A Conservation Strategy for the Black-backed Woodpecker (*Picoides arcticus*) in California – Version 2.0

Male Black-backed Woodpecker foraging, Lassen National Forest. Photo by Joseph Leibrecht

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Executive Summary

The Black-backed Woodpecker (*Picoides arcticus*) inhabits boreal and montane forests of northern North America, where it is widely considered the North American bird species most strongly associated with burned forest. In California, Black-backed Woodpeckers occur at middle to higher elevations in inland mountains from the Oregon border to the southern tip of the Sierra Nevada, the southernmost extent of the species' range. The woodpeckers occur at relatively low densities in most unburned forest types, but reach their greatest density in recently (typically 1-8 year-old) burned forests with abundant fire-killed trees. Black-backed Woodpeckers feed primarily on wood-boring beetle larvae, which become abundant after adult beetles lay their eggs on dying or recently dead trees. As the abundance of beetle larvae declines with time since fire, so too does the abundance of Black-backed Woodpeckers in the post-fire forest.

Figure 1. Male Black-backed Woodpecker. Photo by Monica Bond

In California, the Black-backed Woodpecker's relative rarity and strong association with recently burned forest, a habitat that is ephemeral, patchy, and often greatly modified by post-fire logging, makes the woodpecker of conservation interest. Additionally, Black-backed Woodpeckers in California are affected by the management of unburned forests – both because pre-fire stand conditions affect the suitability of post-fire habitat for the species, and because a substantial proportion of California's Black-backed Woodpeckers nest and forage at a low population density in unburned forests. Conserving the Black-backed Woodpecker across its historical range in California will likely be most successful if management of both burned forest, where the species reaches its highest density, as well as 'green' forest that has not burned recently, includes retention of key habitat components utilized by the species. For both burned and unburned forests, existing science and decision support tools, particularly from studies conducted in California forests during the past decade, can point the way toward habitat management that will allow Black-backed Woodpeckers to persist and thrive.

Interest in the conservation status of the Black-backed Woodpecker in California, the species' sensitivity to some post-fire forest management actions, and the lack of synthesized information from California for this species, spurred the development of Version 1.0 of this Conservation Strategy, which was released in 2012. The purpose of the Conservation Strategy was to provide a roadmap for conserving Black-backed Woodpeckers in California through informed management. It was our hope that state and federal agencies, as well as managers of private lands, would use the information and recommendations in the Strategy to formulate policies and actions to conserve Black-backed Woodpeckers. Our goal was to facilitate Black-backed

Woodpecker conservation by: (1) summarizing what is known about the taxonomy, distribution, population status, life history and ecology, and habitat requirements of the species in California and identifying potential threats; (2) recommending management approaches and specific actions to conserve the species in California; and (3) suggesting priorities for future research to help refine the recommended management actions. Subsequent to the release of Version 1.0 in 2012, much additional science on Black-backed Woodpeckers and their ecosystems within and outside of California has become available – including more than 20 peer-reviewed journal articles addressing diverse aspects of Black-backed Woodpecker ecology or conservation, as well as multiple models and decision support tools based on new or existing science. Here we build on Version 1.0 by updating the information synthesis in the original document with the latest science, and then updating the relevant conservation recommendations based on that science as well as feedback on the original recommendations from land managers and conservation advocates. We also strived to consolidate and shorten the document to make it more user friendly. As in the past version, we identify overarching goals and recommend specific actions for achieving those goals in three broad areas: Habitat Management (4 goals, 15 recommended actions), Education and Outreach (1 goal, 2 recommended actions), and Research and Monitoring (8 questions, 16 recommended actions).

About Version 2.0

In 2012 we released Version 1.0 of this Conservation Strategy, with the intention to provide a roadmap for conserving Black-backed Woodpeckers in California through informed management. It was our hope that state and federal agencies, as well as managers of private lands, would use the information in the Conservation Strategy to formulate policies and actions to better manage for Black-backed Woodpeckers. Subsequent to the release of Version 1.0 in 2012, much additional science on Black-backed Woodpeckers and their ecosystems within and outside of California has become available – including more than 20 peer-reviewed journal articles addressing diverse aspects of Black-backed Woodpecker ecology or conservation (many from California), as well as multiple models and decision support tools.

Here we build on Version 1.0 by updating the information synthesized in the original strategy with the latest science, updating conservation considerations based on that science, and incorporating feedback on the original version from land managers and conservation practitioners. We reviewed and summarized published and unpublished scientific literature, but generally emphasized published works where possible. We gave precedence to studies from California, but we also report results from studies conducted elsewhere throughout the woodpecker's range, especially for aspects of the woodpecker's biology where information from California was lacking. We also endeavored to consolidate and shorten the document to make it more user friendly.

The overall objectives of Version 2.0 of this Conservation Strategy are to: (1) summarize what is known about the taxonomy, distribution, population status, life history and ecology, and habitat requirements of the species in California and identify potential threats; (2) suggest management recommendations to conserve the species in California; and (3) suggest priorities for future research to further refine the management considerations. Additional new information on the ecology and conservation of the Black-backed Woodpecker in California is likely to be developed in the coming years, and we hope to incorporate it into future versions of this document. Readers aware of new or additional information relevant to this Conservation Strategy are invited to contact the editors.

