number of Black-backed Woodpecker detections were garnered at fire areas surveyed late in the season, after we stopped conducting

passive point counts because of changes in multi-species breeding phenology). We did not detect Black-backed Woodpecker during passive point counts at any of these 11 stations where presence was subsequently confirmed by responses to playback. However, we recorded 'unidentified woodpecker' during 6 of these 11 point counts where black-backed Woodpecker presence was later confirmed by responses to playback. The 'unidentified woodpecker' determination was usually based on hearing drumming by unseen birds. Even though we often suspected the unseen birds were Black-backed Woodpeckers, we felt unable to definitely identify them without visual confirmation or hearing characteristic *pik* or *scream-rattle-snarl* vocalizations.

Black-backed Woodpecker Nest Description

Although we did not have time during the 2008 field season to systematically search for Black-backed Woodpecker nests, we tried to remain vigilant for signs of nesting in the course of our other activities. We found just one Black-backed Woodpecker nest during the field season—on June 30 in the Vista Fire area (Sequoia NF). The forest stand where we found the nest was a mix of Jeffrey Pine and Red Fir, with many trunks >30 cm in diameter. The stand had been burned by moderate-severity fire (and thus contained a mix of snags and live trees), and the nest tree itself was near the edge of the stand, <100 m from the fire perimeter. The nest was excavated 1.8 m above the ground in an apparently fire-killed Red Fir (dbh = 32 cm, height = 20 m). Begging nestlings could be heard inside the nest.

Other Bird Species Occupying the Fire Areas

In addition to Black-backed Woodpecker, our 123 passive point counts detected 74 other bird species (Table 3). The most frequently detected species was Fox Sparrow (*Spizella passerine,* 82 detections), but 23 species were detected at least 20 times. Several of these frequently detected species, including Western Wood-Pewee (*Contopus sordidulus*), Olive-sided Flycatcher (*Contopus cooperi*), and Mountain Bluebird (*Sialia currucoides*), are known to have strong associations with burned forest in the Sierra Nevada (Siegel and Wilkerson 2004).

Discussion

Assessing our survey methodology

Our results suggest that Black-backed Woodpecker detectability during passive point counts is quite low, although we have not quantitatively assessed it. We observed Black-backed Woodpeckers to be much less conspicuous than their *Picoides* congeners. Unlike Hairy Woodpecker and White-headed Woodpecker, the Black-backed Woodpeckers we observed rarely vocalized spontaneously, and when they did, their vocalizations were much quieter than the loud, even piercing rattles and calls of other Sierra Nevada woodpeckers. Anecdotal observations also suggest the birds may be more sedentary than Hairy and White-headed Woodpeckers; we frequently observed Black-backed Woodpeckers spending long periods of time clinging silently to fire-blackened tree trunks, where their cryptically-colored black backs make them inconspicuous.

The only truly conspicuous aspect of Black-backed Woodpecker behavior is their loud and relatively frequent drumming. However, Black-backed Woodpeckers frequently co-occur with Hairy and/or White-headed Woodpeckers (Farris 2001 and Siegel *personal observation*), which make similar, if not indistinguishable, drumming sounds. During point counts we frequently heard drumming that we suspected to be emanating from Black-backed Woodpeckers, but we could not be certain.

Due to their inconspicuousness, Black-backed Woodpeckers in Sierra Nevada forests are thus not very effectively surveyed with passive point counts. Additionally, since visual confirmation is often needed for a definitive detection, there may be an additional problem of detection probability varying substantially with habitat. Specifically, we suspect that detection probability may be higher in areas of high-severity fire (where little if any live foliage that could serve as a visual barrier persists) than in less severely burned areas (Fig. 7). If this is true, then passive point counts may yield estimates of Black-backed Woodpecker abundance that are biased with respect to burn severity, unless habitat-specific detectability is explicitly estimated and then taken into account. The birds also seemed somewhat more conspicuous at fire areas where many Black-backed Woodpeckers were clearly present (particularly the Bassetts, Boulder Complex, and Moonlight fire areas), perhaps due to territorial interactions that caught our attention. We did not conduct any passive point counts at the three aforementioned sites because they were not surveyed until late in July after we had suspended point counts, but we suspect that had we done so, we would have detected Black-backed Woodpeckers during passive point counts at some of the survey stations.

Our playback surveys were much more successful than our point counts at confirming Black-backed Woodpecker presence. We found the birds to be very responsive to playback, generally flying in close to the observer soon after playback was initiated. Of the 67 playback surveys that resulted in Black-backed Woodpecker responses, we detected the species during the first three minutes of the playback survey during 42 (63%) of them, compared with only 25 playback surveys (37%) where the species was not detected until the last two minutes of the survey. The woodpeckers often approached the observer in pairs, and whether alone or accompanied, would generally fly to a trunk within approximately 30 m of the observer, and drum or make the *scream-rattle-snarl* vocalization while flaring their wings in what Short (1974) termed the 'wing-spreading display'. Although we did not have adequate resources this season to assess detection probability during playback quantitatively (which would likely require repeat surveys of the same survey stations), the method appears to be very successful for determining presence/absence. Furthermore, because Black-backed Woodpeckers typically respond to playback by flying close to the observer and/or vocalizing, there is no obvious reason why detectability using this method would vary substantially with fire severity or other habitat variables.

However, we also found that our playback methodology was not very effective as a means for *counting* Black-backed Woodpeckers. We frequently elicited responses from Black-backed Woodpeckers at multiple adjacent survey stations. Although we tried to note the direction from which responding birds approached, and the direction they flew when they departed, we nevertheless found it very difficult to determine with confidence whether we were detecting new individuals, or whether the same birds that responded to playback at a previous point had

followed us to subsequent points. The possibility of individual birds responding to playback at multiple adjacent survey stations in not unreasonable, as home range size estimates for the species have ranged from 61 ha in Vermont (Lisi 1988) to a median of 124 ha in central Oregon (Goggans et al. 1988). A circular home range covering 124 ha would have a radius of 628 m, and easily encompass multiple survey stations spaced 250-m apart. We therefore do not suggest that each survey station with a detection on the maps in Appendix 2 represents a unique Black-backed Woodpecker territory; rather, all we can say is that each of those points lies within a Black-backed Woodpecker territory. In some cases we were able to confirm the presence of more than one pair of Black-backed Woodpeckers because we could see or hear three or more adult birds at the same time, but in general we are unable to estimate how many pairs were present in each of the occupied fire areas.

One potential solution to this problem might be greater spacing between survey stations, perhaps increasing the distance between adjacent stations to 500 m rather than the 250 m we used in this pilot study. Increasing the distance between stations would make luring the same individuals from station to station less likely, but it probably would not altogether eliminate the possibility. Even more troubling, increasing the distance between stations would likely increase the chances of failing to detect Black-backed Woodpeckers occupying the surveyed area. Thus we may be faced with a trade-off between upwardly biased survey results when smaller distances between stations are used (that is, counting birds as 'new' when in fact they were already counted at a previous survey station) and false negative survey results when larger distances between stations are used (that is, failing to detect birds when in fact they are present). Selecting the appropriate spacing of survey stations may thus depend on which monitoring goal takes primacy—determining definitively whether a fire area is occupied (relatively small distances between stations would be preferable), or estimating abundance within a fire area (relatively large distances between stations would be preferable).

In addition to having difficulty determining whether individual Black-backed Woodpeckers represented 'new' detections, we were also frequently unable to determine with certainty whether individual Black-backed Woodpeckers that responded to playback were males or females. Sometimes we could clearly see the yellow patch on the heads of males, but on multiple occasions we saw birds whose plumage was heavily stained with black soot, making it difficult to ever be certain we were looking at a female or a soot-stained male.

Finally, although our results strongly indicate that the probability of detecting Black-backed Woodpeckers is much lower during passive point counts than during playback surveys, our study does not yield an estimation of detection probability during playback surveys. Due to the broad geographic distribution of our study areas, and our relatively limited resources, we were unable to conduct repeat visits to any of the fire areas we surveyed. Repeated playback surveys, within the same breeding season, would be necessary to estimate detection probability during playback surveys. Other methods of estimating detection probability, such as distance estimation (Buckland et al. 2001), are appropriate for passive point counts, but will not work for playback surveys, in which the study animals are deliberately lured towards the observer.

Preliminary inferences about Black-backed Woodpecker distribution in the Sierra Nevada

Our results indicate that Black-backed Woodpecker is widely distributed across recently burned forest stands in the ten national forests of the greater Sierra Nevada. We detected Black-backed Woodpeckers near the northern and southern extremes of the study area, on both sides of the Sierra crest, and in every major pre-fire CWHR habitat type we surveyed, including Eastside Pine, Jeffrey Pine, Jeffrey Pine/Red Fir, Sierra Mixed Conifer, and Subalpine Conifer.

With only 19 sites visited and numerous variables that could potentially predict occurrence, it is premature to draw conclusions about characteristics of fire areas that may encourage or discourage Black-backed Woodpecker occupancy. Potential predictive variables include elevation, pre-fire forest type, pre-fire forest structure, fire severity, years elapsed since fire, size of fire area, remoteness from other suitable burned forest stands, and intensity and extent of post-fire salvage logging. Although it is beyond the scope of this report—and the capacity of the existing data—to quantitatively assess the importance of these variables, we can at least make anecdotal observations about several of them.

Elevation and pre-fire forest type. We detected Black-backed Woodpeckers at sites with pre-fire habitats dominated by Eastside Pine, Jeffrey Pine, Jeffrey Pine/Red Fir, Sierra Mixed Conifer, and Subalpine Conifer. Our results corroborate suggestions that within conifer forest, Black-backed Woodpecker is not tied to any particular tree species, and can occur from the Sierra Mixed Conifer zone up into the Subalpine zone.

Fire severity. We found that more severely burned forest stands were more likely to be occupied by Black-backed Woodpeckers (see Results), but woodpeckers were nonetheless detected at survey stations within stands classified as each of the three burn severity categories. Many of the fire areas were quite heterogeneous with respect to fire severity, with interdigitated patches of low-, medium-, and high-severity fire areas. Given the relatively large home range of the species, and the fact that our playback methodology lured birds towards the observers, our data do not permit a definitive assessment of the species' affinity for habitat burned at various severities. Nevertheless, our fairly large numbers of detections in mid- and high-severity burned stands, coupled with relatively few detections in low-severity burned stands, suggest that low-severity burned areas in the Sierra Nevada are probably not optimal habitat. Indeed, most stands we visited that had been mapped as low-severity were characterized by little if any tree mortality, and in some cases we saw almost no remaining signs of fire—ground cover was similar to adjacent unburned areas and charring on trunks was difficult to find. It seems unlikely that such areas would host densities of Black-backed Woodpeckers substantially above those of adjacent unburned stands.

Years elapsed since fire. We found Black-backed Woodpeckers at both sites we surveyed where only one year had elapsed since fire, underscoring the species' remarkable ability to quickly find and colonize new habitat patches. We also found no evidence to suggest that areas where as many as seven years had elapsed since the fire were becoming less suitable for Black-backed Woodpecker—3 of the 4 seven-years post-fire sites we surveyed were occupied. Suggestions that burned stands lose their enhanced attractiveness for foraging and nesting Black-backed Woodpeckers after 5-7 years are based primarily on information from other regions, and do not

appear well-supported by our Sierra Nevada surveys. Further survey work is needed to determine how many years after a fire burned stands continue to host Black-backed Woodpeckers in the Sierra Nevada, where particular assemblages of tree and insect species and/or unique environmental conditions may prolong the duration of resource availability compared with other areas of the species' range.

Size of fire area. We found Black-backed Woodpeckers at two of our smaller fire areas, as well as our largest one, suggesting that this may not be a useful variable for predicting presence/absence. However, it seems reasonable to assume that larger fire areas have the potential to support more individual Black-backed Woodpeckers than smaller fire areas.

Remoteness from other occupied fire areas. Little is known about how Black-backed Woodpeckers colonize new fire areas, but it possible that remoteness from other occupied fire areas is a variable that contributes substantially to whether a new site will be colonized. We do not yet have sufficient data for assessing this issue, but if occupancy information is gathered from additional fire areas as part of a Black-backed Woodpecker monitoring program, the data may yield inferences on this subject. Such information could have substantial management implications, as it may suggest that some fire areas are better positioned to support Black-backed Woodpeckers than others, and therefore should be prioritized more highly for management prescriptions that favor the species.

Snag availability and post-fire salvage logging. Post-fire salvage logging is likely an important variable in determining Black-backed Woodpecker habitat suitability. When implemented through clearcutting, salvage logging can completely remove Black-backed Woodpecker habitat (Fig. 8a), but even selective post-fire logging could likely render burned forest unsuitable or less suitable for Black-backed Woodpeckers, if it removed a critically high proportion of the foraging substrate. We noted that at two of the fire areas we surveyed—the Kibbie Fire and the Vista Fire—Black-backed Woodpeckers were abundant in areas that had not been salvage logged, but were absent from the areas that clearly had been. However, we also found Black-backed Woodpeckers at numerous fire areas where at least some degree of post-fire logging had occurred (Fig. 8b), or was currently in progress, indicating that some salvage logging may be compatible with Black-backed Woodpecker occupancy, at least under some forest conditions. At most such sites, however, patches of unlogged habitat remained nearby.

Understanding the impacts of post-fire salvage logging on Black-backed Woodpeckers is part of a larger issue of better quantifying the snag availability necessary to support a population of breeding birds. Other factors besides post-fire logging, including pre-fire forest management, stand age, and forest composition, likely influence the characteristics and number of snags that remain after a fire. On-the-ground assessments of stand characteristics conducted in conjunction with future Black-backed Woodpecker monitoring efforts will likely yield a better understanding of the snag resource base needed to support breeding Black-backed Woodpeckers, and the management actions necessary to retain it.

Collecting Data on Other Bird Species Occupying the Fire Areas

Event though passive point counts proved to be a poor method for surveying Black-backed Woodpecker, the point counts provided an inexpensive opportunity to collect information on additional bird species occupying the fire areas we surveyed, including several species known to have strong associations with burned forest in the Sierra Nevada. Although detailed analysis of these multi-species data are beyond the purview of this report, the added value of collecting data on so many additional species at little additional cost suggests that passive point counts are worth incorporating into Black-backed Woodpecker monitoring efforts, provided that survey personnel are qualified to conduct them.

Monitoring Recommendations

Monitoring Black-backed Woodpecker populations across the Sierra Nevada national forests is a worthwhile objective, but is made particularly challenging by two aspects of the species' natural history: 1) its reliance on a highly ephemeral habitat, and 2) its inconspicuousness. These characteristics pose substantial challenges to both sample design and data collection.

Sample Design Challenges

The ephemeral nature of the post-fire conditions in which Black-backed Woodpecker is most abundant precludes the usual procedure of defining a sampling frame and selecting survey sites at the initiation of a monitoring program, and then monitoring those sites through time. If Black-backed Woodpeckers only occupy burned forest stands for a finite number of years after fire, then monitoring their populations at sites believed to be appropriate habitat at the beginning of the monitoring program would inevitably track the disappearance of the species over time, as the suitability of the sites declined with years since fire. Selection of monitoring sites will thus have to occur within a temporally dynamic framework, in which new sites can be added into the sampling frame as they are created by fire, and old sites can be retired from sampling as they become unsuitable habitat over time.

An information need that remains is the period of time over which burned forest in the Sierra Nevada remains suitable Black-backed Woodpecker habitat. Studies elsewhere in the species' range have indicated the birds stop using a site 5-7 years after fire, but our finding that 3 of 4 surveyed sites were still occupied seven years after fire suggests that habitat may remain suitable for longer in the Sierra Nevada. Further monitoring, particularly of the Crater, Gap, and Rock Creek Fire areas can resolve this question.

Data Collection Challenges

Our results make clear that passive point counts alone are inadequate for Black-backed Woodpecker monitoring, because detection probability is too low. This is unfortunate, because the point count technique, when combined with distance estimation and detectability modeling, can yield reliable estimates not just of relative abundance (i.e., number of birds detected per survey station), but of absolute abundance or density (i.e., birds per ha) as well. Using playback lures birds towards the observer, making the estimation of detection probability as a function of

distance from the observer—and the absolute abundance of birds on the landscape—difficult if not impossible to estimate. Furthermore, playback greatly increases the likelihood (over passive detection methods) that birds might follow observers from one survey station to another, which would also violate assumptions necessary for estimating absolute abundance.

For all these reasons it may not be realistic to expect a spatially extensive monitoring program for Black-backed Woodpecker to actually count (or estimate from counts) numbers of individual birds. Doing so with confidence would likely require intensive efforts involving color-banding and repeated surveys. Such efforts are not compatible with a spatially extensive monitoring program, at least without incurring substantial financial costs. Rather than estimating annual population size, a more tractable survey goal would be to estimate and track the area of occupied habitat and the area of available habitat each year. Assessing the area of occupied habitat at each site can be done with the methodology used in our 2008 pilot study, and does not require determining how many unique individuals are detected in an area. Furthermore, a short-term effort to assess Black-backed Woodpecker home range sizes in the Sierra Nevada (see Monitoring Recommendation No.11, below) could allow the extrapolation of occupied-area estimates into population size estimates.

Specific Monitoring Recommendations

1) Develop the monitoring program around a sampling frame that includes all fire areas in the ten national forests that:

> *i) burned sometime during the ten years prior to the survey year*. Our results suggest that fire areas are regularly occupied by Black-backed Woodpeckers in the Sierra Nevada for at least seven years after fire, but give no indication of how many additional years must pass before they are no longer occupied. Continued monitoring of the older occupied sites we discovered in 2008 will provide information on this matter, and could suggest alteration of the 10-year time-horizon for the sampling frame in the future. Regardless, the sampling frame will need to be revisited annually or at least every few years, and sites that burned too long ago to continue providing suitable Black-backed Woodpecker habitat should be retired from sampling.
>
> *ii) burned areas dominated (pre-fire) by mid- or high-elevation conifer forest*. Fires that burned primarily foothill plant communities, chaparral, sagebrush, and/or grassland should be excluded.
>
> *iii) burned at least 50 ha of national forest land at moderate or high severity.* Although we detected Black-backed Woodpeckers at five survey stations classified as low-severity fire, patches of moderate- or high-severity burn were generally nearby. Given the generally very low number of fire-killed tress in low-severity fire areas, it seems doubtful that low-severity fire areas in and of themselves would host substantial numbers of Black-backed Woodpeckers, and in any case, low-severity fire areas only nominally constitute the habitat (snags in burned forests) for which Black-backed Woodpecker was selected as an MIS. We suggest that fire areas with less than 50 ha of moderate- and/or high-severity burn are probably not worth the personnel effort to visit and survey, as they

will contribute negligibly to the overall total of suitable habitat on the ten national forests at any given time. We estimate that approximately 5 ha are effectively surveyed from a single survey station, so a fire area constituting 50 ha of moderate- and/or high-severity burn should accommodate at least ten survey stations.

iv) have not been clearcut subsequent to the fire. Moderate or even substantial post-fire salvage logging should not exclude sites from being sampled, but if there are very few or no snags remaining, a fire area no longer warrants being surveyed.

2) Solicit participation from national parks within the Sierra Nevada region. Coordinated surveys of recent fire areas at Lassen, Yosemite, Sequoia and Kings Canyon National Parks would yield a truly Sierra-wide program. Additionally, sites in the national parks would likely be free of any salvage logging, providing rich opportunities for comparing occupancy rates with more heavily managed sites on the national forests.

3) Conduct annual surveys at selected fire areas. Depending on available funding and personnel, consider re-surveying all occupied fire areas in the following year, and replacing unoccupied fire areas with newly selected fire areas.

4) Conduct surveys between mid- May and mid-July. Although we started our surveys during the first week of June in 2008, we saw no reason why they could not have begun earlier, at least at sites where access would not be complicated by snow-blocked roads or dangerous river crossings. Black-backed Woodpecker response to playback appeared robust throughout the duration of our surveys. It is possible that surveys could even continue beyond mid-July, provided that territorial behavior does not decrease; repeat surveys at occupied sites could test this.

5) Begin each field season with a weeklong, intensive training program to standardize data collection procedures and promote safe and productive field operations. Topics to cover during training include woodpecker identification (sight and sound), tree and shrub species identification, orienteering (including proper use of topographic map, compass, and GPS unit), data collection procedures, field safety, and basic first aid.

6) At each selected site, establish survey stations 250 m apart, at the vertices of a regularly spaced grid, opportunistically along roads and trails, or using a combination of both. Small sites can be essentially saturated with survey effort using the grid-based approach, but at larger sites that cannot be fully surveyed by available personnel, there is a trade-off between working off-trail (and randomly selecting the portion of the fire area that is surveyed) or instead placing most or all survey stations along existing trails and roads (where ease of travel allows for many more stations to be surveyed in a morning). We suggest there is greater value in maximizing the number of stations that are surveyed, but that determination may be reevaluated depending on how monitoring objectives are prioritized.

7) Conduct surveys at each survey station using the 5-min playback methodology implemented during the 2008 pilot study (See Methods, above).

8) If qualified observers are available, precede as many of the playback surveys as is logistically feasible with passive point counts, to collect information about other bird species using burned forest stands. If playback surveys are conducted by individuals who come to the project already qualified to conduct point counts, then quantitative information on other bird species can be gathered at very little additional cost. However the training needed to conduct multi-species point counts is much greater than that required for single-species playback surveys, and is probably not cost-effective to incorporate into the crew training efforts for this monitoring program. To be qualified to conduct point counts, observers should not only be competent at identifying by sight and sound all bird species likely to be encountered, but should also have received instruction in and/or have extensively practiced estimating distances to singing birds. Even with qualified observers, passive point counts are only worth conducting during the height of the breeding season, which varies with elevation and latitude. In general, lower-elevation sites should not be surveyed by point counts after the end of June, because singing rates of many species decline, leading to artificially low abundance estimates. Finally efforts should be make to standardize passive point count methods so that results are directly comparable with those from any other MIS monitoring activities.