Introduction

Woodpeckers play a critical ecological role in forests throughout the world (Virkkala 2006). They are disproportionately important to their ecosystems in part because they are primary cavity excavators – essentially the only strong excavators capable of penetrating into hard wood – and nesting holes created by woodpeckers are later used by secondary cavity-nesters including owls, songbirds, ducks, mammals such as squirrels, martens, and fishers, and even some reptiles and amphibians (Martin et al. 2004). Woodpeckers also can regulate populations of bark and wood-boring beetles (Fayt et al. 2005), and are known to carry fungus that can aid in the decay of dead trees, termed "snags" (Farris et al. 2004). Because most woodpecker species are sensitive to changes in habitat, they can be useful indicators of biological diversity (Virkkala 2006).

Figure 2. Male Black-backed Woodpecker excavating a nest cavity in a fire-killed incense-cedar. Photo by Joseph Leibrecht

The Black-backed Woodpecker (*Picoides arcticus*) inhabits boreal and montane forests of northern North America, where it is associated with burned forests. In California, the species is found at middle to higher elevations in inland mountains from the Oregon border to the southern Sierra Nevada (Saracco et al. 2011), the southernmost extent of the species' range (Tremblay et al. 2016). The woodpecker occurs infrequently in most unburned conifer forest types, but occurs in the greatest density in forests recently burned (1–8 years post-fire) at medium and high severity. The species is highly specialized to take advantage of post-fire conditions for nesting and foraging, and feeds primarily on wood-boring beetle larvae which become abundant after adult beetles lay their eggs on dying or recently dead trees (Hutto 2008). As the abundance of

beetle larvae declines with time since fire, so too does the abundance of Black-backed Woodpeckers in the post-fire stand (Saab et al. 2007, Nappi and Drapeau 2009, Nappi et al. 2010, Saracco et al. 2011). Interest in the conservation status of the Black-backed Woodpecker in California, and the species' sensitivity to some post-fire forest management actions (Saab and Dudley 1998, Hutto and Gallo 2006, Saab et al. 2007, Koivula and Schmiegelow 2007, Hutto 2008, Hanson and North 2008, Cahall and Hayes 2009, Saab et al. 2009), as well as the relative paucity of data from California prior to 2012, spurred the development of this Conservation Strategy.

Figure 3. Male Black-backed Woodpecker. Photo by Dayna Mauer

Black-backed Woodpecker population density is generally much higher in recently burned forest stands than in unburned forest (Hutto 1995, Hoyt and Hannon 2002, Smucker et al. 2005, Hutto 2008, Fogg et al. 2014), although the species is found in unburned forest stands throughout its range (Tremblay et al. 2016). In Canadian boreal forests it has even been demonstrated that unburned habitats contribute more to the species' demography than unburned habitats, because of the much greater extent of unburned forest on the landscape (Tremblay et al. 2015a), but a similar analysis is not available for California habitats. Within the burn-severity spectrum, the

woodpecker occurs more frequently and at higher densities in forests where medium- or high-severity fire yielded high densities of dead trees (Saab and Dudley 1998, Saab et al. 2002, Nappi et al. 2003, Hutto and Gallo 2006, Russell et al. 2007, Koivula and Schmiegelow 2007, Vierling et al. 2008, Hanson and North 2008, Nappi and Drapeau 2009, Nappi et al. 2010, Saab et al. 2009, Forristal 2009, Seavy et al. 2012, Tingley et al. 2014, White at al. 2016).

Species status – The woodpecker's strong association with burned forests, and the potential effects of post-fire snag removal within those forests on the species, have garnered increased attention from the conservation community during the past decade. Although the species' overall conservation status is ranked as G5 (indicating "Secure – common, widespread, and abundant") by NatureServe (NatureServe 2017), within California its statewide conservation status is ranked as S2 (indicating "Imperiled – Imperiled in the state because of rarity due to very restricted range, very few populations, steep declines, or other factors making it very vulnerable to extirpation from the state") by California Department of Fish and Wildlife (CDFW Natural Diversity Database 2017). The Black-backed Woodpecker was chosen as a Focal Species in the 2002 California Partners in Flight Draft Coniferous Forest Bird Conservation Plan (California Partners in Flight 2002), but little information on habitat requirements was provided for the account. In 2007 the U.S. Forest Service designated the Black-backed Woodpecker as a Management Indicator Species for snags in burned forests for 10 National Forests of the Sierra Nevada (Eldorado, Inyo, Lassen, Modoc, Plumas, Sequoia, Sierra, Stanislaus, and Tahoe National Forests, and the Lake Tahoe Basin Management Unit). Management Indicator Species are selected because their population changes may indicate the effects of land-management activities (USDA Forest Service 2007). Otherwise, the Black-backed Woodpecker has no special status in California. The species was evaluated for inclusion in the state's revised list of Bird Species of Special Concern (Shuford and Gardali 2008) but was rejected based on ranking criteria and the limited information on the species in California that was available at the time. In December 2011, the California Fish and Game Commission accepted for consideration a petition submitted by the John Muir Project and the Center for Biological Diversity (Hanson and Cummings 2010) to list the Black-backed Woodpecker as threatened or endangered under the California Endangered Species Act, but the petition was ultimately denied. In May 2012, a consortium of environmental groups including the John Muir Project, the Center for Biological Diversity, the Blue Mountains Biodiversity Project, and the Biodiversity Conservation Alliance filed a petition (Hanson et al. 2012) to list the Oregon/California and Black Hills (South Dakota and Wyoming) populations of the Black-backed Woodpecker as threatened or endangered under the federal Endangered Species Act. The U.S. Fish and Wildlife Service issued a '90-day' finding indicating that the petitioned action might be warranted, but subsequently issued a '12-month' finding rejecting the petition on October 5, 2017 (82 FR 46618), on the grounds that the two populations were neither subspecies nor 'distinct population segments'.