9) Collect on-the-ground habitat information at each survey point. In addition to classifying each survey station according to pre-fire CWHR forest type and fire severity (as we did during the 2008 survey), we suggest quantifying or classifying snag density. While it would be feasiblie to count snags in a small-radius (perhaps 30 m) circular plot around each survey station, we are unsure how meaningful the data would be for interpreting Black-backed Woodpecker habitat preferences, given that a pair's home range is probably orders of magnitude larger. A better solution may be to assign a course classification (but avoiding a time-consuming snag count) to the snag density in a larger-radius plot (perhaps 100 m) centered on the survey station. Counts or classifications could be performed separately for multiple size classes (dbh) of snags. Observers should also note whether evidence of post-fire salvage logging is present within the snag density plot.

10) Develop and follow a clear data management plan. As with any monitoring program, careful thought should be given to data management procedures. The data management plan should include a project database structure with metadata, as well as explicit procedures for entering, editing and certifying the data collected each year and updating the master database after each year's data are certified.

11) Conduct a short-term (one breeding season should be sufficient) radio-telemetry study to estimate home range size of Black-backed Woodpeckers in the Sierra Nevada. Existing home range estimates for the species are based on very small numbers of birds from regions other than the Sierra Nevada, and vary widely (Lisi 1988, Goggans et al. 1988, Dixon et al. 2000). Reliable home range size estimates from within the Sierra Nevada would greatly enhance interpretation of monitoring results that track temporal changes in the area of occupied habitat throughout the region, by allowing a rough estimation of the number of breeding pairs in the region (area of occupied habitat divided by average home range size). Furthermore, assessing habitat conditions within determined home ranges could yield estimates of the quantity of snags necessary to support a pair of territorial birds, a parameter that could lead directly to management recommendations for the species.

12) Analyze monitoring data and report findings annually, and use findings to develop scientifically informed Black-backed Woodpecker management recommendations. Black-backed Woodpecker monitoring should yield actionable management recommendations that forest managers can use to explicitly consider the effects on Black-backed Woodpecker populations when making management decisions about stands of fire-killed snags. Additionally, as data from numerous sites across the Sierra Nevada are accumulated, data analysis may yield recommendations not just for stand-level management, but for landscape-level management as well. Little is known about Black-backed Woodpecker dispersal; assessing which fire areas throughout the region become occupied and which do not may lend insight into optimizing the spatial distribution of suitable habitat across the larger region, and prioritizing which stands of fire-killed snags are most important for the species.

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Table 1. National forest, age, size, and dominant pre-fire habitat of each fire visited during our 2008 Black-backed Woodpecker pilot study, along with the number of stations at which we conducted playback surveys, and the number of stations at which we detected one or more Black-backed Woodpeckers.

National Forest	Fire Name	Year of Fire	Years Since Fire	Hectares of Burned Area (Any Severity) on National Forest Land	Dominant Pre-fire Habitat[1]	No. Stations Surveyed	No. Stations w/ BBWO Detections
Eldorado	Plum	2002	6	461	Sierra Mixed Conifer	19	0
Eldorado	Saint Pauli	2002	6	132	Sierra Mixed Conifer	0	0
Eldorado	Ralston	2006	2	2,699	Sierra Mixed Conifer	4	0
Inyo	Crater	2001	7	996	Jeffrey Pine	29	8
Lassen	Cone	2002	6	769	Eastside Pine	20	0
Lassen	Poe	2001	7	551	Sierra Mixed Conifer	0	0
Lassen	Straylor	2004	4	1,231	Eastside Pine	21	1
Modoc	Bell	2001	7	1,092	Eastside Pine	22	0
Plumas	Boulder Complex	2006	2	1,416	Jeffrey Pine	22	11
Plumas	Moonlight	2007	1	26,159	Jeffrey Pine/Red Fir	24	16
Sequoia	Cooney	2003	5	751	Jeffrey Pine/Red Fir	25	0
Sequoia	Vista	2007	1	170	Jeffrey Pine/Red Fir	20	5
Sierra	North Fork	2001	7	1,636	Sierra Mixed Conifer	20	0
Sierra	Rock Creek 2	2002	6	99	Sierra Mixed Conifer	15	0
Stanislaus	Kibbie	2003	5	1,374	Jeffrey Pine/Red Fir	39	5
Stanislaus	Mud	2003	5	1,641	Jeffrey Pine/Red Fir	33	6
Tahoe	Bassetts	2006	2	925	Subalpine Conifer	14	11
Tahoe	Gap	2001	7	947	Sierra Mixed Conifer	25	1
Tahoe	Rock Creek	2001	7	187	Jeffrey Pine/Red Fir	19	4
					Total	**371**	**68**

[1]Habitat classifications follow California Habitat Relationships (CWHR; California Department of Fish and Game 2005), and indicate the primary pre-fire habitat at the greatest number of survey points in a particular fire area, based on our own on-the-ground assessments.

Table 2. Number of survey stations where we conducted passive point counts, and the date the point counts were conducted, at each of the 12 fire areas where we conducted passive point counts.

Fire Name	No. of Passive Point Counts	Survey Date (all 2008)
Bell	10	9 July
Cone	8	8 July
Cooney	12	28 June
Crater	11	1 July
Gap	10	7 June
Kibbie	17	4-5 June
Mud	11	6 June
North Fork	10	18 June
Plum	10	9 June
Rock Creek 2	7	19 June
Straylor	9	10 July
Vista	8	30 June
Total	**123**	**4 June – 10 July**

Table 3. Numbers of each bird species detected during 123 passive point counts conducted in conjunction with Black-backed Woodpecker surveys across 12 fire areas surveyed for the species in 2008.

Species Common Name	Species Latin Name	No. of Detections	Detections per Point
Northern Goshawk	*Accipiter gentilis*	1	0.008
Red-tailed Hawk	*Buteo jamaicensis*	2	0.016
American Kestrel	*Falco sparverius*	2	0.016
Mountain Quail	*Oreortyx pictus*	31	0.252
California Gull	*Larus californicus*	1	0.008
Band-tailed Pigeon	*Patagioenas fasciata*	1	0.008
Mourning Dove	*Zenaida macroura*	14	0.114
Common Nighthawk	*Chordeiles minor*	1	0.008
Common Poorwill	*Phalaenoptilus nuttallii*	1	0.008
Anna's Hummingbird	*Calypte anna*	2	0.016
Lewis's Woodpecker	*Melanerpes lewis*	1	0.008
Acorn Woodpecker	*Melanerpes formicivorus*	1	0.008
Williamson's Sapsucker	*Sphyrapicus thyroideus*	2	0.016
Red-breasted Sapsucker	*Sphyrapicus ruber*	2	0.016
Hairy Woodpecker	*Picoides villosus*	34	0.276
White-headed Woodpecker	*Picoides albolarvatus*	11	0.089
Black-backed Woodpecker	*Picoides arcticus*	1	0.008
Northern Flicker	*Colaptes auratus*	35	0.285
Pileated Woodpecker	*Dryocopus pileatus*	1	0.008
Olive-sided Flycatcher	*Contopus cooperi*	32	0.260
Western Wood-Pewee	*Contopus sordidulus*	78	0.634
Gray Flycatcher	*Empidonax wrightii*	3	0.024
Dusky Flycatcher	*Empidonax oberholseri*	31	0.252
Pacific-slope Flycatcher	*Empidonax difficilis*	1	0.008
Ash-throated Flycatcher	*Myiarchus cinerascens*	1	0.008
Western Kingbird	*Tyrannus verticalis*	4	0.033
Cassin's Vireo	*Vireo cassinii*	23	0.187
Warbling Vireo	*Vireo gilvus*	12	0.098
Steller's Jay	*Cyanocitta stelleri*	49	0.398
Pinyon Jay	*Gymnorhinus cyanocephalus*	2	0.016
Clark's Nutcracker	*Nucifraga columbiana*	5	0.041
Common Raven	*Corvus corax*	13	0.106
Horned Lark	*Eremophila alpestris*	2	0.016
Tree Swallow	*Tachycineta bicolor*	7	0.057
Violet-green Swallow	*Tachycineta thalassina*	21	0.171
Mountain Chickadee	*Poecile gambeli*	64	0.520
Red-breasted Nuthatch	*Sitta canadensis*	45	0.366
White-breasted Nuthatch	*Sitta carolinensis*	12	0.098
Pygmy Nuthatch	*Sitta pygmaea*	2	0.016
Brown Creeper	*Certhia americana*	25	0.203

Table 3, continued.

Species Common Name	Species Latin Name	No. of Detections	Detections per Point
Rock Wren	*Salpinctes obsoletus*	8	0.065
House Wren	*Troglodytes aedon*	30	0.244
Golden-crowned Kinglet	*Regulus satrapa*	2	0.016
Western Bluebird	*Sialia mexicana*	12	0.098
Mountain Bluebird	*Sialia currucoides*	28	0.228
Townsend's Solitaire	*Myadestes townsendi*	3	0.024
American Robin	*Turdus migratorius*	38	0.309
Nashville Warbler	*Vermivora ruficapilla*	16	0.130
Yellow Warbler	*Dendroica petechia*	14	0.114
Audubon's Warbler	*Dendroica coronata*	44	0.358
Black-throated Gray Warbler	*Dendroica nigrescens*	1	0.008
Hermit Warbler	*Dendroica occidentalis*	10	0.081
MacGillivray's Warbler	*Oporornis tolmiei*	8	0.065
Western Tanager	*Piranga ludoviciana*	51	0.415
Green-tailed Towhee	*Pipilo chlorurus*	10	0.081
Spotted Towhee	*Pipilo maculatus*	26	0.211
Chipping Sparrow	*Spizella passerina*	21	0.171
Brewer's Sparrow	*Spizella breweri*	29	0.236
Vesper Sparrow	*Pooecetes gramineus*	3	0.024
Fox Sparrow	*Passerella iliaca*	82	0.667
Song Sparrow	*Melospiza melodia*	2	0.016
Lincoln's Sparrow	*Melospiza lincolnii*	3	0.024
Oregon Junco	*Junco hyemalis*	59	0.480
Black-headed Grosbeak	*Pheucticus melanocephalus*	14	0.114
Lazuli Bunting	*Passerina amoena*	8	0.065
Brewer's Blackbird	*Euphagus cyanocephalus*	8	0.065
Brown-headed Cowbird	*Molothrus ater*	5	0.041
Bullock's Oriole	*Icterus bullockii*	1	0.008
Purple Finch	*Carpodacus purpureus*	1	0.008
Cassin's Finch	*Carpodacus cassinii*	26	0.211
House Finch	*Carpodacus mexicanus*	2	0.016
Red Crossbill	*Loxia curvirostra*	10	0.081
Pine Siskin	*Carduelis pinus*	6	0.049
Lesser Goldfinch	*Carduelis psaltria*	6	0.049

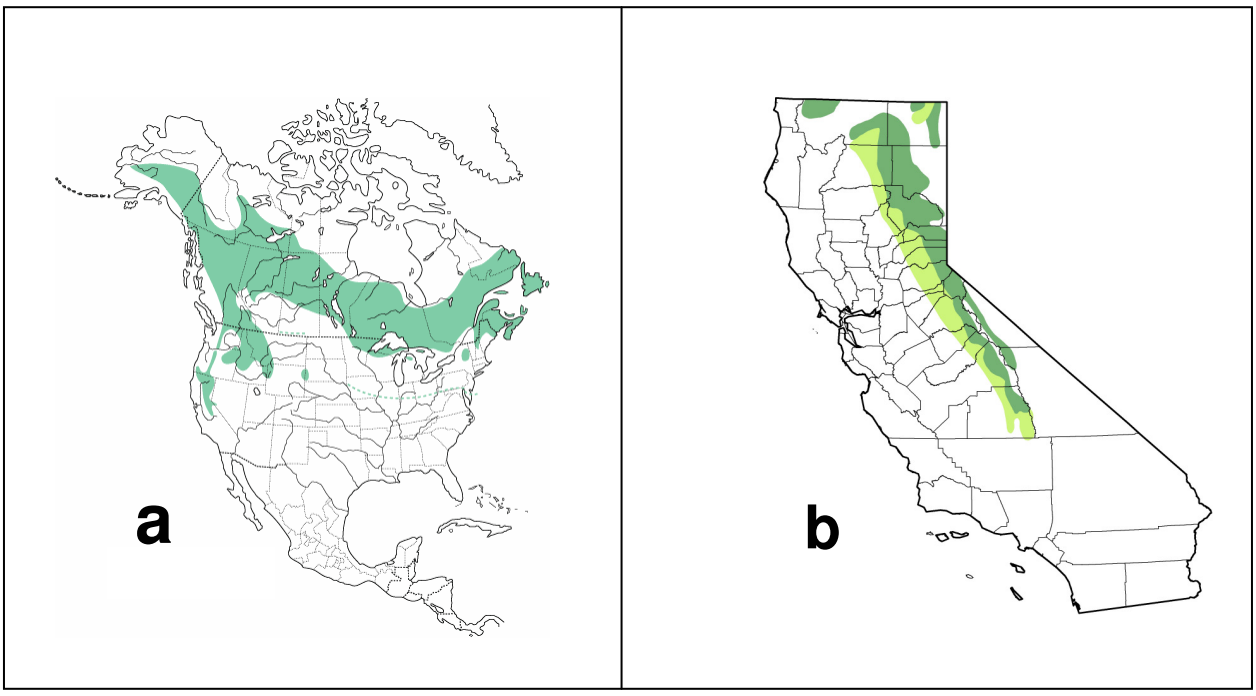

Figure 1. Distribution of Black-backed Woodpecker across (a) North America (Dixon et al. 2000) and (b) California (California Department of Fish and Game 2005). In part (b), light green indicates winter range, dark green indicates year-round range.

Figure 2. FoxPro ZR2 digital game caller used for broadcasting Black-backed Woodpecker vocalizations.

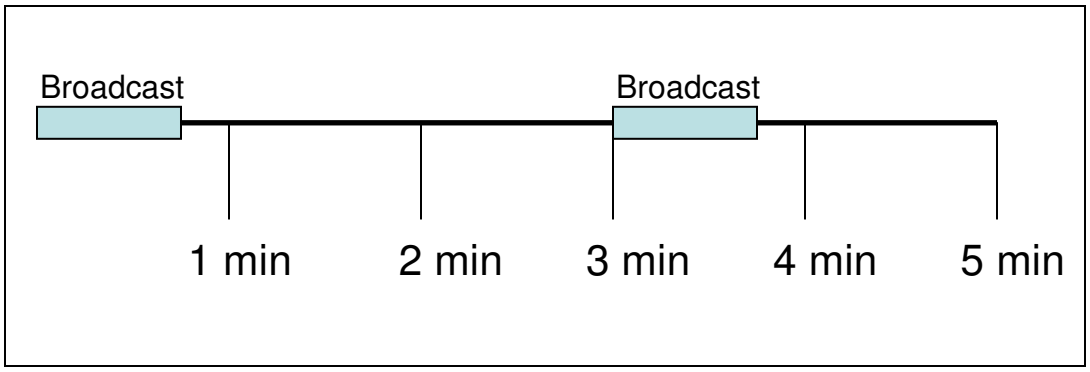

Figure 3. Schematic diagram of the 5-minute playback survey to elicit responses from Black-backed Woodpeckers. The survey incorporates two 45-second periods of broadcasting Black-backed Woodpecker vocalizations and drumming; the first period starts at the beginning of the 5-min survey and the second period starts at the third minute.

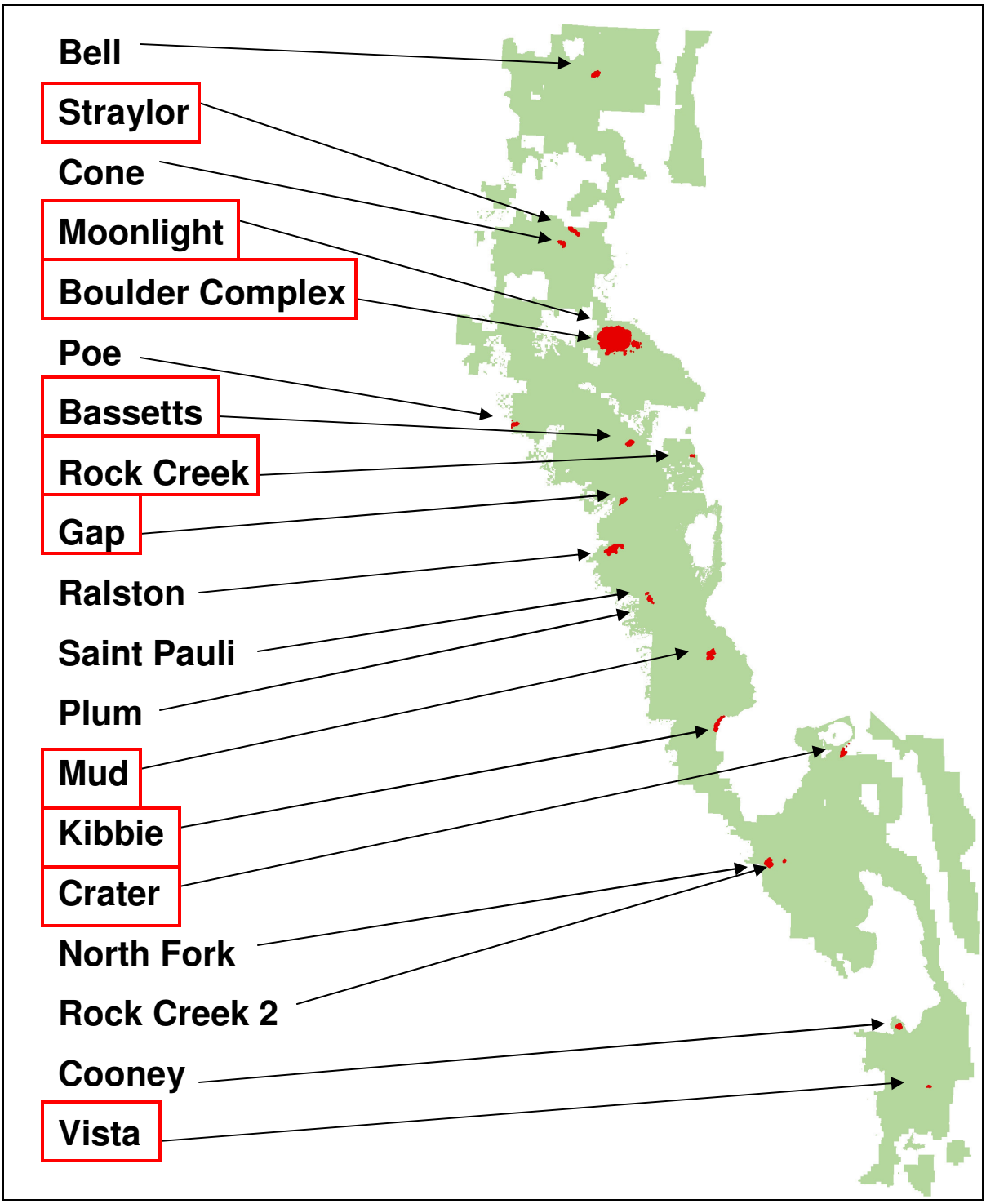

Figure 4. Nineteen fire areas (indicated in red) across the Sierra Nevada national forests (indicated in green, and extending from Modoc NF in the north to Sequoia NF in the south) surveyed for Black-backed Woodpecker during summer 2008. All fire areas burned between 2000 and 2007. Red boxes indicate fire areas where Black-backed Woodpecker was detected during the 2008 surveys.