The Black-backed Woodpecker is thus not presently considered threatened or endangered at either the state (California) or federal level. However, its relative rarity and strong association

with a habitat (recently burned conifer forest) that is ephemeral, patchy, and the focus of substantial management, have spurred the development of this conservation strategy, to help ensure that future habitat management does not imperil the species in California.

Recommended Conservation Actions

Actions to conserve the Black-backed Woodpecker in California may be classified into three categories:

- habitat management
- research and monitoring
- education and outreach

Below we provide general goals and specific recommendations within each category of action. **The goals and considerations are based on information presented in the subsequent sections of the Conservation Strategy.** These goals and recommendations, like this entire Conservation Strategy, should be modified over time as new information becomes available.

Habitat Management

Effective conservation of Black-backed Woodpeckers in California requires maintenance of sufficient suitable habitat across the species' range in the state. Prior to the last decade, little research on Black-backed Woodpeckers had been conducted within California, but recent and ongoing efforts are rapidly addressing many information gaps (although we recognize that almost all information on Black-backed Woodpecker ecology in the state comes from work in forests that have been strongly influenced by historical forest management practices, including fire suppression and logging). Existing science can now inform and support management of recent fire areas and other habitat in California to benefit Black-backed Woodpeckers, even as ongoing research further refines our understanding of habitat needs and spurs the development of new conservation approaches.

Goal 1 – Manage recently burned forest to preserve and promote habitat for Black-backed Woodpeckers.

Recommendation 1.1. When new fires burn within the range of Black-backed Woodpeckers, land managers weighing post-fire logging should consider using remote-sensed data and other available information to assess whether (and how much of) the burned area is suitable habitat for Black-backed Woodpeckers (see ***Habitat Needs*** section of this document for an explicit definition of suitable habitat). Black-backed Woodpecker habitat in recently burned areas will be maximized where post-fire logging does not occur; however, specific strategies for sustaining Black-backed Woodpeckers, even in the context of some post-fire logging, are provided in Recommendations 1.2 through 1.9. In some cases substantial scientific uncertainty remains, but we nevertheless provide recommendations based on the best available science.

Recommendation 1.2. Where post-fire logging will occur, consider snag retention to yield post-logging landscapes that may still support Black-backed Woodpecker foraging and reproduction.

Recommendation 1.3. When post-fire logging is planned, use available decision support tools to develop and evaluate the likely effects of spatially explicit harvest scenarios on local Black-backed Woodpecker populations. One tool that many land managers have found useful, the Black-backed Woodpecker Abundance model (sometimes referred to informally as the 'Tingley model'), is described in Tingley et al. (2016) and Tingley et al. (2015), with additional resources available at http://birdpop.org/pages/bbwoPredPostFireDist.php.

Recommendation 1.4. When patches of burned forest are retained for Black-backed Woodpecker habitat, retain patches that are large enough, and have high enough snag density, to support Black-backed Woodpeckers occupancy and reproduction. In a study in the northern Sierra Nevada (Tingley et al. 2014), Black-backed Woodpecker home ranges during the breeding season in burned forest varied from 24–184 ha (mean = 52 ha; all calculations based on the 95% kernel method), with snag basal area averaging 26 m^2/ha (min = 17 m^2/ha) across the home range. Accordingly, snag retention that meets at least this minimum threshold of snag basal area $\geq$ 17 m^2/ha, and preferably the average observed value of snag basal area = 26 m^2/ha across an area large enough to accommodate multiple adjacent home ranges (generally $\geq$ 200 ha is a good target) will likely be most valuable for the species, because multiple adjacent home ranges may be more likely to facilitate longer persistence of a breeding population, although this is an issue requiring further study. Where retained snag basal area is substantially higher, smaller retention areas may support multiple home ranges. Black-backed Woodpeckers have been observed routinely to fly 300 meters over logged areas or other non-use habitats to access nearby habitat patches (R. Siegel, personal observation; see also home-range maps in Tingley et al. 2014); patches too small to support even one Black-backed Woodpecker home range will likely be of limited value unless they are proximal (i.e., within 300 m) to other patches of retained habitat.