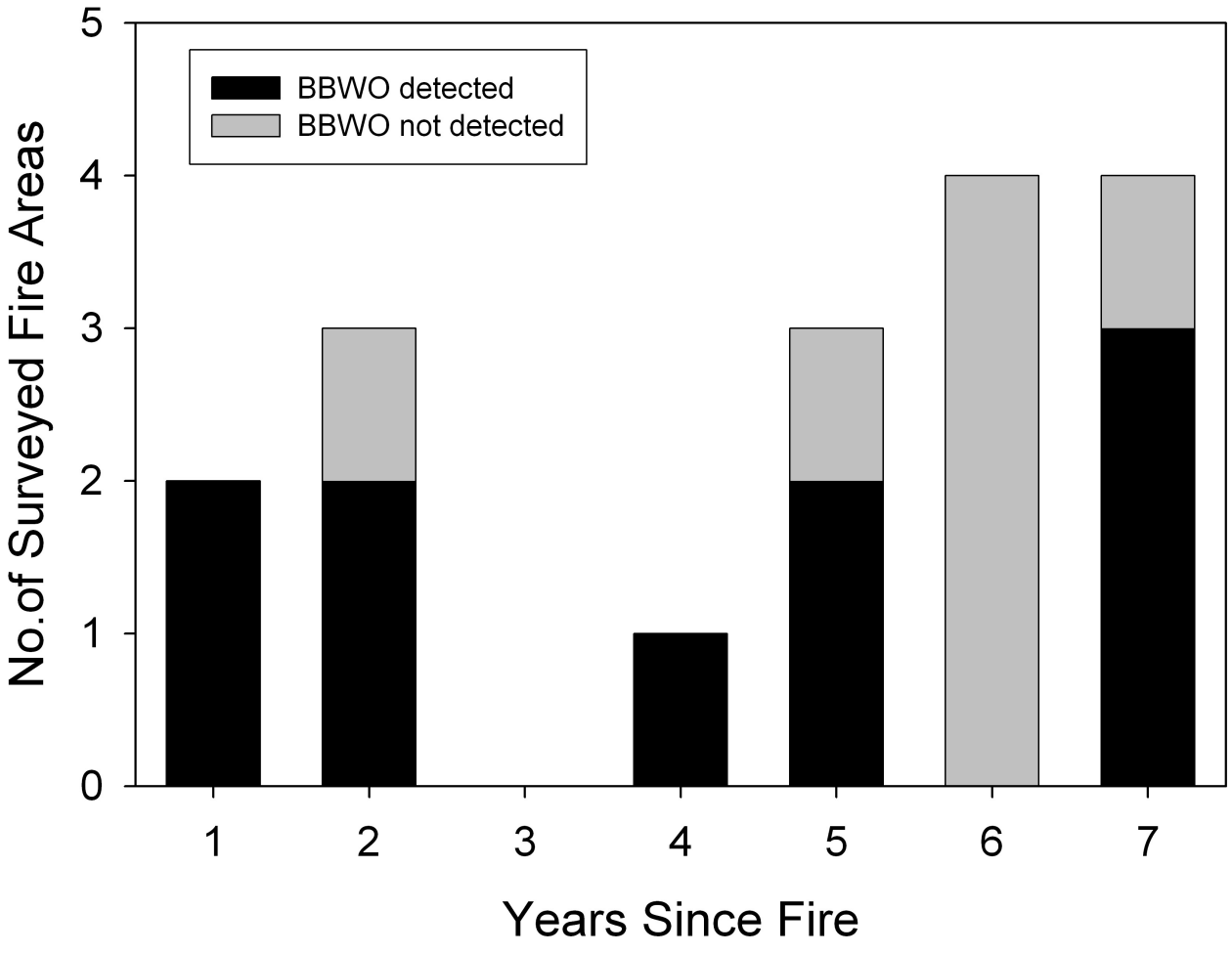

Figure 5. Number of fire areas of each age where Black-backed Woodpecker was detected (black portion of bars) and was not detected (gray portion of bars) during playback surveys on Sierra Nevada national forests in 2008. The Poe Fire area (7 years since fire) and Saint Pauli Fire area (6 years since fire), which were visited and found not to have suitable Black-backed Woodpecker habitat, are not included in this graph.

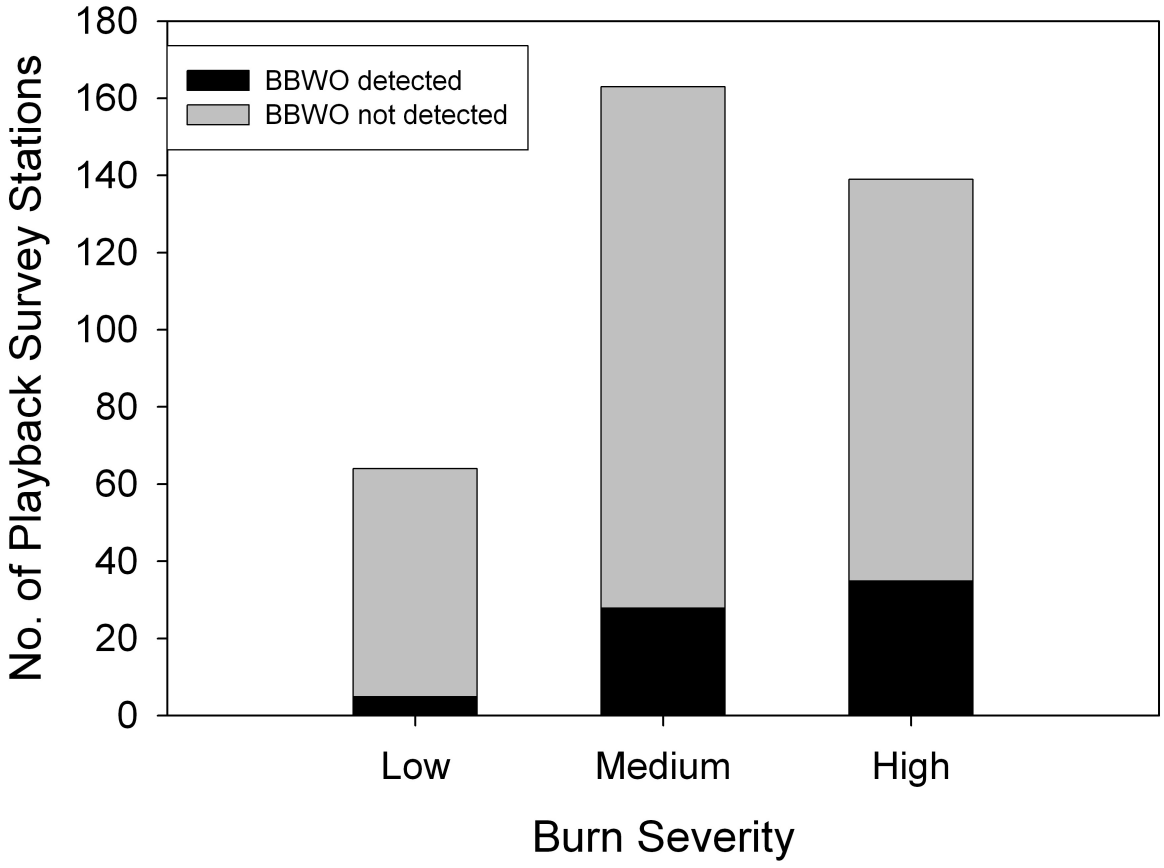

Figure 6. Number of playback survey stations placed in each of three fire severity classes (low, medium, and high), the number of stations in each fire severity class where Black-backed Woodpecker was detected during surveys on the Sierra Nevada national forests in 2008. There was a statistically significant association between fire severity and the likelihood of detecting Black-backed Woodpeckers at a survey station (*chi-square* = 7.45, $p < 0.05$).

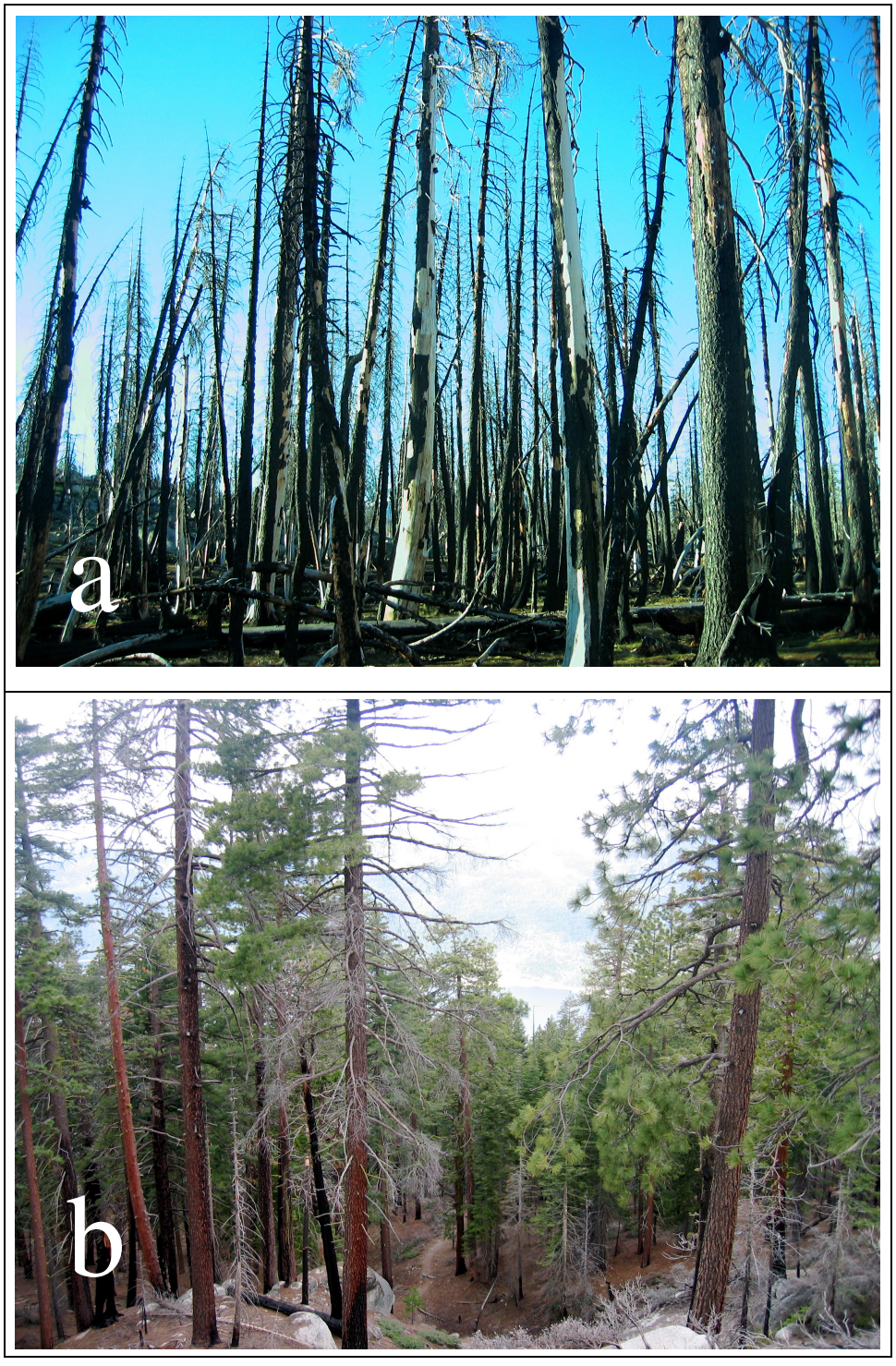

Figure 7. Examples of a) a forest stand burned by high-severity fire (photo taken in the Mud Fire area) and b) a forest stand burned by moderate-severity fire (photo taken in the Kibbie Fire area). We hypothesize that detection probability during passive point counts, where visual cues are important, is likely higher in the conditions shown in a) than in those shown in b).

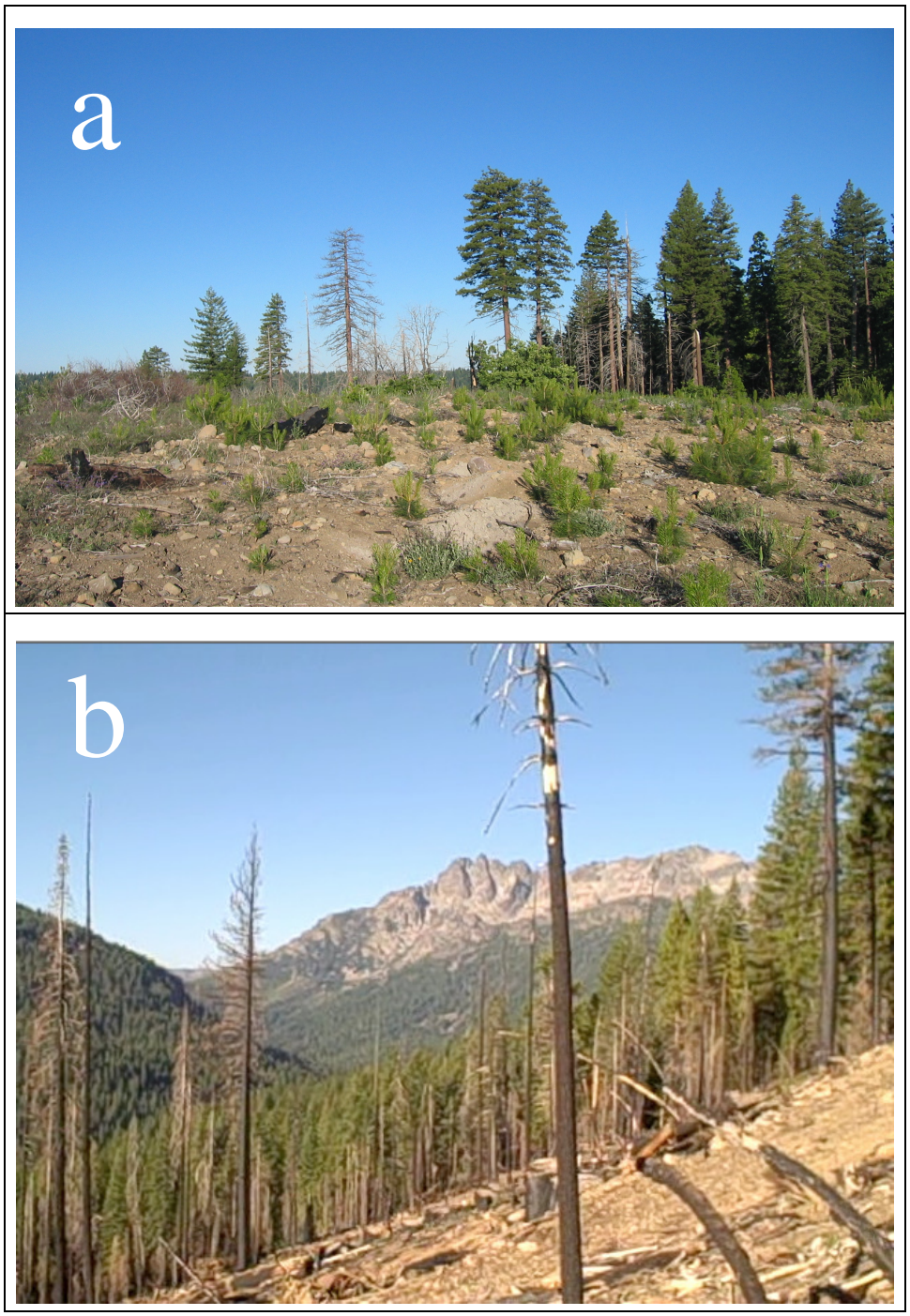

Figure 8. Examples of burned forest stands subject to post-fire salvage logging in a) the Plum Fire area (no Black-backed Woodpeckers detected) and b) the Bassetts Fire area (Black-backed Woodpeckers detected at 11 of 14 survey stations).

Appendix 1: UTM locations (NAD 83) of all stations surveyed in 2008.

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Bassetts	BASSB01	Off-trail	10	705649	4388097	Yes
Bassetts	BASSB02	Off-trail	10	705822	4388317	No
Bassetts	BASSB03	Off-trail	10	705953	4388485	Yes
Bassetts	BASSB04	Off-trail	10	705786	4388655	Yes
Bassetts	BASSB05	Off-trail	10	705624	4388837	Yes
Bassetts	BASSB06	Off-trail	10	705394	4388983	Yes
Bassetts	BASSD01	Road	10	707824	4389544	No
Bassetts	BASSD02	Road	10	707738	4389494	Yes
Bassetts	BASSD03	Off-trail	10	707627	4389369	Yes
Bassetts	BASSD04	Off-trail	10	707498	4389137	Yes
Bassetts	BASSD05	Off-trail	10	707353	4389037	Yes
Bassetts	BASSD06	Off-trail	10	707221	4388903	Yes
Bassetts	BASSD07	Off-trail	10	707047	4388760	No
Bassetts	BASSD08	Off-trail	10	706994	4388566	Yes
Bell	BELLB01	Road	10	668342	4619336	No
Bell	BELLB02	Road	10	668362	4619573	No
Bell	BELLB03	Road	10	668599	4619627	No
Bell	BELLB04	Road	10	668830	4619621	No
Bell	BELLB05	Road	10	669027	4619678	No
Bell	BELLB06	Road	10	669126	4619927	No
Bell	BELLB07	Road	10	669315	4620058	No
Bell	BELLB08	Road	10	668238	4620007	No
Bell	BELLB09	Road	10	668066	4620186	No
Bell	BELLB10	Road	10	667895	4620368	No
Bell	BELLB11	Road	10	667638	4620376	No
Bell	BELLR01	Road	10	668397	4620032	No
Bell	BELLR02	Road	10	668431	4620225	No
Bell	BELLR03	Road	10	668531	4620470	No
Bell	BELLR04	Road	10	668621	4620707	No
Bell	BELLR05	Road	10	668726	4620955	No
Bell	BELLR06	Road	10	668706	4621206	No
Bell	BELLR07	Road	10	668753	4621463	No
Bell	BELLR08	Road	10	668847	4621712	No
Bell	BELLR09	Road	10	668970	4621956	No
Bell	BELLR10	Road	10	669089	4622211	No
Bell	BELLR11	Road	10	669070	4622492	No
Boulder Complex	BOCOB01	Road	10	706083	4451477	Yes
Boulder Complex	BOCOB02	Road	10	706361	4451416	No
Boulder Complex	BOCOB03	Road	10	706598	4451393	Yes
Boulder Complex	BOCOB04	Road	10	706881	4451404	Yes
Boulder Complex	BOCOB05	Road	10	707160	4451306	No
Boulder Complex	BOCOB06	Road	10	707334	4451126	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Boulder Complex	BOCOB07	Road	10	707219	4450887	No
Boulder Complex	BOCOB08	Road	10	707187	4450615	Yes
Boulder Complex	BOCOB09	Road	10	706936	4450511	Yes
Boulder Complex	BOCOB10	Road	10	706694	4450550	No
Boulder Complex	BOCOD01	Road	10	704648	4451947	No
Boulder Complex	BOCOD02	Road	10	704656	4452197	Yes
Boulder Complex	BOCOD03	Road	10	704796	4452371	Yes
Boulder Complex	BOCOD04	Road	10	705036	4452244	Yes
Boulder Complex	BOCOD05	Road	10	705059	4451936	No
Boulder Complex	BOCOD06	Road	10	705019	4451710	No
Boulder Complex	BOCOD07	Road	10	704828	4451541	No
Boulder Complex	BOCOD08	Road	10	704819	4451316	No
Boulder Complex	BOCOD09	Road	10	705354	4451842	No
Boulder Complex	BOCOD10	Road	10	705552	4451787	Yes
Boulder Complex	BOCOD11	Road	10	705750	4451646	Yes
Boulder Complex	BOCOD12	Road	10	705961	4451643	Yes
Cone	CONEB01	Road	10	655704	4513367	No
Cone	CONEB02	Road	10	655720	4513608	No
Cone	CONEB03	Road	10	655812	4513839	No
Cone	CONEB04	Road	10	655725	4513120	No
Cone	CONEB05	Road	10	655747	4512833	No
Cone	CONEB06	Road	10	655505	4512901	No
Cone	CONEB07	Road	10	655724	4512583	No
Cone	CONEB08	Road	10	655737	4512345	No
Cone	CONEB09	Road	10	655967	4513079	No
Cone	CONEB10	Road	10	656527	4512909	No
Cone	CONEB11	Road	10	656780	4512898	No
Cone	CONER01	Road	10	654749	4512959	No
Cone	CONER02	Road	10	654879	4513158	No
Cone	CONER03	Road	10	654971	4513403	No
Cone	CONER04	Road	10	655144	4513586	No
Cone	CONER05	Road	10	655107	4513860	No
Cone	CONER06	Road	10	654882	4513842	No
Cone	CONER07	Road	10	654648	4513747	No
Cone	CONER08	Road	10	654448	4513661	No
Cone	CONER09	Road	10	654617	4512725	No
Cooney	COOND01	Trail	11	362360	4025074	No
Cooney	COOND02	Trail	11	362449	4024889	No
Cooney	COOND03	Trail	11	362585	4024734	No
Cooney	COOND04	Trail	11	362751	4024596	No
Cooney	COOND05	Trail	11	362950	4024613	No
Cooney	COOND06	Trail	11	363143	4024665	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Cooney	COOND07	Trail	11	363336	4024770	No
Cooney	COOND08	Trail	11	363499	4024855	No
Cooney	COOND09	Trail	11	363566	4024719	No
Cooney	COOND10	Trail	11	363588	4024532	No
Cooney	COOND11	Trail	11	363733	4024397	No
Cooney	COOND12	Trail	11	363849	4024316	No
Cooney	COOND13	Trail	11	363874	4024145	No
Cooney	COONR01	Off-trail	11	362496	4024757	No
Cooney	COONR02	Off-trail	11	362232	4025034	No
Cooney	COONR03	Off-trail	11	362204	4024819	No
Cooney	COONR04	Off-trail	11	362319	4024615	No
Cooney	COONR05	Off-trail	11	362429	4024402	No
Cooney	COONR06	Off-trail	11	362589	4024192	No
Cooney	COONR07	Off-trail	11	362853	4024171	No
Cooney	COONR08	Off-trail	11	362986	4024073	No
Cooney	COONR09	Off-trail	11	362911	4023805	No
Cooney	COONR10	Off-trail	11	362811	4023577	No
Cooney	COONR11	Off-trail	11	362792	4023305	No
Cooney	COONR12	Off-trail	11	362867	4023087	No
Crater	CRATD01	Off-trail	11	327516	4195394	No
Crater	CRATD02	Off-trail	11	327481	4195616	Yes
Crater	CRATD03	Off-trail	11	327417	4195821	Yes
Crater	CRATD04	Off-trail	11	327403	4196055	Yes
Crater	CRATD05	Road	11	327341	4196268	Yes
Crater	CRATD06	Road	11	327311	4196469	No
Crater	CRATD07	Off-trail	11	327209	4196665	No
Crater	CRATD08	Off-trail	11	327004	4196776	No
Crater	CRATD09	Off-trail	11	326916	4196955	No
Crater	CRATD10	Off-trail	11	326725	4196907	No
Crater	CRATD11	Off-trail	11	326642	4196727	No
Crater	CRATD12	Off-trail	11	326624	4196541	No
Crater	CRATD13	Off-trail	11	326724	4196365	No
Crater	CRATD14	Off-trail	11	326740	4196189	Yes
Crater	CRATR01	Road	11	326435	4195949	Yes
Crater	CRATR02	Road	11	326393	4195676	No
Crater	CRATR03	Road	11	326346	4195429	No
Crater	CRATR04	Road	11	326337	4195183	No
Crater	CRATR05	Road	11	326380	4194931	No
Crater	CRATR06	Road	11	326415	4194688	No
Crater	CRATR07	Off-trail	11	326637	4194785	No
Crater	CRATR08	Off-trail	11	326656	4195033	No
Crater	CRATR09	Off-trail	11	326662	4195265	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Crater	CRATR10	Off-trail	11	326757	4195489	No
Crater	CRATR11	Off-trail	11	326988	4195489	Yes
Crater	CRATR12	Off-trail	11	327008	4195254	No
Crater	CRATR13	Off-trail	11	327045	4195019	No
Crater	CRATR14	Off-trail	11	327211	4195199	Yes
Crater	CRATR15	Off-trail	11	326242	4196141	No
Gap	GAPFD01	Road	10	705301	4353440	No
Gap	GAPFD02	Road	10	705651	4353216	No
Gap	GAPFD03	Road	10	705847	4352878	Yes
Gap	GAPFD04	Road	10	703270	4353305	No
Gap	GAPFD05	Road	10	703296	4353060	No
Gap	GAPFD06	Road	10	703245	4352839	No
Gap	GAPFD07	Road	10	703294	4352632	No
Gap	GAPFD08	Road	10	703504	4352692	No
Gap	GAPFD09	Road	10	703615	4352912	No
Gap	GAPFD10	Road	10	703804	4352891	No
Gap	GAPFD11	Road	10	704011	4352982	No
Gap	GAPFD12	Road	10	704240	4352943	No
Gap	GAPFR01	Road	10	705052	4353534	No
Gap	GAPFR02	Road	10	705528	4353311	No
Gap	GAPFR03	Road	10	705701	4353051	No
Gap	GAPFR04	Road	10	703318	4353469	No
Gap	GAPFR05	Road	10	703516	4353565	No
Gap	GAPFR06	Road	10	703747	4353566	No
Gap	GAPFR07	Road	10	703998	4353657	No
Gap	GAPFR08	Road	10	704258	4353749	No
Gap	GAPFR09	Road	10	704253	4353588	No
Gap	GAPFR10	Road	10	704134	4353450	No
Gap	GAPFR11	Road	10	703941	4353345	No
Gap	GAPFR12	Off-trail	10	703770	4353184	No
Gap	GAPFR13	Off-trail	10	703549	4353170	No
Kibbie	KIBBB01	Trail	11	247213	4212443	Yes
Kibbie	KIBBB02	Trail	11	247207	4212682	No
Kibbie	KIBBB03	Trail	11	247148	4212925	No
Kibbie	KIBBB04	Trail	11	247221	4213146	No
Kibbie	KIBBB05	Trail	11	247215	4213377	No
Kibbie	KIBBB06	Trail	11	247135	4213577	No
Kibbie	KIBBB07	Trail	11	247126	4213828	No
Kibbie	KIBBB08	Trail	11	247065	4214090	No
Kibbie	KIBBB09	Trail	11	246848	4214219	No
Kibbie	KIBBB10	Trail	11	246670	4214430	No
Kibbie	KIBBB11	Trail	11	246767	4214700	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Kibbie	KIBBB12	Trail	11	246886	4214902	No
Kibbie	KIBBB13	Trail	11	246984	4215111	No
Kibbie	KIBBB14	Trail	11	247064	4215342	No
Kibbie	KIBBB15	Trail	11	247214	4215511	No
Kibbie	KIBBD01	Trail	11	247265	4215561	Yes
Kibbie	KIBBD02	Trail	11	247363	4215745	No
Kibbie	KIBBD03	Trail	11	247492	4215927	Yes
Kibbie	KIBBD04	Trail	11	247667	4216088	No
Kibbie	KIBBD05	Trail	11	247890	4216134	No
Kibbie	KIBBD06	Trail	11	248091	4216258	No
Kibbie	KIBBD07	Trail	11	248264	4216435	No
Kibbie	KIBBD08	Trail	11	248385	4216652	No
Kibbie	KIBBD09	Trail	11	248578	4216823	No
Kibbie	KIBBR01	Trail	11	246631	4211189	No
Kibbie	KIBBR02	Trail	11	246740	4211016	No
Kibbie	KIBBR03	Trail	11	246681	4210768	No
Kibbie	KIBBR04	Trail	11	246730	4211368	No
Kibbie	KIBBR05	Trail	11	246774	4211612	No
Kibbie	KIBBR06	Trail	11	246769	4211842	No
Kibbie	KIBBR07	Trail	11	246918	4211789	No
Kibbie	KIBBR08	Trail	11	246971	4211896	No
Kibbie	KIBBR09	Trail	11	247138	4212001	No
Kibbie	KIBBR10	Trail	11	247155	4212188	No
Kibbie	KIBBR11	Trail	11	249518	4217764	No
Kibbie	KIBBR12	Trail	11	249334	4217600	Yes
Kibbie	KIBBR13	Trail	11	249145	4217492	Yes
Kibbie	KIBBR14	Trail	11	248879	4217416	No
Kibbie	KIBBR15	Trail	11	248697	4217198	No
Moonlight	MOONB01	Road	10	700220	4452542	No
Moonlight	MOONB02	Road	10	700092	4452332	Yes
Moonlight	MOONB03	Road	10	699881	4452154	Yes
Moonlight	MOONB04	Road	10	699695	4452059	Yes
Moonlight	MOONB05	Road	10	699491	4452201	No
Moonlight	MOONB06	Road	10	699261	4452284	Yes
Moonlight	MOONB07	Road	10	699021	4452314	Yes
Moonlight	MOONB08	Road	10	698813	4452520	Yes
Moonlight	MOONB09	Road	10	698570	4452557	No
Moonlight	MOONB10	Road	10	698305	4452658	No
Moonlight	MOONB11	Road	10	698091	4452760	Yes
Moonlight	MOONB12	Road	10	698015	4452978	No
Moonlight	MOOND01	Road	10	701215	4453310	No
Moonlight	MOOND02	Road	10	701032	4453370	Yes