Recommendation 1.5. Land managers assessing habitat suitability of burned forests within the Black-backed Woodpecker's range in California should consider conifer-dominated stands with the following pre-fire classifications (based on California Wildlife Habitat Relationships; Mayer and Laudenslayer 1988) to be at least potentially suitable Black-backed Woodpecker habitat after fire: 3M, 3D, 4M, 4D, 5M, and 5D. Post-fire habitat retained for Black-backed Woodpeckers will be most beneficial if it incorporates the highest densities of the largest snags available (typically in stands classified as 4M, 4D, 5M, or 5D) to provide high quality foraging opportunities (Dudley et al. 2012, Siegel et al. 2012b), adjacent to small, high-density patches of medium- and small-diameter snags (typically in stands classified as 4M or 4D, or occasionally 3M or 3D) for nesting (Seavy et al. 2012, Manley and Tarbill 2012, Tarbill et al. 2015). While medium- and small-diameter snags are used most frequently for nesting, larger snags preferred for foraging are likely to be the limiting factor in many contemporary forest stands.

Recommendation 1.6. In areas where some selective post-fire snag removal occurs but habitat retention is nonetheless an objective, tree marking efforts should emphasize the retention of snags with burned-out hollows, forked trunks, or other relatively unusual structures that may create crevices or other shelter suitable for night-time roosting (Siegel et al. 2014b).

Recommendation 1.7. To avoid cutting down active nest trees in areas where some post-fire snag removal occurs but habitat retention is also an objective, avoid harvest between May 1 and July 4 (though some outlier nests may already be active in late April and others may still be active throughout all of July) for 8 years after fire, after which most stands are unlikely to contain nesting Black-backed Woodpeckers. Alternately, conduct broadcast surveys (Saracco et al. 2011) to identify unoccupied stands where logging during the nesting season poses no risk to nesting Black-backed Woodpeckers.

Recommendation 1.8. In areas managed for Black-backed Woodpecker habitat, discourage the cutting of standing snags for fuelwood in recent fire areas (≤8 years after fire) during the nesting season (generally May 1 through July 4). Harvesting a portion of the available downed trees (on the ground) is an alternative that will not jeopardize Black-backed Woodpecker nests. Alternately, conduct broadcast surveys (Saracco et al. 2011) to identify unoccupied stands where fuelwood cutting during the nesting season may pose little risk to nesting Black-backed Woodpeckers.

Recommendation 1.9. When evaluating post-fire harvest scenarios for a given fire, take into consideration the availability and distribution of other large patches of recently (≤8 years) burned forest across the broader landscape (e.g., District, Forest, or even the Black-backed Woodpecker's entire range in California). Where other suitable burned forest habitat across the landscape is abundant, snag retention for Black-backed Woodpeckers at an individual fire may be a less important consideration, but where burned forest habitat is relatively rare across the landscape, consider a greater emphasis on habitat retention.

Goal 2 – Manage for Black-backed Woodpeckers in unburned forests

While less is known about Black-backed Woodpeckers in unburned forest in California, they are found most commonly in the upper montane zone, particularly in lodgepole pine or red fir forest. Other conifer forest types in the unburned periphery around recent fires are also frequently used by the woodpeckers. Large trees in these habitat types are important for foraging and appear to be a more limiting factor on the landscape than trees of other size classes.

Recommendation 2.1. Manage unburned forests, particularly stands dominated by lodgepole pine or red fir (the forest types most frequently occupied by Black-backed Woodpeckers in the absence of fire; Fogg et al. 2014), as well as conifer forest of any type in the unburned periphery around recent fire areas, to recruit and retain large trees (i.e., roughly corresponding to CWHR size class 5) and recently dead snags in the earliest stages of decay (***large trees***: Setterington et

al. 2000, *early decay stages*: Nielsen-Pincus and Garton 2007, Tremblay et al. 2009, Tremblay et al. 2010, Nappi et al. 2015, Tremblay et al. 2015b).

Recommendation 2.2. In the oldest, most decadent stands of unburned lodgepole pine, discourage fuelwood cutting (or avoid issuing fuelwood cutting permits) during the nesting season (generally May 1 through July 4). Alternately, conduct broadcast surveys to identify unoccupied stands where fuelwood cutting during the nesting period may not pose any risk to Black-backed Woodpecker nests, or limit harvesting to downed wood.

Goal 3 – Use wildland fire (and perhaps prescribed fire – See Recommendation 9.1) to create primary habitat that is well-dispersed across the landscape.

Recommendation 3.1. Where feasible and compatible with other management objectives, allow naturally ignited fires to burn within the natural range of variation for the forest type, to create or enhance Black-backed Woodpecker habitat.

Goal 4 – Address Black-backed Woodpecker habitat and monitoring needs in relevant public agency planning efforts.