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Moonlight	MOOND03	Road	10	700847	4453429	No
Moonlight	MOOND04	Road	10	700665	4453368	Yes
Moonlight	MOOND05	Road	10	700529	4453201	Yes
Moonlight	MOOND06	Road	10	700468	4452999	Yes
Moonlight	MOOND07	Road	10	700388	4452776	No
Moonlight	MOOND08	Road	10	700172	4452841	Yes
Moonlight	MOOND09	Road	10	700081	4453037	Yes
Moonlight	MOOND10	Road	10	699978	4453180	Yes
Moonlight	MOOND11	Road	10	699815	4453219	Yes
Moonlight	MOOND12	Road	10	699601	4453314	Yes
Mud	MUDFB01	Off-trail	11	243100	4261000	No
Mud	MUDFB02	Off-trail	11	243350	4261000	No
Mud	MUDFB03	Off-trail	11	243600	4261000	No
Mud	MUDFB04	Off-trail	11	243050	4261000	No
Mud	MUDFB05	Off-trail	11	244100	4261000	No
Mud	MUDFB06	Off-trail	11	244350	4261000	No
Mud	MUDFB07	Off-trail	11	244350	4260750	No
Mud	MUDFB08	Off-trail	11	244350	4260500	No
Mud	MUDFB09	Off-trail	11	244350	4260250	No
Mud	MUDFB10	Off-trail	11	244100	4260250	No
Mud	MUDFB11	Off-trail	11	243850	4260250	No
Mud	MUDFD01	Trail	11	242391	4258272	No
Mud	MUDFD02	Trail	11	242411	4258168	Yes
Mud	MUDFD03	Trail	11	242503	4257987	Yes
Mud	MUDFD04	Trail	11	242644	4257819	Yes
Mud	MUDFD05	Trail	11	242882	4257718	No
Mud	MUDFD06	Trail	11	243012	4257546	No
Mud	MUDFD07	Trail	11	243027	4257396	No
Mud	MUDFD08	Trail	11	243153	4257261	No
Mud	MUDFR01	Trail	11	242849	4261066	No
Mud	MUDFR02	Trail	11	242775	4260828	No
Mud	MUDFR03	Trail	11	242705	4260583	No
Mud	MUDFR04	Trail	11	242775	4260343	Yes
Mud	MUDFR05	Trail	11	242739	4260188	Yes
Mud	MUDFR06	Trail	11	242671	4259859	No
Mud	MUDFR07	Trail	11	242710	4259566	No
Mud	MUDFR08	Trail	11	242716	4259282	Yes
Mud	MUDFR09	Trail	11	242646	4259041	No
Mud	MUDFR10	Trail	11	242540	4258766	No
Mud	MUDFR11	Trail	11	242486	4258500	No
Mud	MUDFR12	Trail	11	242286	4258297	No
Mud	MUDFR13	Trail	11	242056	4258245	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Mud	MUDFR14	Trail	11	241775	4258211	No
North Fork	NOFOB01	Road	11	281772	4125153	No
North Fork	NOFOB02	Road	11	281682	4125421	No
North Fork	NOFOB03	Road	11	281733	4125679	No
North Fork	NOFOB04	Road	11	281512	4125851	No
North Fork	NOFOB05	Road	11	281347	4125643	No
North Fork	NOFOB06	Road	11	281385	4125426	No
North Fork	NOFOB07	Road	11	281328	4125160	No
North Fork	NOFOB08	Road	11	281646	4125969	No
North Fork	NOFOR01	Road	11	281803	4129393	No
North Fork	NOFOR02	Road	11	281930	4129581	No
North Fork	NOFOR03	Road	11	281502	4129160	No
North Fork	NOFOR04	Road	11	281254	4129053	No
North Fork	NOFOR05	Road	11	281119	4128780	No
North Fork	NOFOR06	Road	11	280942	4128538	No
North Fork	NOFOR07	Road	11	280950	4128820	No
North Fork	NOFOR08	Road	11	280857	4129061	No
North Fork	NOFOR09	Road	11	280650	4129234	No
North Fork	NOFOR10	Road	11	280603	4129459	No
North Fork	NOFOR11	Road	11	280582	4129701	No
North Fork	NOFOR12	Road	11	280712	4129952	No
Plum	PLUMD01	Road	10	725168	4293071	No
Plum	PLUMD02	Road	10	725316	4293391	No
Plum	PLUMD03	Road	10	725206	4293811	No
Plum	PLUMD04	Road	10	725583	4293701	No
Plum	PLUMD05	Road	10	725646	4293225	No
Plum	PLUMD06	Road	10	725962	4292901	No
Plum	PLUMD07	Road	10	726780	4291950	No
Plum	PLUMD08	Road	10	726625	4292121	No
Plum	PLUMD09	Road	10	726172	4292457	No
Plum	PLUMR01	Road	10	725305	4292862	No
Plum	PLUMR02	Road	10	725197	4293271	No
Plum	PLUMR03	Road	10	725241	4293667	No
Plum	PLUMR04	Road	10	725406	4293818	No
Plum	PLUMR05	Road	10	725634	4293394	No
Plum	PLUMR06	Road	10	725778	4293095	No
Plum	PLUMR07	Road	10	725970	4292654	No
Plum	PLUMR08	Road	10	725846	4292832	No
Plum	PLUMR09	Road	10	725686	4293011	No
Plum	PLUMR10	Road	10	725484	4292800	No
Ralston	RALSR01	Road	10	699613	4322314	No
Ralston	RALSR02	Road	10	699862	4322392	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Ralston	RALSR03	Road	10	700328	4322488	No
Ralston	RALSR04	Road	10	701858	4323794	No
Rock Creek 2	ROC2B01	Off-trail	11	290172	4128396	No
Rock Creek 2	ROC2B02	Off-trail	11	290320	4128215	No
Rock Creek 2	ROC2B03	Off-trail	11	290250	4128001	No
Rock Creek 2	ROC2B04	Off-trail	11	290110	4127891	No
Rock Creek 2	ROC2B05	Off-trail	11	289837	4127714	No
Rock Creek 2	ROC2B06	Off-trail	11	289615	4127700	No
Rock Creek 2	ROC2B07	Off-trail	11	289414	4127720	No
Rock Creek 2	ROC2R01	Off-trail	11	290138	4129356	No
Rock Creek 2	ROC2R02	Off-trail	11	289795	4129472	No
Rock Creek 2	ROC2R03	Off-trail	11	290491	4128951	No
Rock Creek 2	ROC2R04	Off-trail	11	290255	4128820	No
Rock Creek 2	ROC2R05	Off-trail	11	290046	4128745	No
Rock Creek 2	ROC2R06	Off-trail	11	289710	4128642	No
Rock Creek 2	ROC2R07	Off-trail	11	289674	4128264	No
Rock Creek 2	ROC2R08	Off-trail	11	289588	4128061	No
Rock Creek	ROCRB01	Off-trail	10	747827	4384431	No
Rock Creek	ROCRB02	Off-trail	10	747591	4384405	No
Rock Creek	ROCRB03	Off-trail	10	747344	4384379	No
Rock Creek	ROCRB04	Off-trail	10	747067	4384336	No
Rock Creek	ROCRB05	Off-trail	10	746833	4384333	Yes
Rock Creek	ROCRB06	Off-trail	10	746579	4384337	No
Rock Creek	ROCRB07	Off-trail	10	746316	4384337	No
Rock Creek	ROCRB08	Off-trail	10	746080	4384335	No
Rock Creek	ROCRB09	Off-trail	10	745821	4384313	No
Rock Creek	ROCRD01	Off-trail	10	747743	4383953	No
Rock Creek	ROCRD02	Off-trail	10	747537	4384012	No
Rock Creek	ROCRD03	Off-trail	10	747328	4384087	No
Rock Creek	ROCRD04	Off-trail	10	747143	4384122	Yes
Rock Creek	ROCRD05	Off-trail	10	746960	4384075	No
Rock Creek	ROCRD06	Off-trail	10	746719	4384035	Yes
Rock Creek	ROCRD07	Off-trail	10	746513	4384100	Yes
Rock Creek	ROCRD08	Off-trail	10	746346	4384006	No
Rock Creek	ROCRD09	Off-trail	10	746101	4384098	No
Rock Creek	ROCRD10	Off-trail	10	745931	4384094	No
Straylor	STRAB01	Road	10	659120	4522253	No
Straylor	STRAB02	Road	10	659364	4522219	No
Straylor	STRAB03	Road	10	659588	4522337	No
Straylor	STRAB04	Road	10	659794	4522244	No
Straylor	STRAB05	Road	10	660045	4522292	No
Straylor	STRAB06	Road	10	660285	4522205	No

Appendix 1, continued

Fire Name	Survey Station	Station Type	UTM Zone	Easting	Northing	BBWO Detected
Straylor	STRAB07	Road	10	660282	4521943	No
Straylor	STRAB08	Road	10	660572	4521642	No
Straylor	STRAB09	Road	10	660844	4521501	No
Straylor	STRAB10	Road	10	659812	4522016	No
Straylor	STRAB11	Road	10	660042	4521888	No
Straylor	STRAR01	Road	10	663266	4521443	No
Straylor	STRAR02	Road	10	663423	4521227	No
Straylor	STRAR03	Road	10	663578	4521028	No
Straylor	STRAR04	Road	10	663736	4520828	Yes
Straylor	STRAR05	Road	10	663978	4520623	No
Straylor	STRAR06	Road	10	663466	4520896	No
Straylor	STRAR07	Road	10	663171	4520963	No
Straylor	STRAR08	Road	10	662926	4520967	No
Straylor	STRAR09	Road	10	662792	4520877	No
Straylor	STRAR10	Road	10	662861	4520610	No
Vista	VISTD01	Road	11	381071	3985974	No
Vista	VISTD02	Road	11	381297	3986017	No
Vista	VISTD03	Road	11	381457	3986001	No
Vista	VISTD04	Road	11	381529	3985796	No
Vista	VISTD05	Road	11	381660	3985611	No
Vista	VISTD06	Road	11	381887	3985585	No
Vista	VISTD07	Road	11	382141	3985571	No
Vista	VISTD08	Road	11	382272	3985370	No
Vista	VISTD09	Off-trail	11	382184	3985196	No
Vista	VISTD10	Off-trail	11	382009	3985151	No
Vista	VISTD11	Off-trail	11	381910	3985306	No
Vista	VISTD12	Off-trail	11	381765	3985500	No
Vista	VISTD13	Off-trail	11	381536	3985538	No
Vista	VISTD14	Off-trail	11	381386	3985695	No
Vista	VISTR01	Off-trail	11	380669	3985673	Yes
Vista	VISTR02	Off-trail	11	380636	3985409	No
Vista	VISTR03	Off-trail	11	380594	3985182	Yes
Vista	VISTR04	Off-trail	11	380986	3985255	Yes
Vista	VISTR05	Off-trail	11	380989	3985537	Yes
Vista	VISTR06	Off-trail	11	380941	3985803	Yes

Appendix 2:
Maps of fire-severity and survey stations with and without Black-backed Woodpecker detections at each fire area.

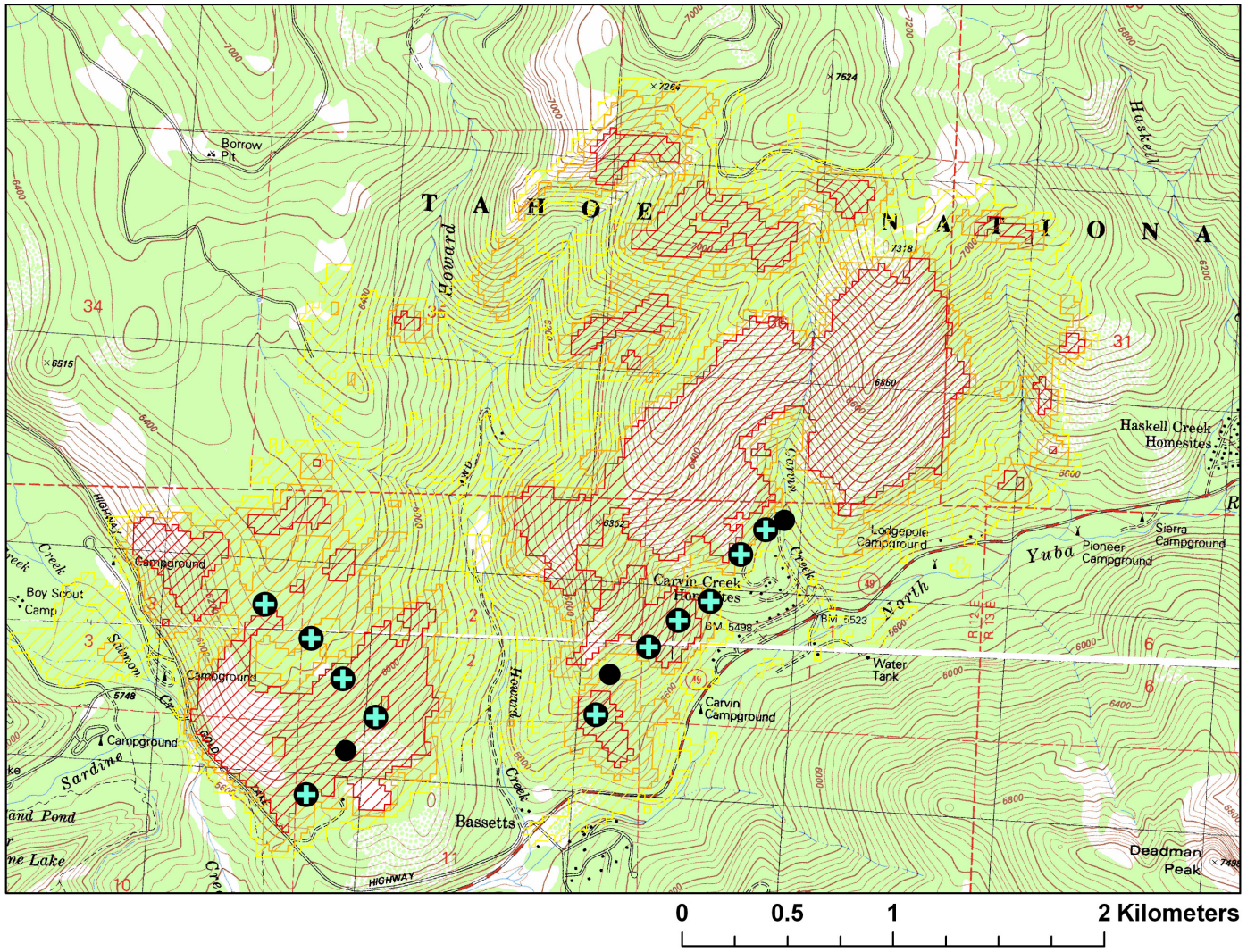

Figure A-1. Fire severity and survey station locations at the **Bassetts Fire** area on Tahoe NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

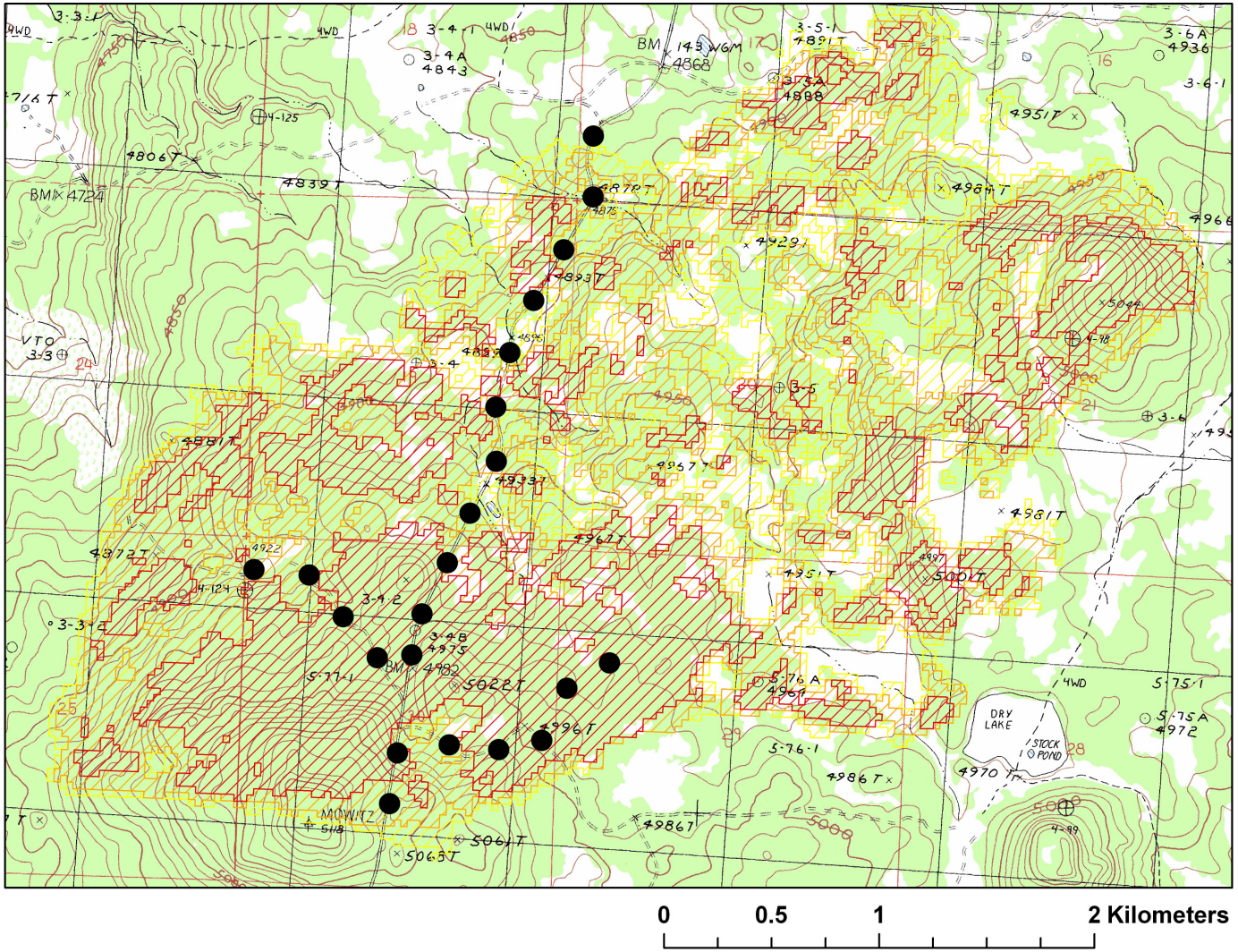

Figure A-2. Fire severity and survey station locations at the **Bell Fire** area on Modoc NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

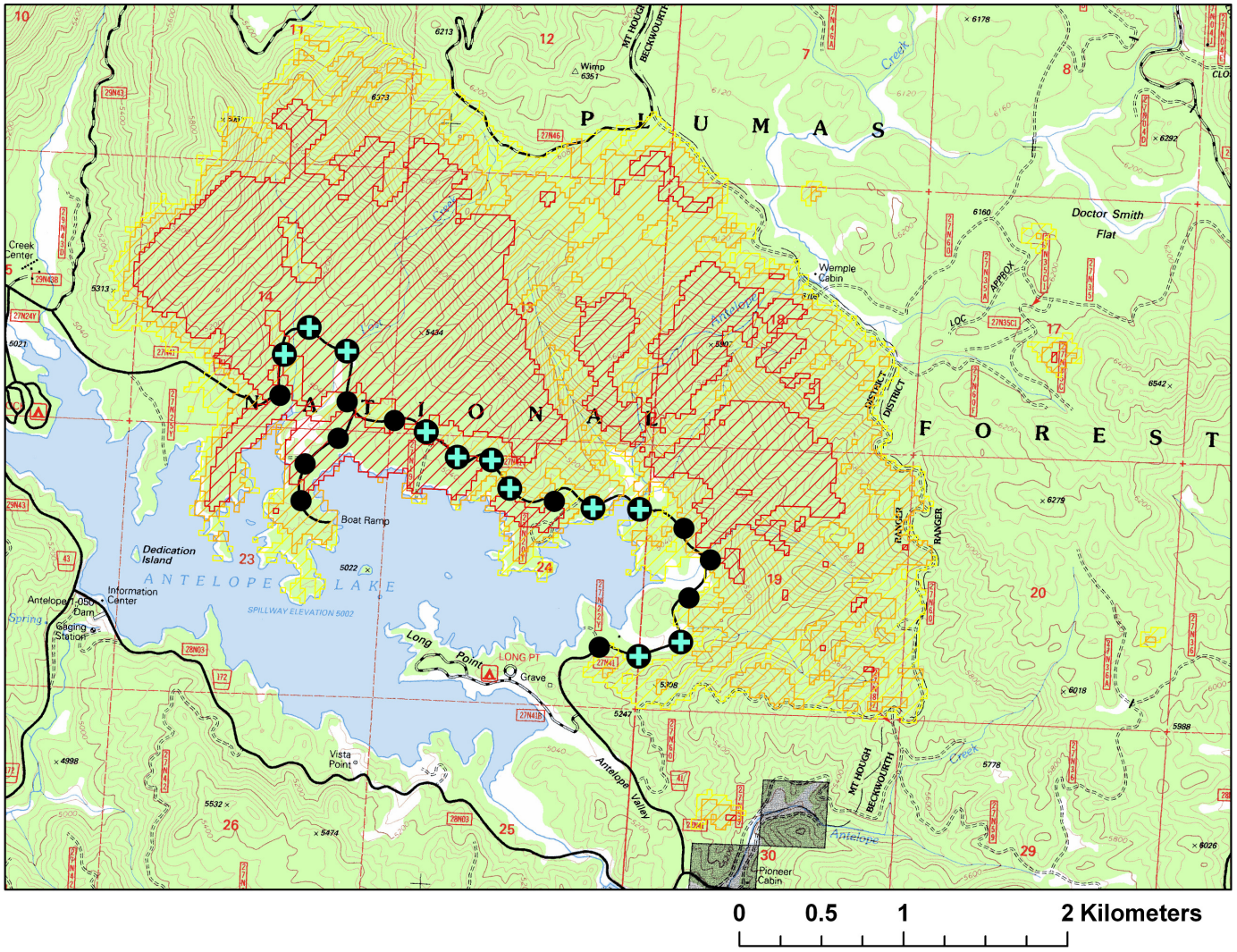

Figure A-3**.** Fire severity and survey station locations at the **Boulder Complex Fire** area on Plumas NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

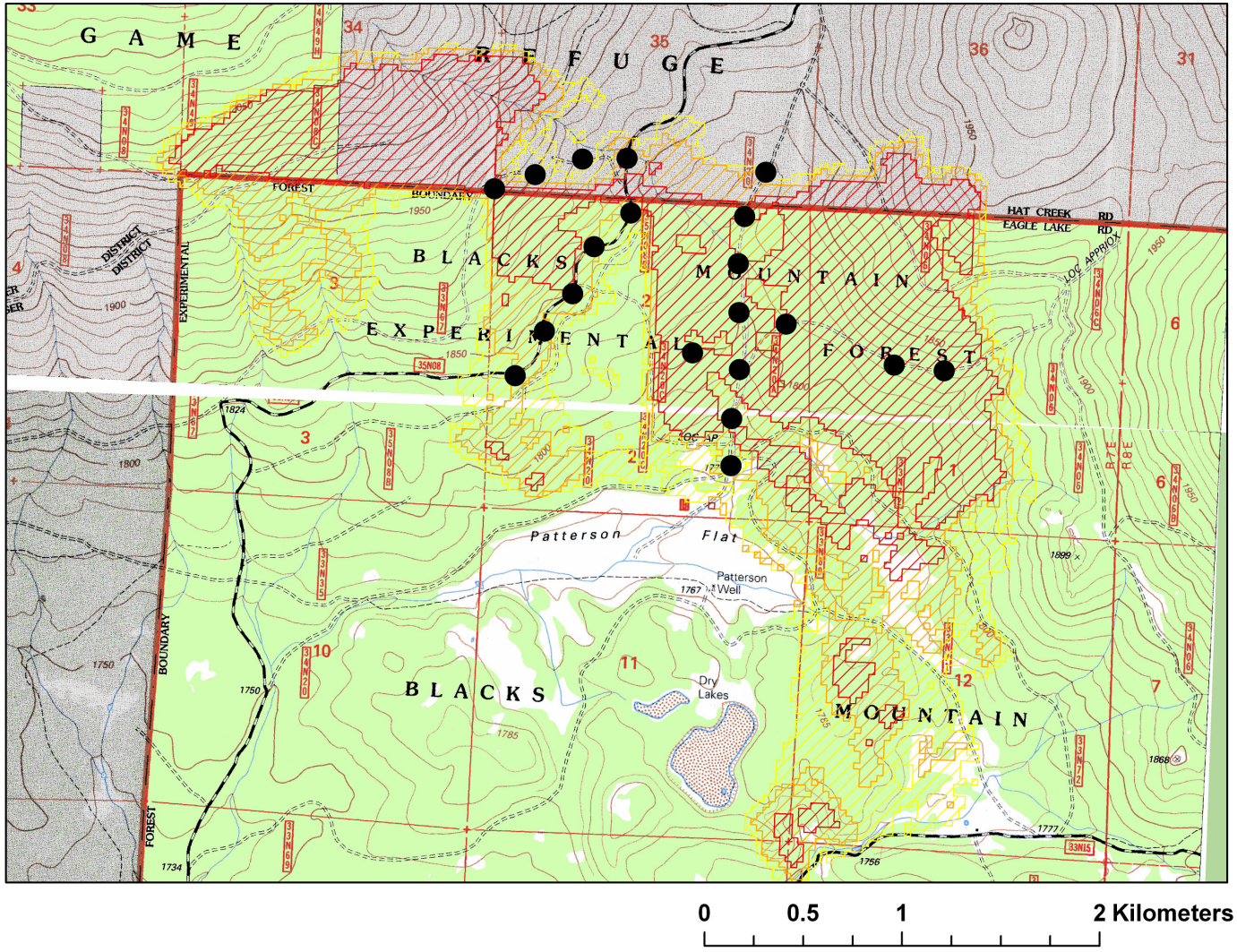

Figure A-4. Fire severity and survey station locations at the **Cone Fire** area on Lassen NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

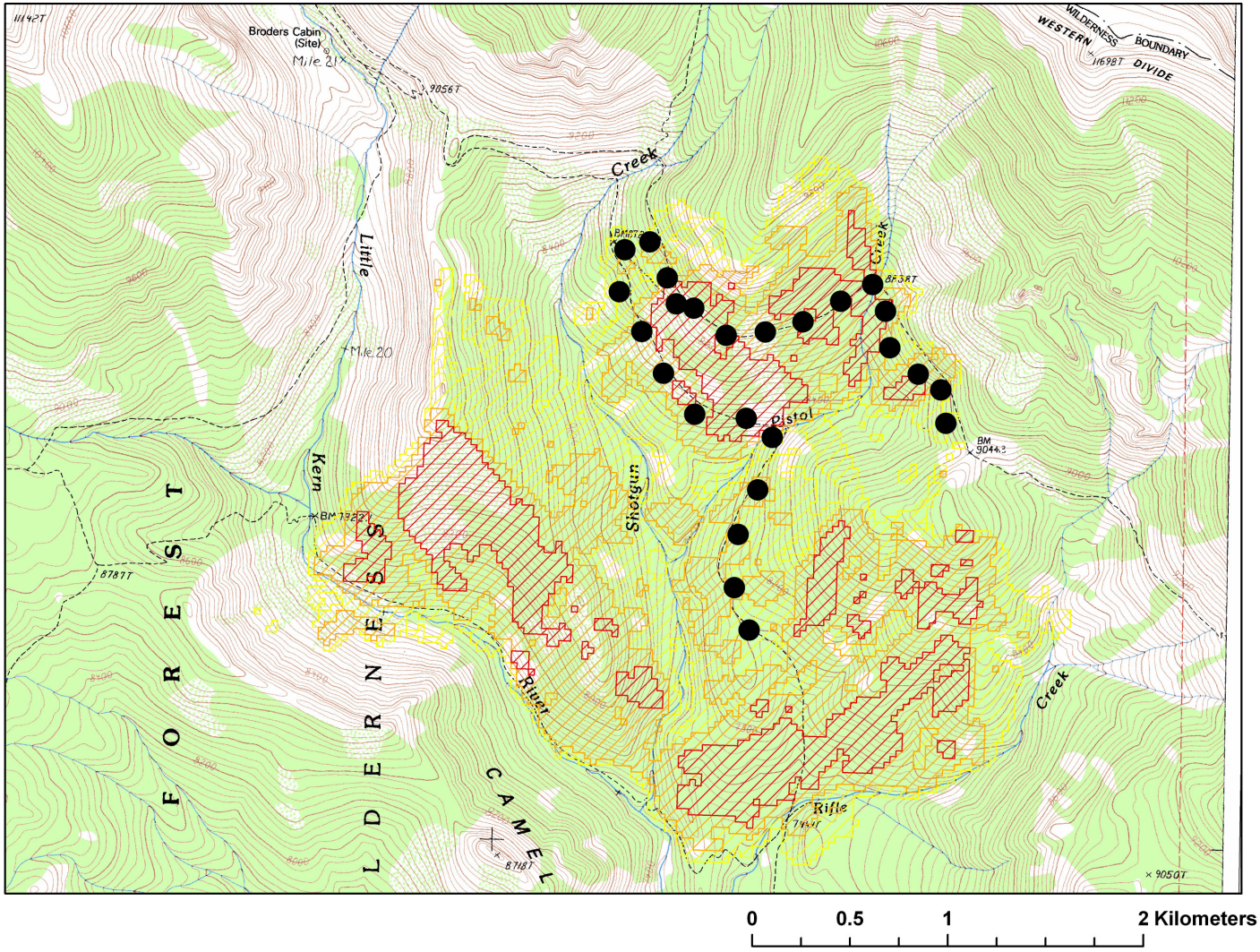

Figure A-5. Fire severity and survey station locations at the **Cooney Fire** area on Sequoia NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

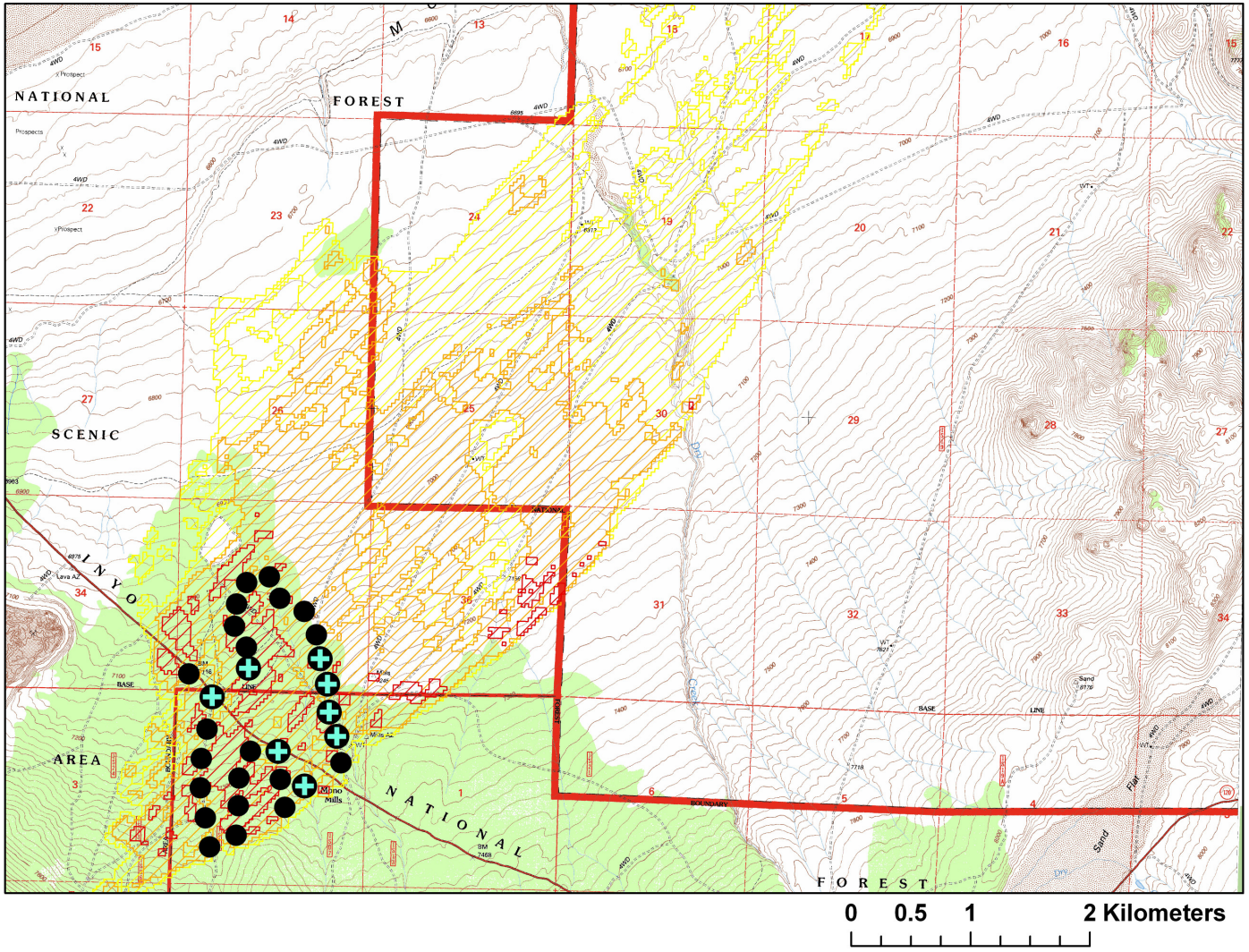

Figure A-6**.** Fire severity and survey station locations at the **Crater Fire** area on Inyo NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

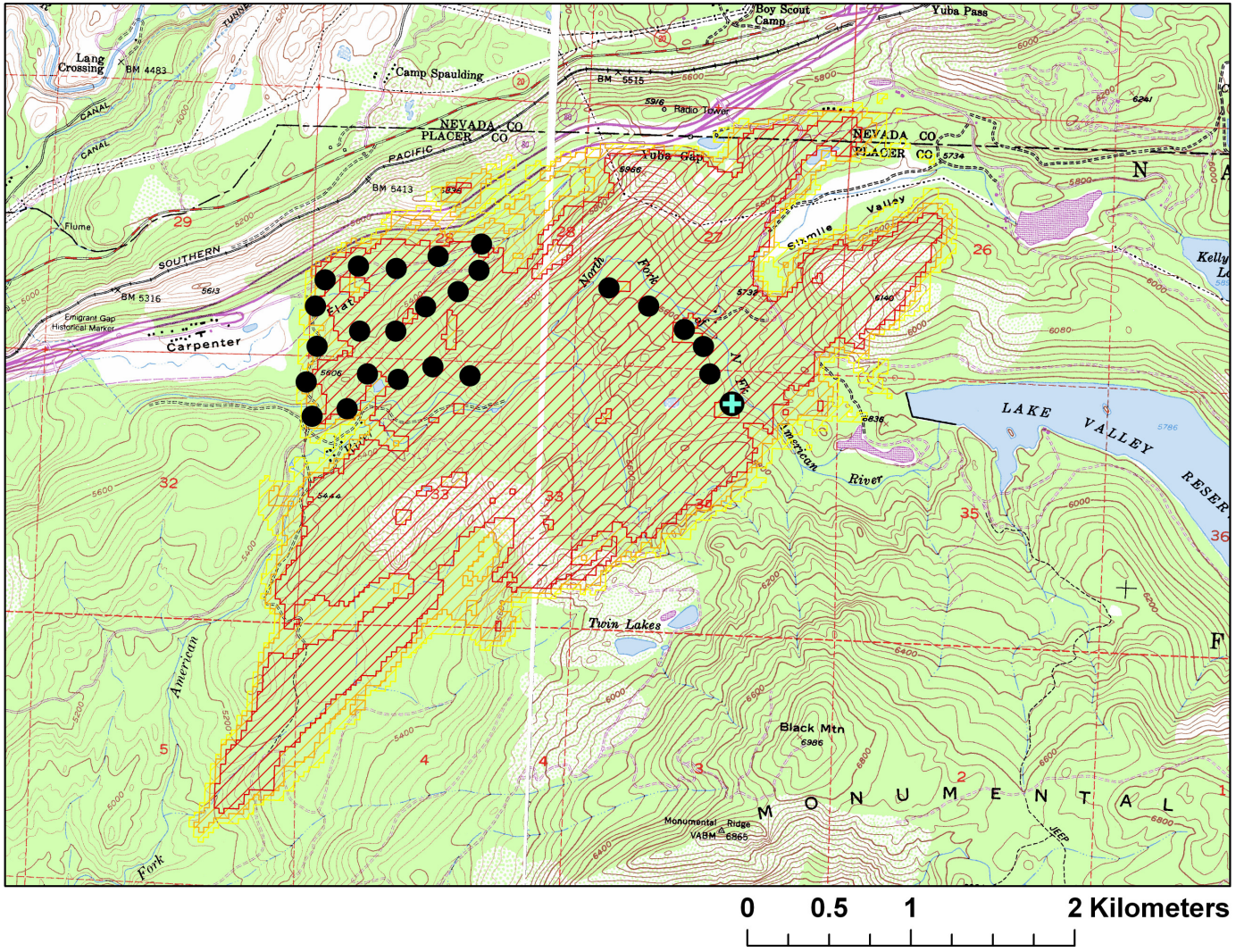

Figure A-7**.** Fire severity and survey station locations at the **Gap Fire** area on Tahoe NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue cross indicates the only station where Black-backed Woodpecker was detected.