Recommendation 4.1. Address the ecological importance of moderate- and high-severity burned forest in U.S. Forest Service updates to Land and Resource Management Plans, especially during Forest Plan Revision efforts under the 2012 Planning Rule. As part of the planning process, assess the feasibility of using fire as a tool create and maintain Black-backed Woodpecker habitat in various portions of the landscape.

Recommendation 4.2. Continue and build on existing Black-backed Woodpecker occupancy monitoring efforts, to inform forest management planning, project design, and project implementation on public lands.

Recommendation 4.3. Given that there is spatial and temporal variability in the occurrence of fires that create Black-backed Woodpecker habitat, consider planning beyond the project scale to assess and track regional availability of suitable Black-backed Woodpecker habitat.

Education and Outreach

Burned forests are often perceived by the general public, and even some land managers, as barren, lifeless landscapes. Black-backed Woodpecker conservation, monitoring, and research efforts likely would be bolstered by increased efforts to inform land managers, land owners, and the general public about the ecological value of recent fire areas to Black-backed Woodpeckers and other fire-associated species, as well as the critical role that Black-backed and other woodpeckers play in creating habitat for cavity-nesting species.

Goal 5 – Expand efforts to educate land managers and the general public about the value of burned forests to Black-backed Woodpeckers and other fire-associated species.

Recommendation 5.1. Continue and build on efforts to produce multi-media materials demonstrating the ecological value of burned forests to Black-backed Woodpeckers and other fire-associated species. Materials should target a variety of audiences, including land managers, private landowners, and the general public, including users of National Forest lands.

Recommendation 5.2. Produce and distribute pamphlets or other materials requesting that woodcutters avoid cutting snags that have nest cavities made by woodpeckers.

Research and Monitoring

Despite substantial progress in recent years, many important questions about Black-backed Woodpecker ecology and conservation in California remain unanswered. Here we highlight key questions that merit further attention to better inform habitat management for the species.

How important to Black-backed Woodpeckers are unburned forest stands with high tree mortality due to drought and bark beetle outbreaks?

Recommendation 6.1. Assess the degree to which unburned forest stands with high tree mortality due to drought and bark beetle outbreaks are used by Black-backed Woodpeckers (see Goggans et al. 1989, Bonnot et al. 2009, Rota et al. 2014b). Describe stand conditions associated with successful Black-backed Woodpecker foraging and reproduction in drought-killed stands; develop habitat conservation measures based on research findings.

What is the size and trajectory of California's Black-backed Woodpecker population?

Recommendation 7.1. Sustain ongoing efforts (e.g., Siegel et al. 2017 to monitor trends in the amount of burned forest on National Forests in California that is occupied by Black-backed Woodpeckers.

Recommendation 7.2. Conduct broadcast surveys to assess the size of Black-backed Woodpecker populations in burned and unburned areas of their range in California that are not part of current U.S. Forest Service monitoring efforts for the species, particularly national parks, private timberlands, and lands in northwestern California. Focus efforts in recently burned conifer forest, unburned mature red fir and lodgepole pine forest, and subalpine forest in the southern Sierra Nevada.

Recommendation 7.4. Synthesize data from efforts described in Recommendations 6.1 and 6.2 to estimate the size of the statewide Black-backed Woodpecker population, which would provide a baseline for monitoring population change through time, and context for assessing the relative importance of various threats or management scenarios that may alter habitat.

Recommendation 7.5. Project future trends and range of variability in fire frequency, size, and severity within the range of the Black-backed Woodpecker in California in the context of climate change and assess likely implications for Black-backed Woodpecker distribution and abundance.

Recommendation 7.6. Conduct a population viability analyses for the Black-backed Woodpecker in California under varying environmental and management scenarios.

Recommendations 7.7. Use genetic approaches and/or reconstruction of past habitat availability to estimate size of the Black-backed Woodpecker population in what is now California in the past, to assess long-term population trends.

Can a better understanding of Black-backed Woodpecker demography and dispersal inform approaches to conservation and habitat management?

Recommendation 8.1. Initiate demographic studies of Black-backed Woodpeckers to estimate and compare adult and juvenile survival and reproductive rates in different-aged fire areas, unburned forests, and stands killed by drought or bark beetles.

Recommendation 8.2. Assess the relative contribution of burned and unburned habitat to the larger Black-backed Woodpecker population by assessing density (as approximated by home-range sizes) and habitat requirements in unburned forest.

Recommendation 8.3. Study and describe dispersal and colonization dynamics of Black-backed Woodpeckers occupying fire areas and surrounding unburned forests in California. Important questions include:

- What factors (e.g., tree density, wood-boring beetle population, proximity to other occupied fires, fire ignition date) predict whether, and how intensively, a new fire area will be colonized?
- Do birds recruit into new fire areas primarily from other fire areas (are there distance thresholds?) or from nearby unburned forest, or both?
- What are the relative roles of burned forest and unburned forest in sustaining Black-backed Woodpecker populations?
- Why have large patches of apparently good habitat gone un-colonized in some recent ‘megafires’?