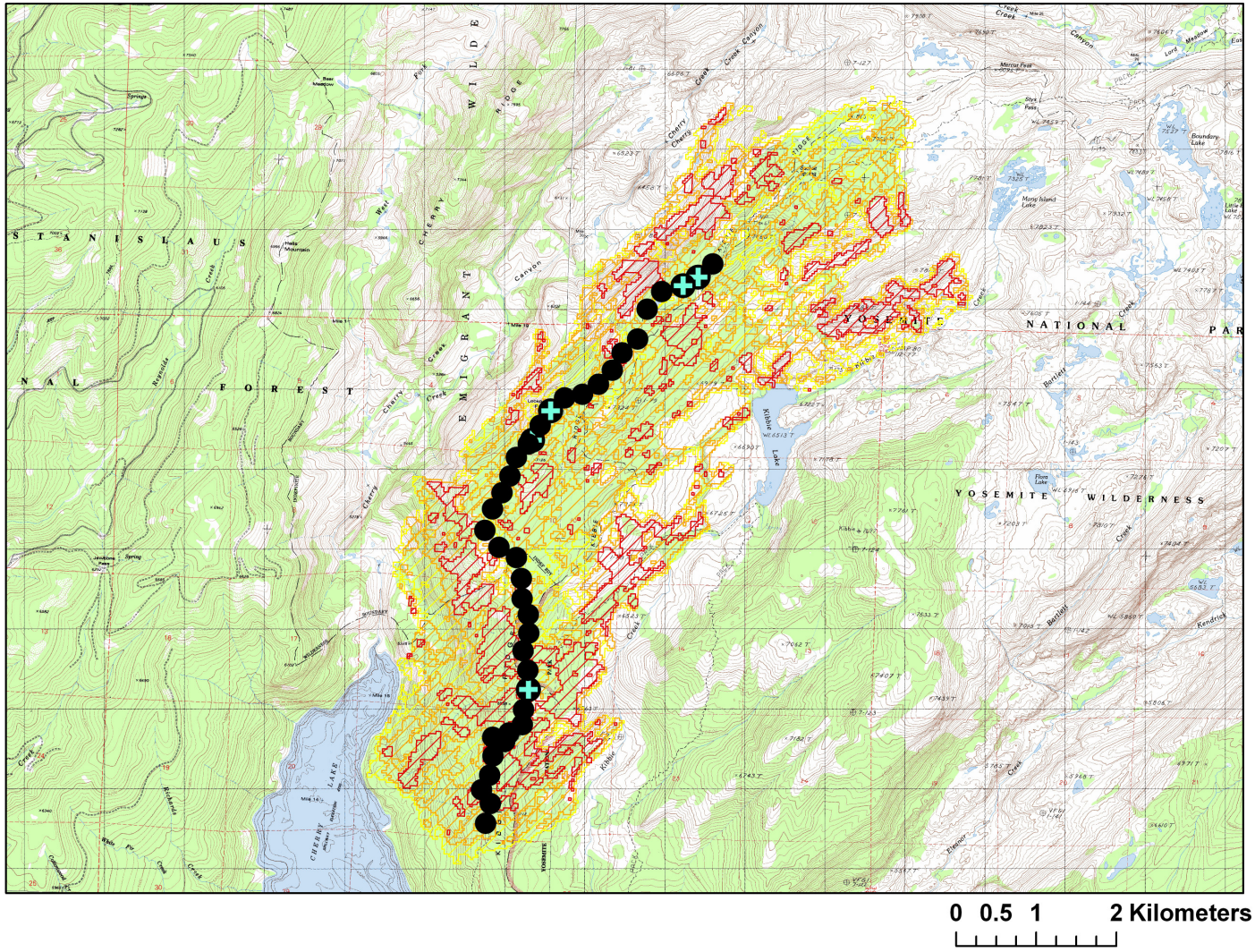

Figure A-8**.** Fire severity and survey station locations at the **Kibbie Fire** area on Stanislaus NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

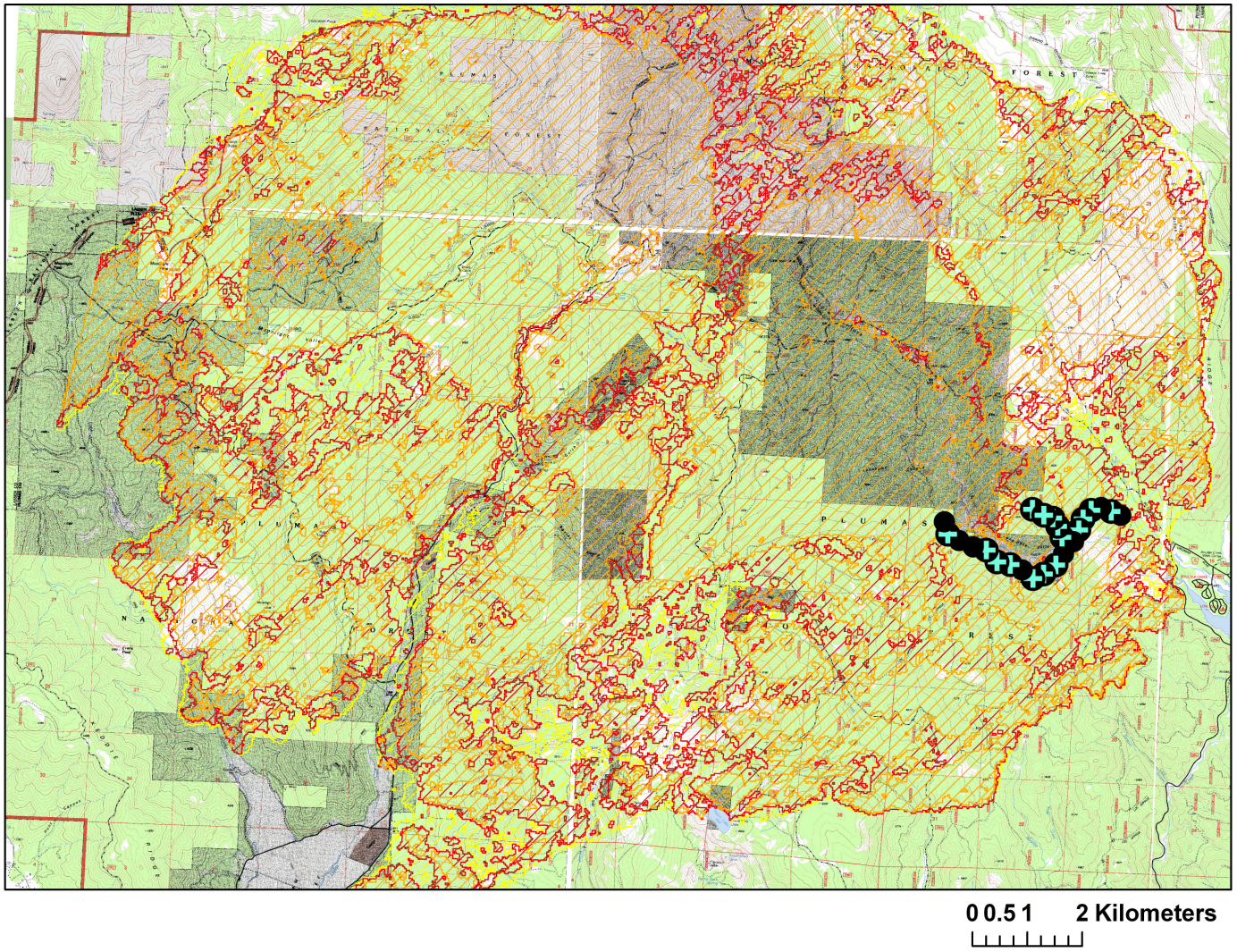

Figure A-9**.** Fire severity and survey station locations at the **Moonlight Fire** area on Plumas NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

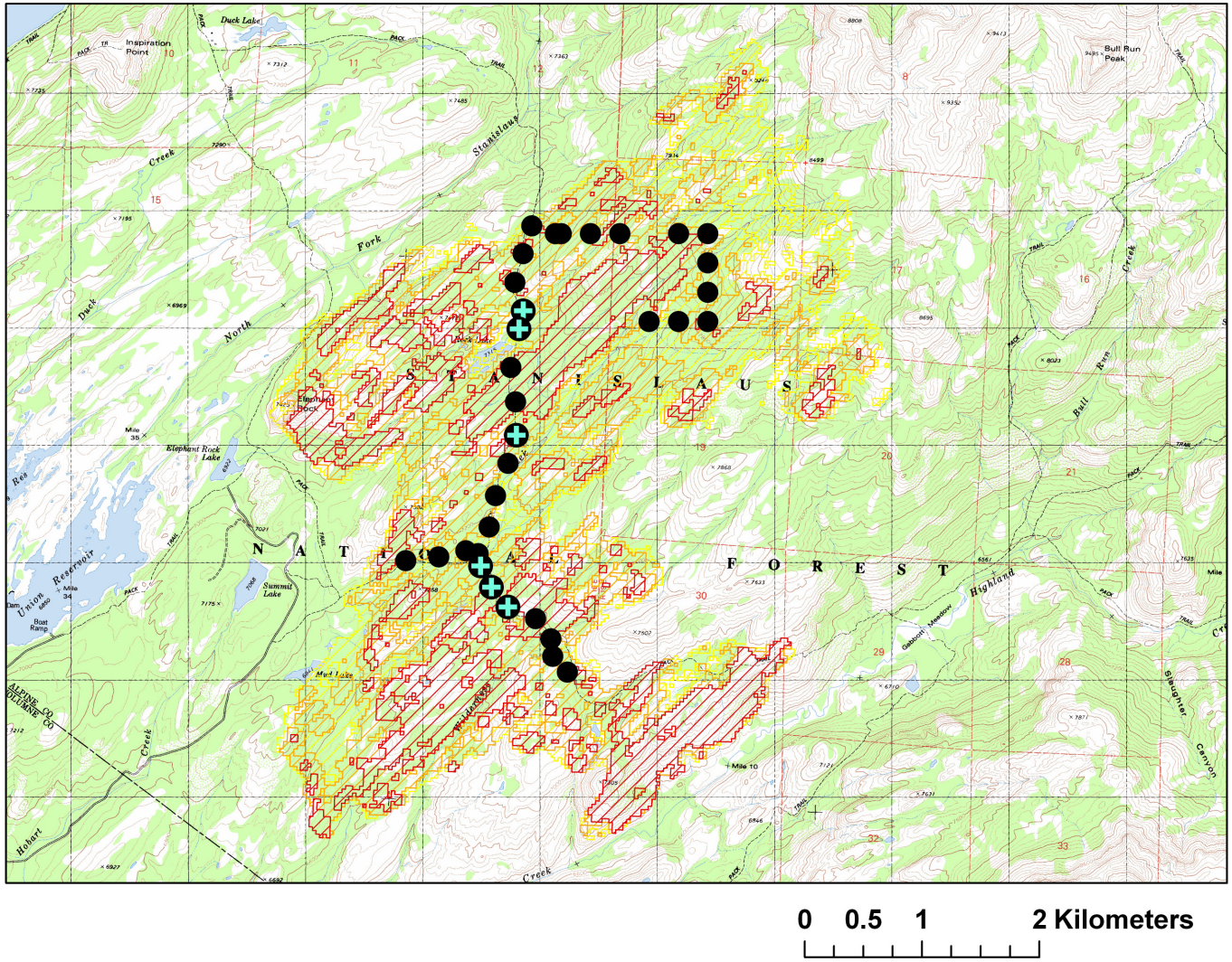

Figure A-10**.** Fire severity and survey station locations at the **Mud Fire** area on Stanislaus NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

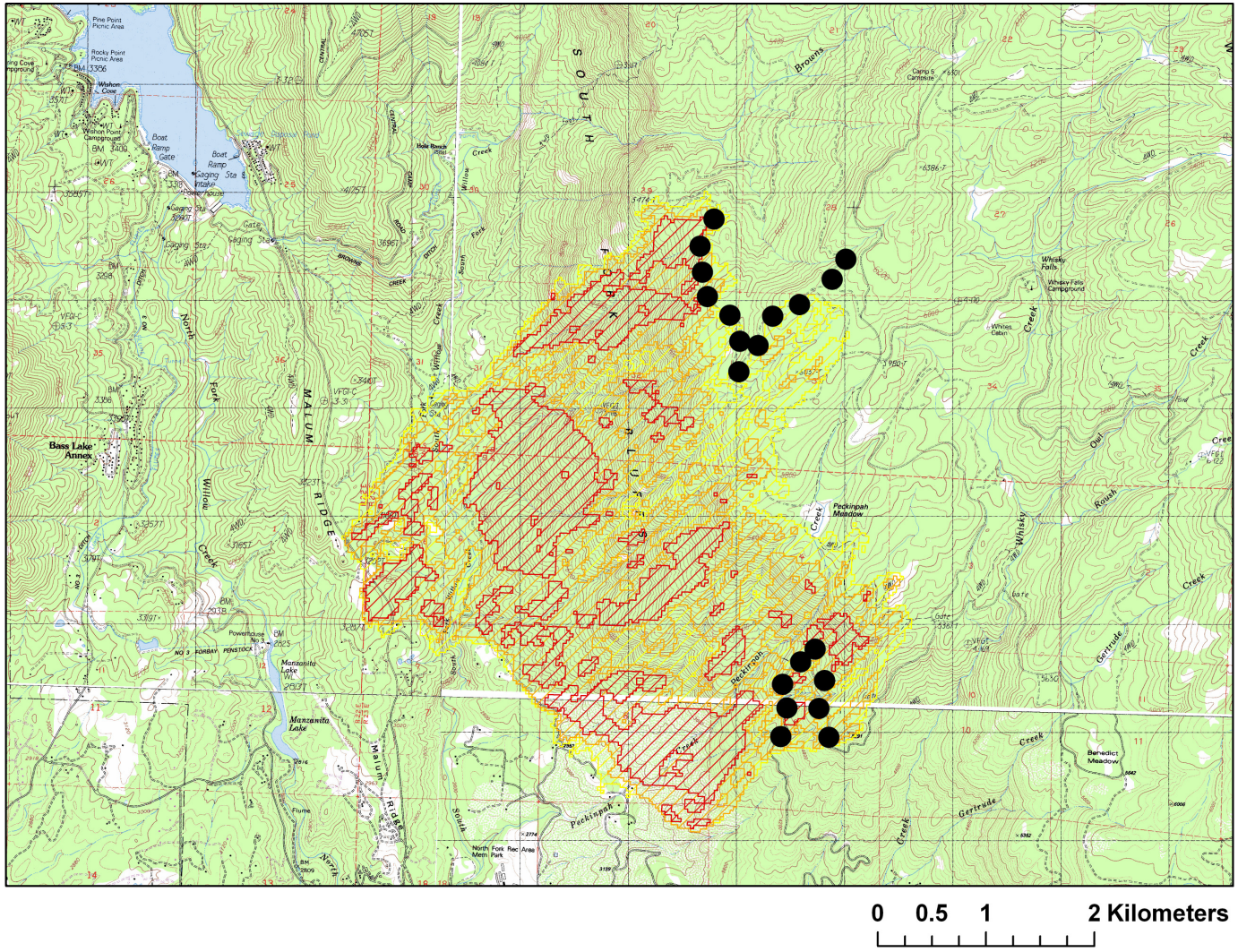

Figure A-11. Fire severity and survey station locations at the **North Fork Fire** area on Sierra NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. Much of the western portion of the fire area is lacking in conifer snags, and therefore is not suitable Black-backed Woodpecker habitat. No Black-backed Woodpeckers were detected at this fire area.

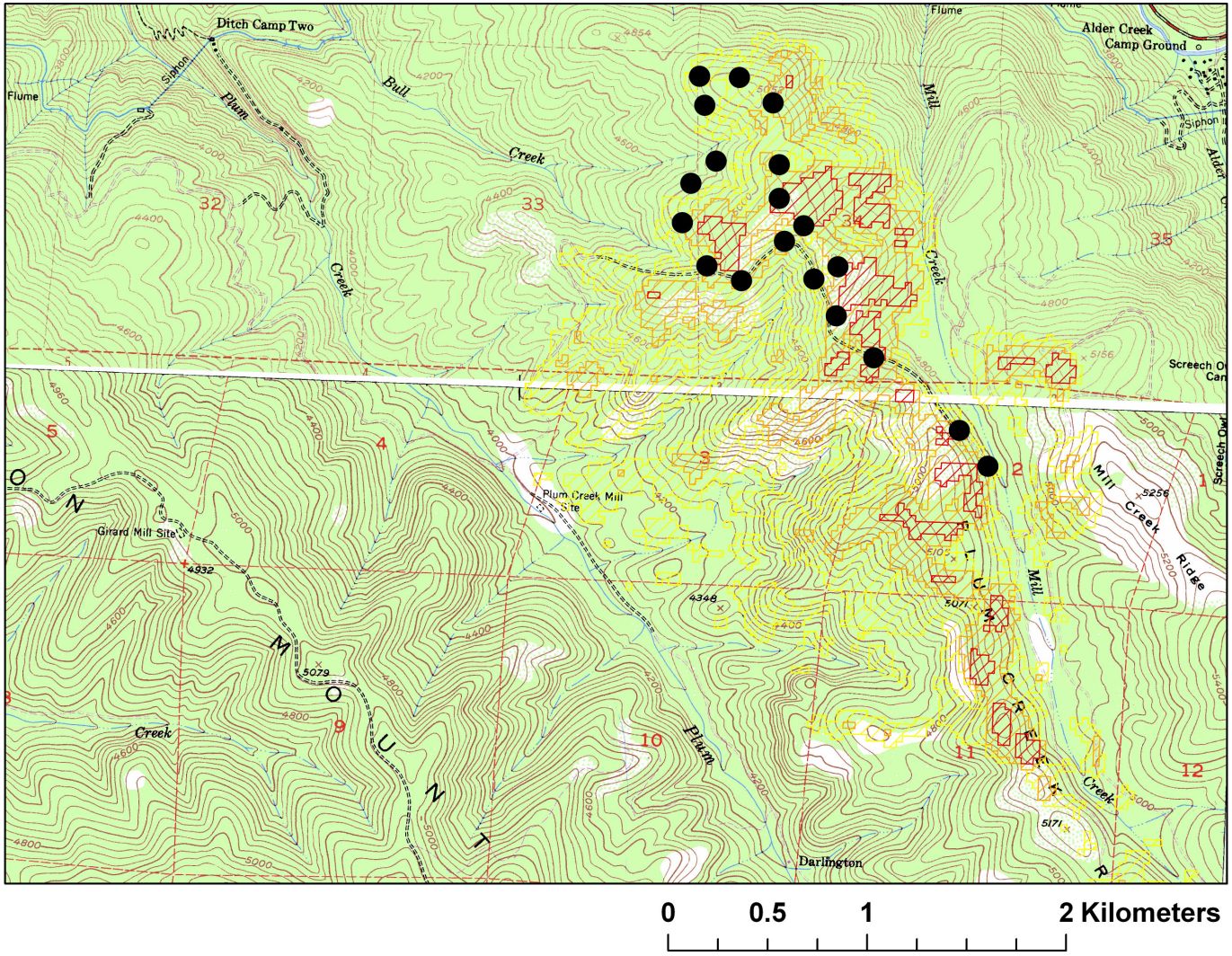

Figure A-12. Fire severity and survey station locations at the **Plum Fire** area on Eldorado NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

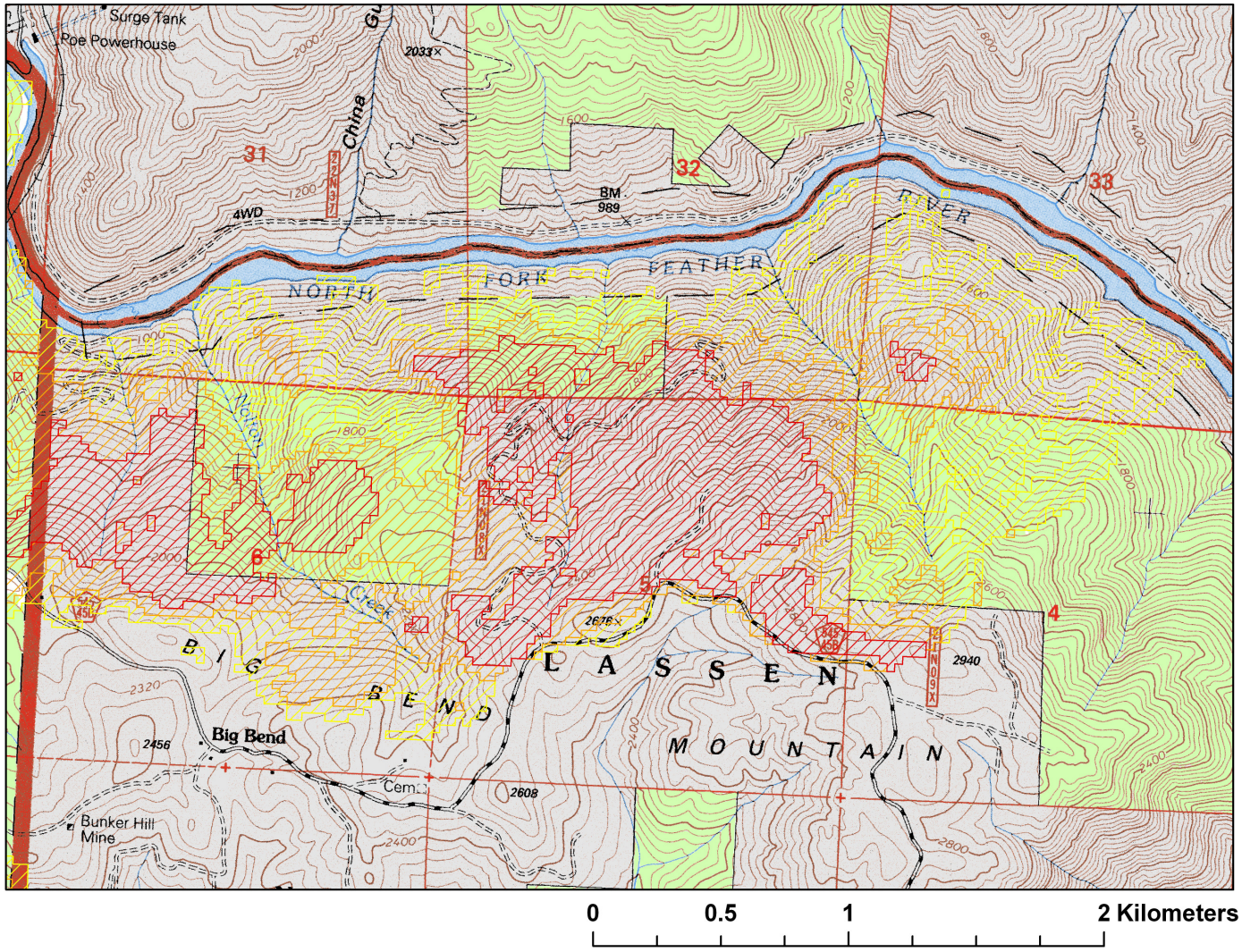

Figure A-13. Fire severity at the **Poe Fire** area on Lassen NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. We did not establish any Black-backed Woodpecker survey stations at this site, as most of the burned forest had been clearcut, and we could not find any suitable Black-backed Woodpecker habitat.

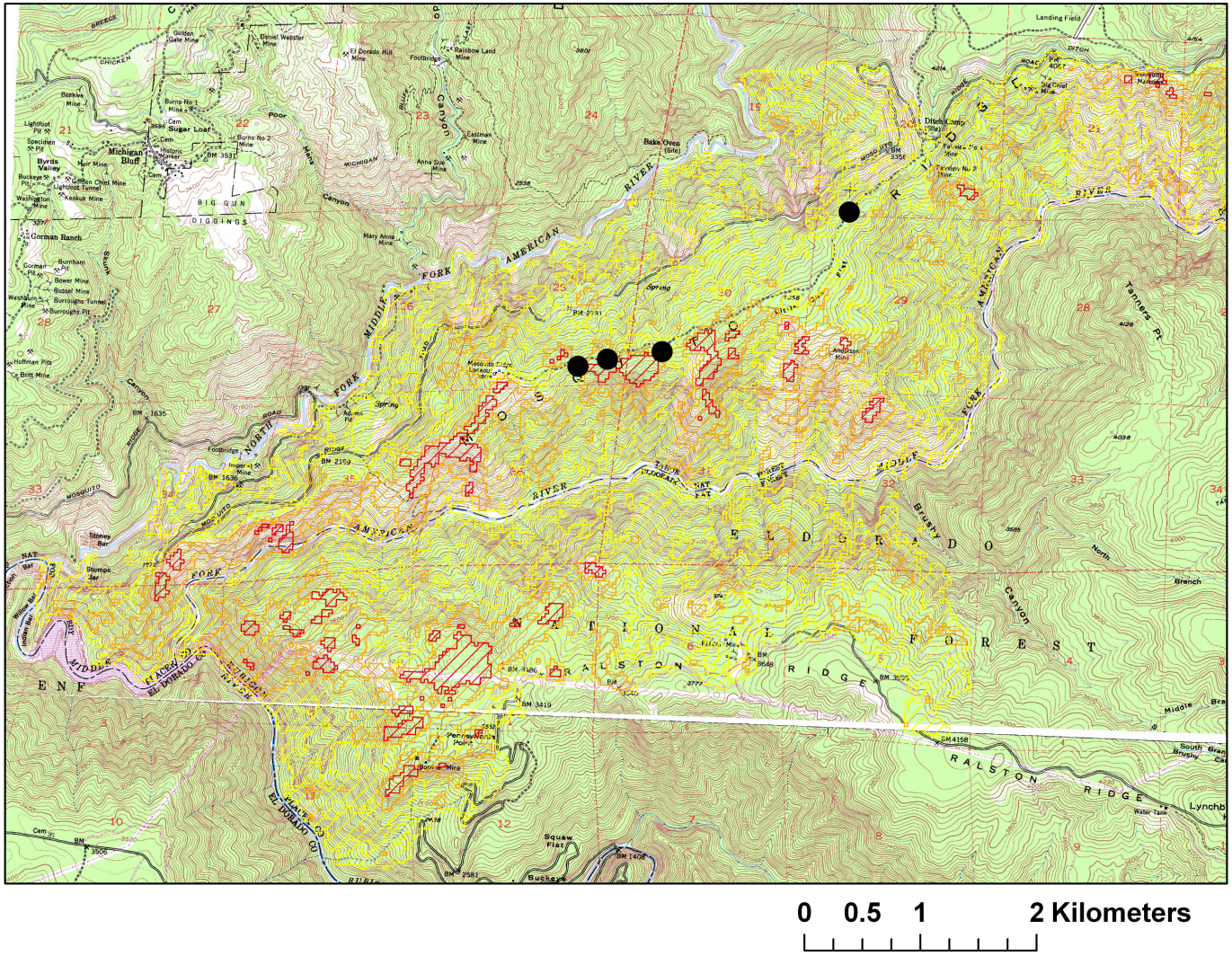

Figure A-14. Fire severity and survey station locations at the **Ralston Fire** area on Eldorado NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

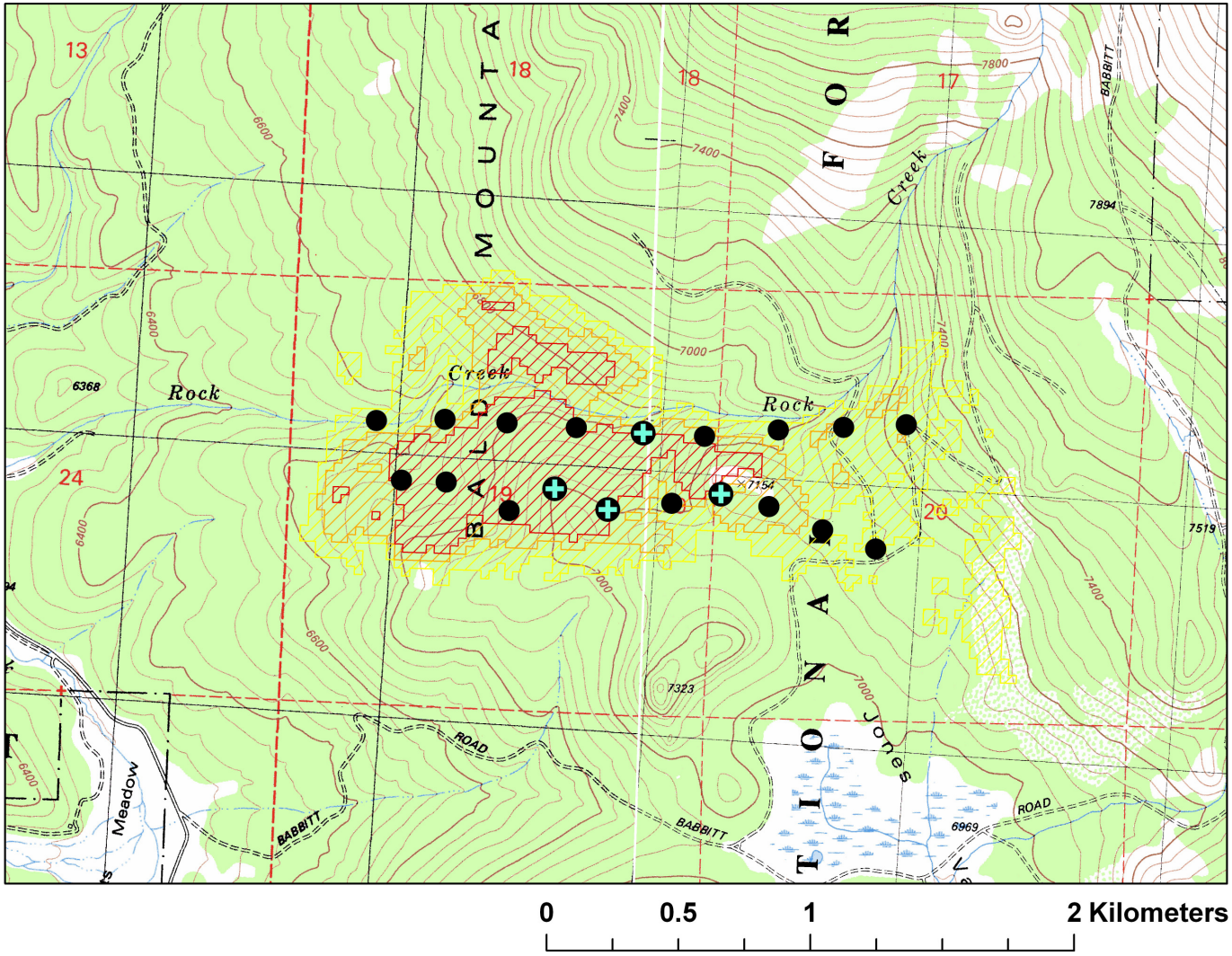

Figure A-15**.** Fire severity and survey station locations at the **Rock Creek Fire** area on Tahoe NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

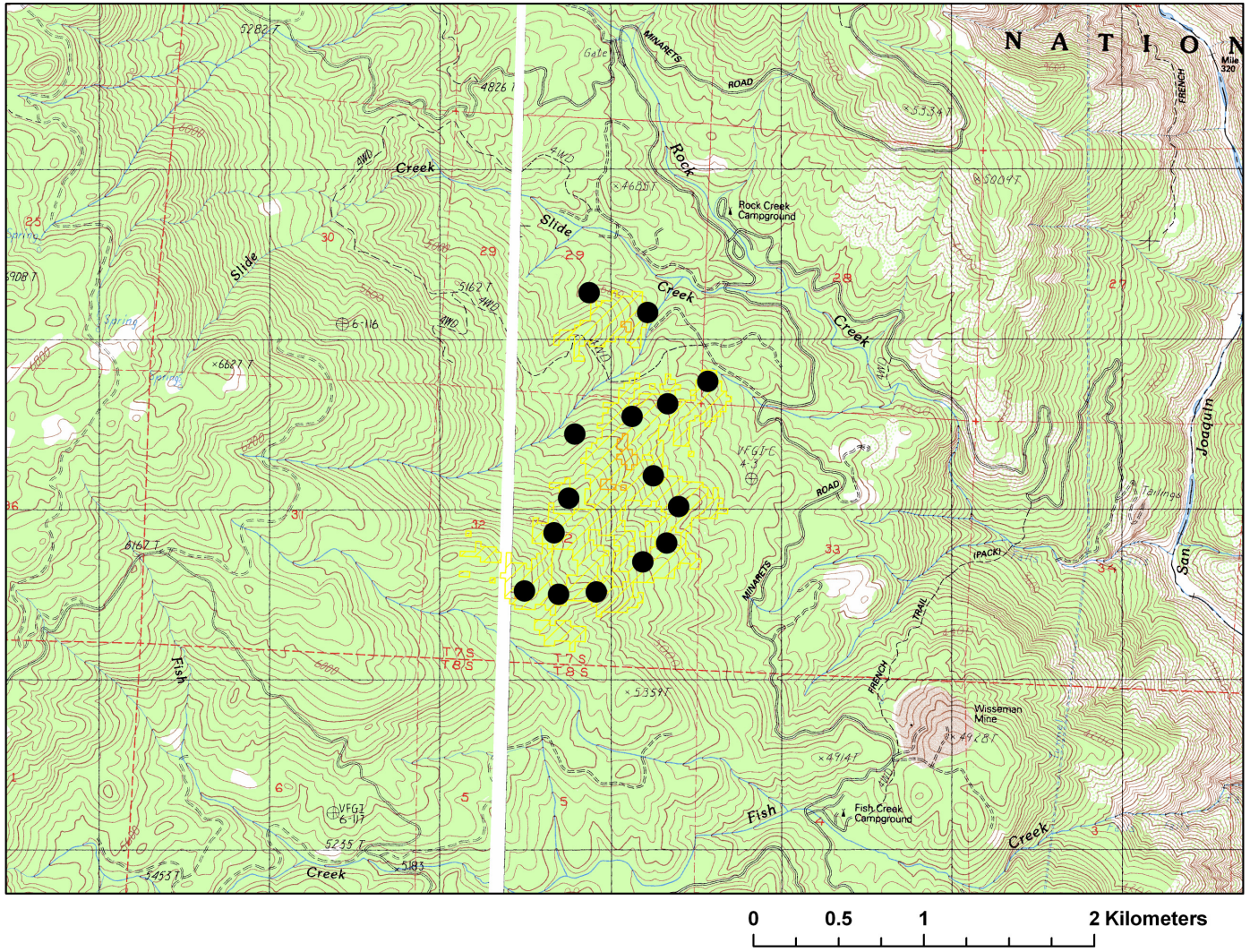

Figure A-16. Fire severity and survey station locations at the **Rock Creek 2 Fire** area on Sierra NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations. No Black-backed Woodpeckers were detected at this fire area.

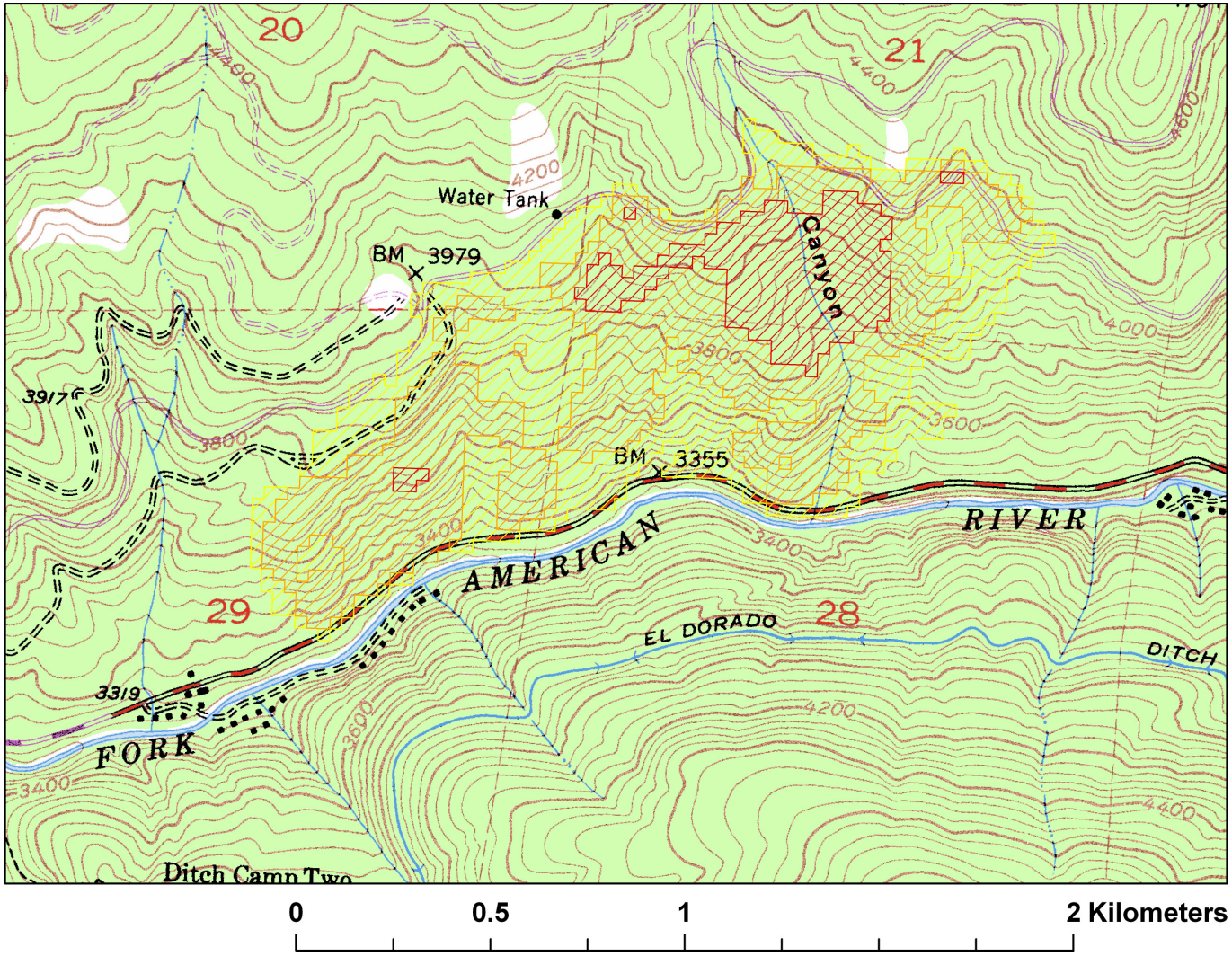

Figure A-17. Fire severity at the **Saint Pauli Fire** area on Eldorado NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. We did not establish any Black-backed Woodpecker survey stations at this site, because there were too few snags or live trees to constitute suitable Black-backed Woodpecker habitat.

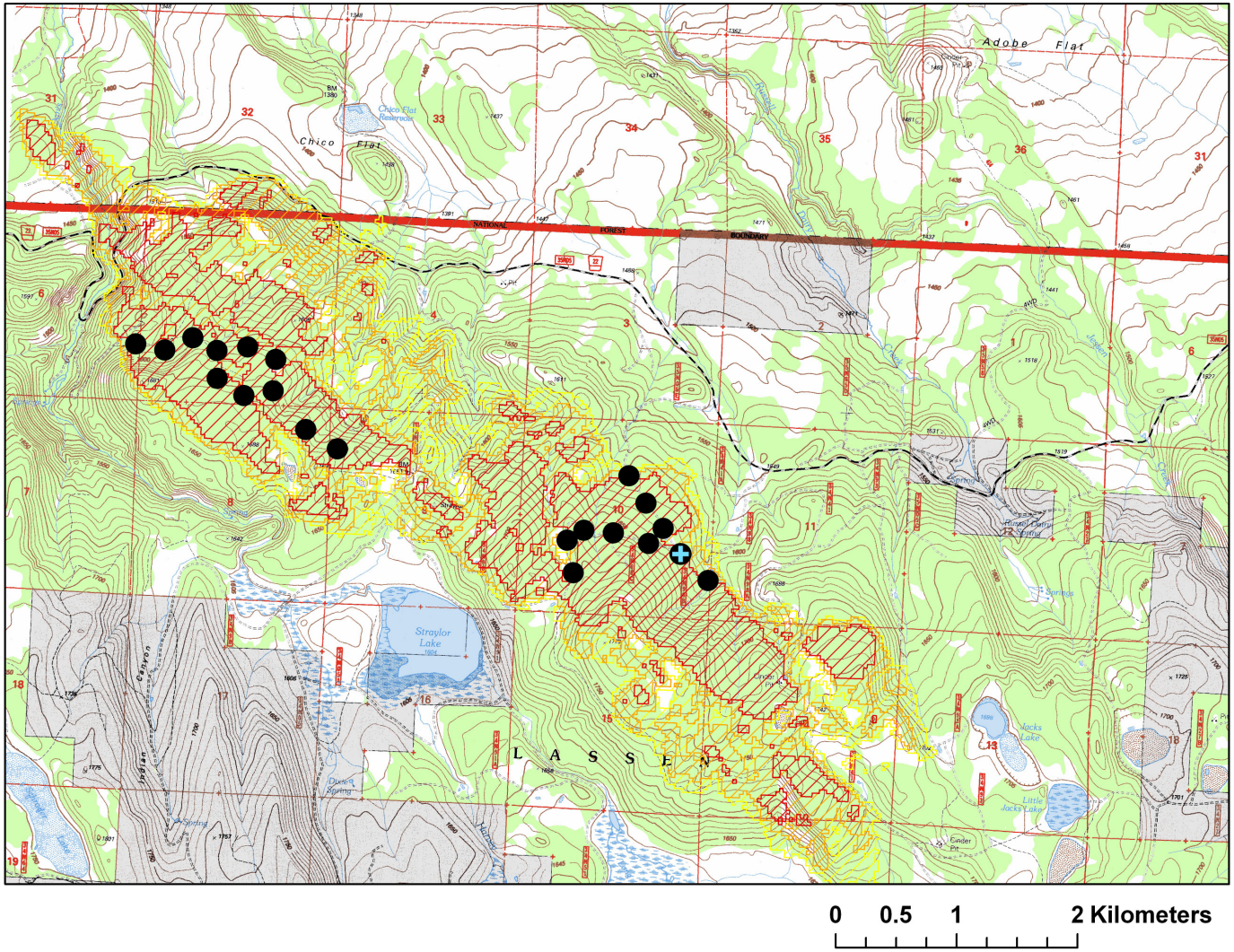

Figure A-18. Fire severity and survey station locations at the **Straylor Fire** area on Lassen NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue cross indicates the only station where Black-backed Woodpecker was detected.