Can prescribed fire create or enhance Black-backed Woodpecker habitat, and if so, under what conditions?

Recommendation 9.1. Assess the efficacy of prescribed fire, especially fire that results in tree mortality, to create Black-backed Woodpecker habitat that is well-distributed across the

landscape, especially in areas that have not experienced wildfire recently. Additional research should provide specific guidance regarding optimal spatial distribution of prescribed burns (see Russell et al. 2009) and which habitat types to prioritize for prescribed burning to maximize benefit to Black-backed Woodpeckers.

How genetically distinct are Black-backed Woodpeckers in California from populations elsewhere, and is there substantial genetic population structure within California that might inform habitat management strategies for the species?

Recommendation 10.1. Collect and analyze Black-backed Woodpecker genetic samples from multiple locations across the species' California range to determine the degree of isolation from birds elsewhere in the species' range, and to assess genetic population structure within California.

What can a better understanding of Black-backed Woodpecker prey dynamics tell us about conservation and habitat management for Black-backed Woodpeckers?

Recommendation 11.1. Assess wood-boring beetle habitat selection in burned forests; determine whether tree and stand characteristics such as tree species, tree size, and degree of scorch can be used as indices for abundance of wood-boring beetle larvae.

How can post-fire logging be made more consistent with retention of Black-backed Woodpecker habitat?

Recommendation 12.1. Assess how different intensities and spatial configurations of post-fire logging affect Black-backed Woodpecker nesting, foraging, and occupancy rates.

Do Black-backed Woodpecker habitat needs change during the winter?

Recommendation 13.1. Assess winter ecology and habitat use, and whether altitudinal migration occurs.

Species Description

Summary Points

- **Black-backed Woodpeckers have a solid black back, white underparts, heavily barred sides, and three toes; males have a solid yellow crown patch.**
- **The California-Oregon population is genetically distinct from the northern boreal and Black Hills, South Dakota, populations. No information has been published on genetic population structure within the Oregon-California population.**

The Black-backed Woodpecker is a medium-sized, three-toed woodpecker with a solid black back, white underparts, and heavily barred sides; males have a solid yellow crown patch, making sex determination relatively easy. Patterns in wing feather tract replacement and retention allow accurate in-the-hand determination of age through after-fourth-year in most individuals (Siegel et al. 2016). Black dorsal feathers provide particularly good camouflage for the species when it forages against the charred bark of burned trees (Murphy and Lehnhausen 1998, Tremblay et al. 2016).

Figure 4. Male Black-backed Woodpecker with extended wing. Photo by Joseph Leibrecht

The species is found in montane and boreal conifer forests of North America (Tremblay et al. 2016, Shunk 2016). Using DNA analysis, Pierson et al. (2010) identified at least three genetically distinct groups of Black-backed Woodpeckers: a large, continuous population throughout the northern boreal forest to the Rocky Mountains (from DNA samples collected in Idaho, Montana, Alberta, and Quebec); a second small, isolated population in the Black Hills of South Dakota and Wyoming; and a third population in the Cascade region of Oregon. Based on genetic data, Pierson et al. (2010) concluded that female Black-backed Woodpeckers do not cross large gaps (e.g., >110 km) in forested habitat and that large gaps of non-forested areas act as a higher-resistance landscape to long-distance dispersal for males. This finding was echoed in a subsequent analysis (Pierson et al. 2013) that reported further genetic evidence for male-biased dispersal (i.e., males being prone to dispersing longer distances than females).

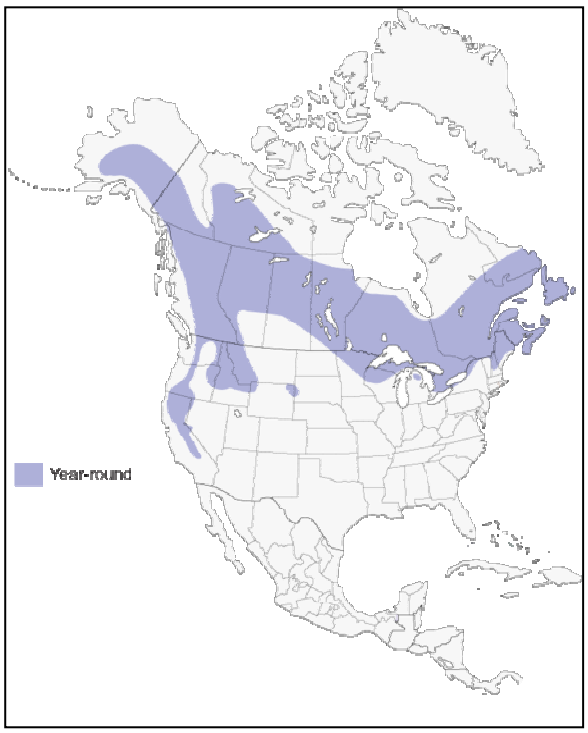


Figure 5. Distribution of Black-backed Woodpecker across North America. Reproduced from Birds of North America (Tremblay et al. 2016)

In California, Black-backed Woodpeckers occur patchily from the Oregon border to the southern tip of the Sierra Nevada, the southernmost extent of their overall range. The California population is likely continuous with the Oregon population, and much less closely related to the large, continuous central population in the northern boreal forest or much smaller, isolated population in the Black Hills of South Dakota and Wyoming. Populations at geographic margins of their ranges may be particularly important for long-term persistence and evolution of species because disjunct or peripheral populations are likely to have diverged genetically from central populations due to either genetic drift or adaptation to local environments (Fraser 1999). Populations at geographic margins of their ranges can exhibit differences from larger, core populations in their habitat relationships, associations with competing species, and feeding and breeding behaviors (Restrepo and Gomez 1998, Lomolino et al. 2006). The potential for adaptation to local environments makes research specific to Black-backed Woodpeckers in California particularly important for understanding the species' ecology and habitat needs in the state.

***Additional Research Needed* – Analysis of genetic variation in California birds is needed to determine the degree of isolation from birds elsewhere in the species' range, and to assess whether there is substantial genetic population structure within California that might inform habitat management strategies for the species.**

Distribution, Population Size, and Population Trend in California

Summary Points

- **Black-backed Woodpeckers in California breed from approximately 1,200–2,800 m above sea level in the southern Cascades, Sierra Nevada, Modoc Plateau, and Warner Mountains, although systematic survey data are lacking for elevations higher than 2,800 m. They may also breed in the Siskiyou Mountains, but are much rarer there.**

- **Black-backed Woodpeckers are still distributed across their historical breeding range in California.**

- **Occupancy probability and densities of Black-backed Woodpeckers are substantially greater in forests recently burned at moderate or high-severity than in unburned forests or forests burned at low severity.**

- **Occupancy probability of burned forests in California is greater in the north, at higher elevations (within the generally mid-elevation stands that have been systematically sampled), and in younger fires, with occupancy declining dramatically within ten years after fire.**

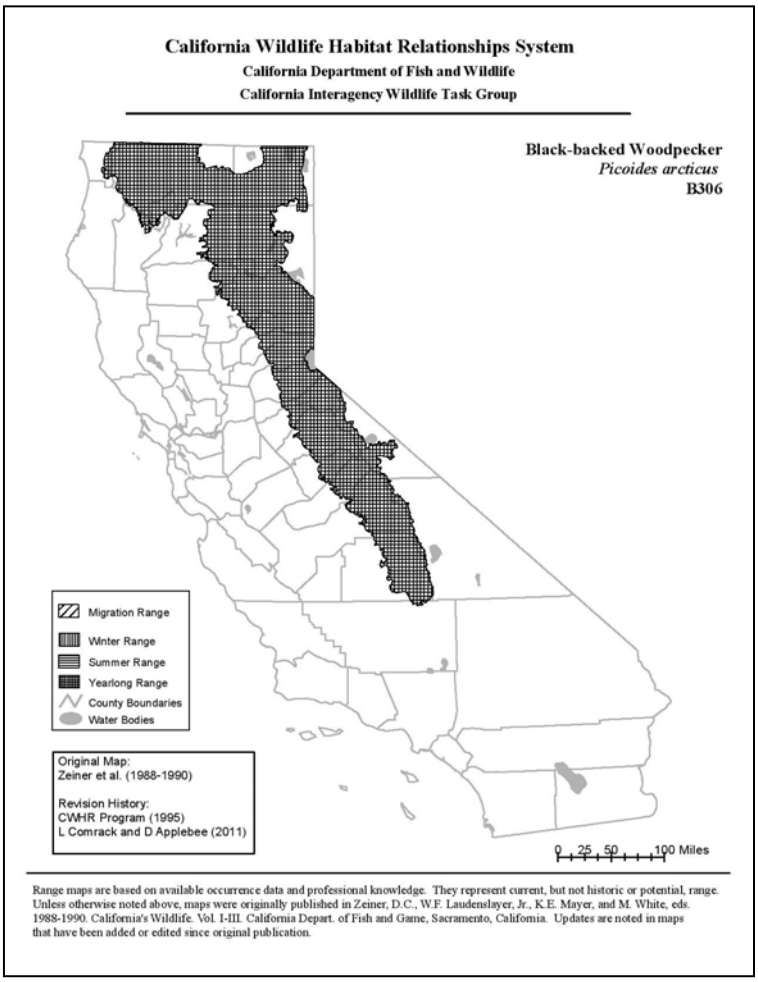
- **Black-backed Woodpeckers occur at lower densities in unburned forests, but because these areas are far more widespread than recently burned forests, woodpeckers in unburned forest likely account for a substantial portion of California's total population.**

- **The number of Black-backed Woodpeckers occupying recent fire areas (fires that burned within the previous 10 years) in California appears not to exceed several hundred pairs. Population estimates in unburned forests have ranged from several hundred to several thousand pairs.**