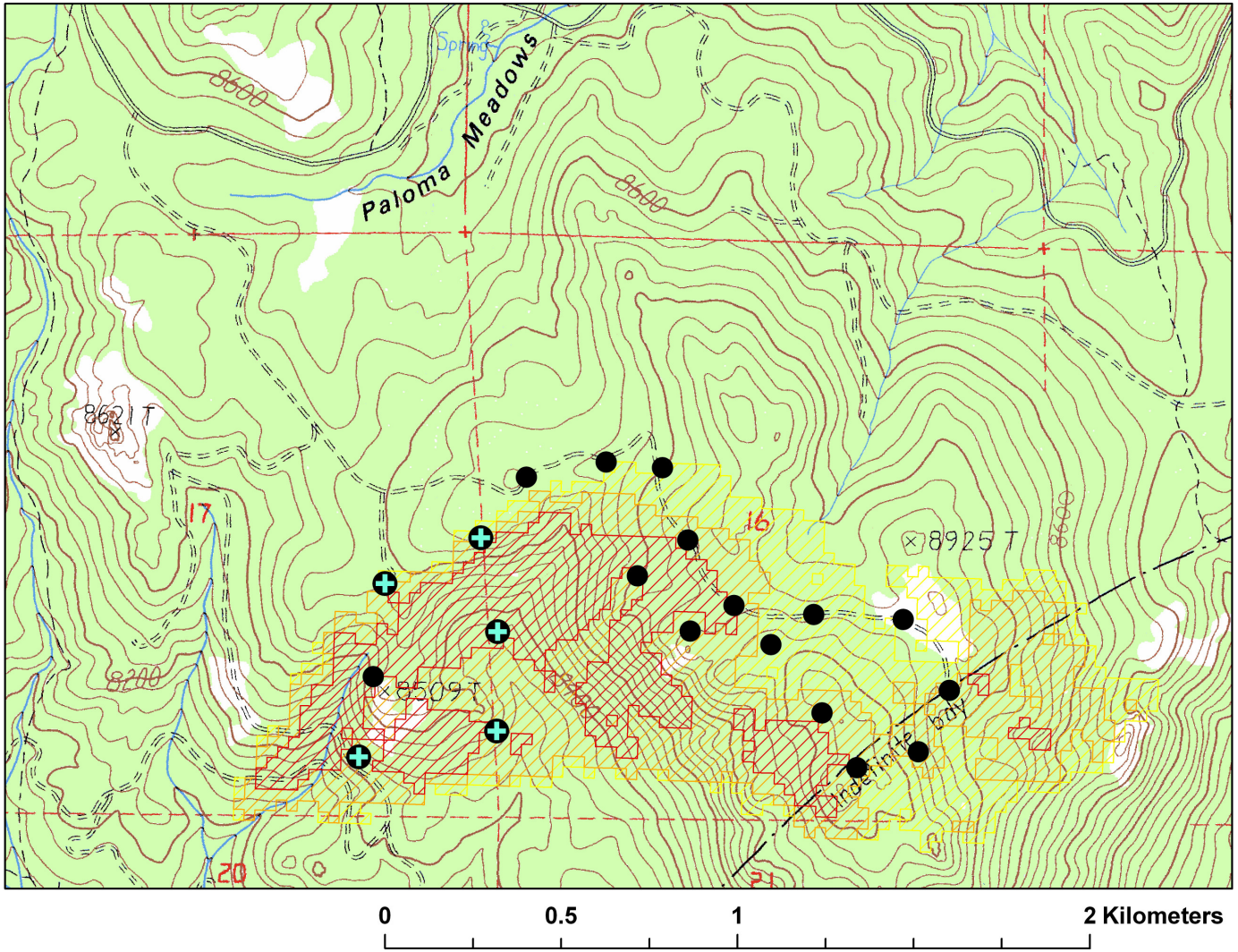

Figure A-19**.** Fire severity and survey station locations at the **Vista Fire** area on Sequoia NF. Red hatching indicates high-severity fire, orange hatching indicates moderate-severity fire, and yellow hatching indicates low-severity fire. Black circles indicate station locations; blue crosses indicate Black-backed Woodpecker detections.

Appendix 3:
Field forms used during the 2008 pilot study

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BBWO 2008—Playback Form

Fire Name:_____ **Date:**_____/_____/_____ **Observer:**_____

Point	Start Time	Initial Dist.	Bearing	Min. Dist.	Time Interval	Visual	Age/Sex (F/M/A/J)	Sound			Prev. Obs.	Comments
								D	R	P		
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					3 2							
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Notes:

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BBWO 2008—Passive Point Count Form

Fire Name:_____ **Date:**_____/_____/_____ **Observer:**_____

									FOR BBWO DETECTIONS ONLY							
Point	**Start Time**	**Species Code**	**Dist.**	**Ever Sang**	**Time Interval**	**Prev. Obs.**	**Fly-over**	**Group Size**	**Bearing**	**Min. Dist.**	**Visual**	**Age/Sex (F/M/A/J)**	**Sound**			**Notes**
													D	**R**	**P**	
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BBWO 2008—Survey Location Form

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Fire Name:_____

Point	Survey Type[1]	Easting	Northing	Burn Sev.[2]	CWHR Class[3]	BBWO Detected?

[1] Survey Types: RS=road, systematic TS=trail, systematic OS=off-trail, systematic
RO=road, opportunistic TO=trail, opportunistic OO=off-trail, opportunistic

[2] U=unburned, L=surface fire with little change in cover and little mortality of dominant vegetation, M=mixed effects on dominant vegetation, H=dominant vegetation has high to complete mortality. [3] Classify a 50-m radius circle. 3-character habitat, dbh=1-6, canopy closure=S (<24%), P (25-39%),M (40-59%) or D (60-100%).

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BBWO 2008—BBWO Detection Details

Fire Name or Location:_____ **Date**____/____/____ **Time:**_____

Observer 1:_____ **Observer 2:**_____ **Easting:**__ __ __ __ __ __ **Northing:**__ __ __ __ __ __ __

Number of individuals detected

F:_____ **M:**_____ **A:**_____ **J:**_____

Nest Found?_____

Nest Easting:__ __ __ __ __ __

Nest Northing:__ __ __ __ __ __ __

Notes/habitat description/nest description:

Nesting Stage:

Unkn. Excav. Brood

Nestlings Fledglings

Stand Classification:

Burn Sev.:_____

CWHR: __ __ __ __ __

Fire Name or Location:_____ **Date**____/____/____ **Time:**_____

Observer 1:_____ **Observer 2:**_____ **Easting:**__ __ __ __ __ __
Northing:__ __ __ __ __ __ __

Number of individuals detected

F:_____ **M:**_____ **A:**_____ **J:**_____

Nest Found?_____

Nest Easting:__ __ __ __ __ __

Nest Northing:__ __ __ __ __ __ __

Notes/habitat description/nest description:

Nesting Stage:

Unkn. Excav. Brood

Nestlings Fledglings

Stand Classification:

Burn Sev.:_____

CWHR: __ __ __ __ __

Fire Name or Location:_____ **Date**____/____/____ **Time:**_____

Observer 1:_____ **Observer 2:**_____ **Easting:**__ __ __ __ __ __ **Northing:**__ __ __ __ __ __ __

Number of individuals detected

F:_____ **M:**_____ **A:**_____ **J:**_____

Nest Found?_____

Nest Easting:__ __ __ __ __ __

Nest Northing:__ __ __ __ __ __ __

Notes/habitat description/nest description:

Nesting Stage:

Unkn. Excav. Brood

Nestlings Fledglings

Stand Classification:

Burn Sev.:_____

CWHR: __ __ __ __ __

BBWO 2008—Fire Visit Narrative—Side 1

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Fire Name:_____Observers:_____

Start Date:_____/___/_____ End Date:_____/___/_____

Brief Description of burned area:

Logistic issues that affect surveying this site:

Description of survey effort (include rationale):

Natural history observations:

BBWO 2008—Fire Visit Narrative Side 2

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1. How would you characterize the abundance of tree seedlings that have established since the fire?

a. widely scattered - saw some occaionally
b. moderate abundance - saw them frequently
c. prolific - I was amazed by their abundance

2. What species of tree seedlings did you see, in order of abundance?

3. How would you characterize the abundance of shrub species on the fire area?

a. It was easy to walk around and the shrubs were shorter than me.
b. I had to pick my way through the shrubs, which were sometimes taller than me.
c. It was quick difficult to push through the shrubs, which were frequently taller than me.

4. What species of shrubs did you encounter, in order of abundance? (list the top 3)

5. How tall were the shrubs (feet), on average, by species.

Appendix 4:
Data dictionary to accompany the 2008 Black-backed Woodpecker pilot study database

1) tbl_Survey_Locations: Table provides information about survey station locations.

Field: Point_Code
Description: Unique, 7-character descriptor for each survey station. First 4 characters indicate fire name, fifth character indicates surveyor (b=Bob Wilkerson, d=Dayna Mauer, and R=Rodney Siegel), and sixth and seventh characters are a 2-digit number, assigned sequentially by each observer at each site (example: NOFOR01 is the first point sampled by Rodney Siegel at the North Fork Fire).

Field: Observer
Description: Full name of observer; all observers were personnel of The Institute for Bird Populations.

Field: Date_surveyed
Description: Date the station was surveyed, expressed as mm/dd/yyyy.

Field: Point_type
Description: Indication of how the survey station location was selected. 'Trail' means the station was deliberately placed along a hiking trail, 'Road' means it was deliberately placed along a road (anything from rough 4WD track to 2-lane paved road), and 'Off-trail' means the station was placed on the landscape without respect to transportation routes, and generally is not directly along a road or trail. The modifier 'Systematic' indicates the station was part of a larger array of regularly-spaced stations; 'Opportunistic' indicates the station was not part of a larger array of regularly-spaced stations, but rather was deliberately placed in a location believed to be a promising place to detect BBWO (this rarely happened).

Field: Easting
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: Northing
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: Burn_severity
Description: On-the-ground assessment of fire effects within 50-m radius circle centered on the survey station. Categories include: U=unburned, L=low-severity (surface fire with little change in cover and little mortality of dominant vegetation), M=mid-severity (mixed effects on dominant vegetation), h=high-severity (dominant vegetation has high to complete mortality).

Field: Easting
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: CWHR_type
Description: On-the-ground assessment of pre-fire habitat classification, based on California Wildlife Habitat Relationships (California Department of Fish and game 2005). The following codes were used:

EPN=Eastside Pine
JPN=Jeffrey Pine
JPR=mix of Jeffrey Pine and Red Fir (Jeffrey Pine dominant)
JUN=Juniper
LGS=Low Sagebrush
LPN=Lodgepole Pine
MCH=Mixed Chaparral
MCP=Montane Chaparral
RFJ=mix of Ref Fir and Jeffrey Pine (Red Fir dominant)
RFR=Red Fir
SCN=Subalpine Conifer
SMC=Sierran Mixed Conifer
WFR=White Fir

Field: Size_class
Description: Size class of largest trees and snags in dominant habitat. The following codes, based on California Wildlife Habitat Relationships (California Department of Fish and game 2005), were used:

1=Seedling Tree, <1"dbh
2=Sapling Tree, 1"-6" dbh
3=Pole Tree, 6'-11" dbh
4=Small Tree, 11"-24" dbh
5=Medium/Large Tree, >24" dbh
6=Multi-layered Tree, size class 5 trees over distinct layer of size class 4 or 3 trees

Field: Cover_class
Description: Remaining *live* canopy closure. The following codes, based on California Wildlife Habitat Relationships (California Department of Fish and game 2005), were used:

N=None
S=Sparse Cover, <24%
P=Open Cover, 25%-39%
M=Moderate Cover, 39%-59%
D=Dense Cover, 60%-100%

Field: BBWO_detected
Description: Checked box indicates BBWO was detected at the survey station.

2) tbl_Playback_Surveys: Table provides results of playback surveys, which were conducted once at each survey station.

Field: Fire_name
Description: Name of the fire area surveyed.

Field: Point_Code
Description: Unique, 7-character descriptor for each survey station. First 4 characters indicate fire name, fifth character indicates surveyor (b=Bob Wilkerson, d=Dayna Mauer, and R=Rodney Siegel), and sixth and seventh characters are a 2-digit number, assigned sequentially by each observer at each site (example: NOFOR01 is the first point sampled by Rodney Siegel at the North Fork Fire).

Field: Start_time
Description: Time the 5-min playback survey began (e.g., 0905=9:05 am).

Field: Initial_distance
Description: Estimated distance (m) between the observer and a Black-backed Woodpecker, when it was first detected. Default value is 0 if no BBWO was detected at the station.

Field: Bearing
Description: Compass bearing (degrees) to the BBWO where it was first detected. Default value is blank if no BBWO was detected at the station.

Field: Minimum_distance
Description: Minimum distance between the observer and the BBWO, at any time during the observation.

Field: Easting
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: Time
Description: Value of '2' indicates the BBWO was first detected during the first 2 min of the 5-min survey. Value of '3' indicates the BBWO was first detected during the last 3 min of the 5-min survey.

Field: Visual
Description: Checked box indicates species identification was confirmed visually.

Field: Age/sex
Description: Provides information about age and sex of BBWO detected:
J=juvenile, sex undetermined)
A=adult, sex undetermined
M=adult male
F=adult female

Field: Drum
Description: If BBWO was detected, checked box indicates it drummed during the observation.

Field: Rattle
Description: If BBWO was detected, checked box indicates it made the *scream-rattle-snarl* vocalization during the observation.

Field: Pik
Description: If BBWO was detected, checked box indicates it made the *pik* vocalization during the observation.

Field: Previous_obs
Description: Checked box indicates the observer believed the same individual woodpecker had already been detected at a previous survey station.

Field: Comments
Description: Space for miscellaneous comments.

3) tbl_Passive_Point_Counts: Table provide results of 5-min passive point counts, which preceded playback surveys at some survey stations.

Field: Fire_name
Description: Name of the fire area surveyed.

Field: Point_Code
Description: Unique, 7-character descriptor for each survey station. First 4 characters indicate fire name, fifth character indicates surveyor (b=Bob Wilkerson, d=Dayna Mauer, and R=Rodney Siegel), and sixth and seventh characters are a 2-digit number, assigned sequentially by each observer at each site (example: NOFOR01 is the first point sampled by Rodney Siegel at the North Fork Fire).

Field: Start_time
Description: Time the 5-min passive point count began (e.g., 0905=9:05 am).

Field: Species_code
Description: 4-letter code indicating species identification.

Field: Species_common_name
Description: Common name of species detected.

Field: Species_latin_name
Description: Latin name of species detected.

Field: Distance
Description: Estimated distance (m) between the observer and the bird, when it was first detected.

Field: Start_time
Description: Time the 5-min playback survey began (e.g., 0905=9:05 am).

Field: Ever_sang
Description: Checked box indicates the bird made its territorial vocalization sometime during the 5-min point count.

Field: Time_interval
Description: Value of '2' indicates the bird was first detected during the first 2 min of the 5-min point count. Value of '3' indicates the bird was first detected during the last 3 min of the 5-min point count.

Field: Previous_obs
Description: Checked box indicates the observer believed the same individual bird had already been detected at a previous survey station.

Field: Flyover
Description: Checked box indicates the observed bird flew high over the survey station but never landed in the observer's field of view, and showed not particular attachment to the habitat at the survey station.

Field: Group_size
Description: Number of birds of the same species flocking together; default is 1.

Field: BBWO_bearing
Description: If BBWO was detected during point count, compass bearing (degrees) to the BBWO where it was first detected. Default value is blank if no BBWO was detected at the station.

Field: BBWO_min_distance
Description: If BBWO was detected during point count, minimum distance between the observer and the BBWO, at any time during the observation.

Field: BBWO_visual
Description: If BBWO was detected during point count, checked box indicates species identification was confirmed visually.

Field: BBWO_age/sex
Description: If BBWO was detected during point count, field provides information about age and sex of BBWO detected:

J=juvenile, sex undetermined)
A=adult, sex undetermined
M=adult male
F=adult female

Field: BBWO_drum
Description: If BBWO was detected during point count, checked box indicates it drummed during the observation.

Field: BBWO_rattle
Description: If BBWO was detected during point count, checked box indicates it made the *scream-rattle-snarl* vocalization during the observation.

Field: BBWO_pik
Description: If BBWO was detected during point count, checked box indicates it made the *pik* vocalization during the observation.

Field: Notes
Description: Space for miscellaneous comments.

4) tbl_Detection_Details: Table provides more detailed information about each BBWO detection recorded at survey stations, and also provides information about BBWO detections collected between survey stations.

Field: Fire_name
Description: Name of the fire area surveyed.

Field: Point_Code
Description: Unique, 7-character descriptor for each survey station. First 4 characters indicate fire name, fifth character indicates surveyor (b=Bob Wilkerson, d=Dayna Mauer, and R=Rodney Siegel), and sixth and seventh characters are a 2-digit number, assigned sequentially by each observer at each site (example: NOFOR01 is the first point sampled by Rodney Siegel at the North Fork Fire). Blank entry indicates the observations were collected opportunistically between survey stations, or at some other location that was not a survey station.

Field: Easting
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: Northing
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area).

Field: Observer
Description: Full name of observer; all observers were personnel of The Institute for Bird Populations.

Field: Females
Description: The number of adult female BBWOs observed at the indicated location.

Field: Females
Description: The number of adult male BBWOs observed at the indicated location.

Field: Adults
Description: The number of adult BBWOs *of undetermined sex* observed at the indicated location.

Field: Juveniles
Description: The number of juvenile BBWOs observed at the indicated location.

Field: Nest_found
Description: Checked box indicates an active BBWO nest was found.

Field: Nest_easting
Description: UTM easting, in NAD83 (Zone 10 or 11, depending on location of fire area) of the nest.

Field: Nest_northing
Description: UTM northing, in NAD83 (Zone 10 or 11, depending on location of fire area) of the nest.

Field: Nest_phenology
Description: Description of stage in nest phenology (eggs, nestlings, etc.) if known.

Field: Burn_severity
Description: On-the-ground assessment of fire effects within 50-m radius of the detection location. Categories include: U=unburned, L=low-severity (surface fire with little change in cover and little mortality of dominant vegetation), M=mid-severity (mixed effects on dominant vegetation), h=high-severity (dominant vegetation has high to complete mortality).

Field: CWHR_type
Description: On-the-ground assessment of pre-fire habitat classification, based on California Wildlife Habitat Relationships (California Department of Fish and game 2005). The following codes were used:

EPN=Eastside Pine
JPN=Jeffrey Pine
JPR=mix of Jeffrey Pine and Red Fir (Jeffrey Pine dominant)
JUN=Juniper
LGS=Low Sagebrush
LPN=Lodgepole Pine
MCH=Mixed Chaparral
MCP=Montane Chaparral
RFJ=mix of Ref Fir and Jeffrey Pine (Red Fir dominant)
RFR=Red Fir
SCN=Subalpine Conifer
SMC=Sierran Mixed Conifer
WFR=White Fir

Field: Notes
Description: Space for miscellaneous comments.

5) tbl_Visit_Narrative: Provides summary information about each fire area, including habitat information not tied to any since survey station, and information about survey effort at the fire area.

Field: Fire_name
Description: Name of the fire area surveyed.

Field: Observer1
Description: Full name of an observer who conduct some of the surveys at the fire area; all observers were personnel of The Institute for Bird Populations.

Field: Observer2
Description: Full name of an observer who conduct some of the surveys at the fire area; all observers were personnel of The Institute for Bird Populations.

Field: Observer3
Description: Full name of an observer who conduct some of the surveys at the fire area; all observers were personnel of The Institute for Bird Populations.

Field: Start_date
Description: Date the first station was surveyed at the fire area, expressed as mm/dd/yyyy.

Field: End_date
Description: Date the last station was surveyed at the fire area, expressed as mm/dd/yyyy.

Field: Burned_area_description
Description: Memo field describing general conditions across the fire area.

Field: Logistic_issues
Description: Memo field describing any substantial logistic challenges encountered in surveying the fire area.

Field: Effort_description
Description: Memo field describing survey effort at the fire area.

Field: Natural_history_notes
Description: Memo field describing any noteworthy natural history observations; BBWO presence was generally noted as well.

Field: Seedling_abundance
Description: Qualitative description of seedling abundance in fire area.

Field: Shrub_abundance
Description: Qualitative description of seedling abundance in fire area.

Field: Shrub_species_and_height
Description: Identity and average height (rough visual estimation) of most common shrub species present in fire area.