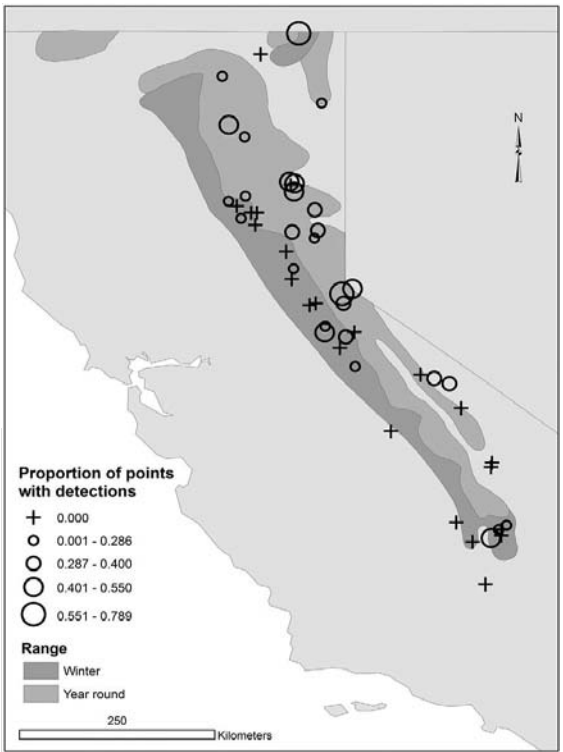
- **Populations in recent fire areas on National Forests have shown considerable annual variation since 2009 (when systematic monitoring in burned areas began) but no clear trend. The annual number of birds estimated to occupy unburned forests on the same National Forests since 2011 (when systematic monitoring on unburned forests began) has shown stability, with little annual variation and no apparent trend.**

Distribution – Black-backed Woodpeckers occur in boreal forests from south-central Alaska across Canada to Newfoundland and Nova Scotia, and south in the western United States into the northern Rocky Mountains and the Cascade and Sierra Nevada Mountains to east-central

California (Tremblay et al. 2016). In California the Black-backed Woodpeckers breed in the southern Cascades, Sierra Nevada, and Warner Mountains, as well as the Siskiyou Mountains where it is much rarer (Fig. 6). The species is very rare on the Shasta-Trinity and Klamath National Forests (Siegel and DeSante 1999; J. Alexander, personal communication). The Sierra Nevada is the most southerly portion of the species' range (Tremblay et al. 2016).



Using broadcast and passive surveys together, Saracco et al. (2011) detected Black-backed Woodpeckers at 169 survey stations placed in stands burned at moderate- to high-severity and distributed within 28 of 51 recent (≤10 years post-fire) fire areas throughout the species' range in the South Cascades, Sierra Nevada, and Warner Mountains in 2010 (see Fig. 7, right, for location of survey stations). The proportion of points surveyed that were estimated to be occupied by Black-backed Woodpeckers was 0.25 (Saracco et al. 2011).



Occupied survey points occurred on both the west and east sides of the Sierra crest, and across nearly the full latitudinal range of the study area, including the most northerly fire area surveyed (the Fletcher fire area on the Modoc National Forest, which spans the California – Oregon border), and the third most southerly fire area surveyed (the Vista fire area on the Sequoia National Forest). These results suggest the Black-backed Woodpecker is still distributed across its historical breeding range in California. Probability of occupancy of a fire area was greater at higher elevations, more northerly latitudes, and in younger fires (with occupancy higher in fires <6 years old than in fires 7–10 years old) (Saracco et al. 2011). Subsequent annual surveys at many additional and more recent fires across the region have yielded similar results that largely corroborate these findings, in terms of both the species' distribution (and the stability of that distribution between 2009 and 2016) and covariates of its occurrence in burned forest (Siegel et al. 2017).

In unburned forests throughout most of their range in California, Black-backed Woodpeckers were found in lodgepole pine, eastside pine, Jeffrey and ponderosa pine, white fir, red fir, and Sierra mixed-conifer, with the highest occupancy values in lodgepole pine, red fir, white fir and eastside pine forest types (Fogg et al. 2014; Figure 8). Using both passive and broadcast surveys in unburned forests between 2011 and 2013, Fogg et al. (2014) detected Black-backed Woodpeckers on 75 of 386 transects of 5 point count stations designed to sample 1km^2 and were located in areas that had not burned at moderate or high severity since 1991 and were more than 2 km from areas burned at moderate or high severity within the previous eight years. Estimated transect-level (with transects generally comprising five survey points) occupancy in the unburned forest at mean covariate values for the point count station sites was 0.21. In addition, site colonization and extinction probability in green forest were low (0.05 and 0.19, respectively) and suggest that many of the individuals detected in green forest were not just actively dispersing across the landscape in search of burned areas, but were occupying relatively stable home ranges. Updated data from 2011-2016 show that Black-backed Woodpeckers have been detected on 119 of 362 (33%) transects in unburned forest (Roberts and Burnett 2016). Interestingly some large-scale studies in from other western montane regions (e.g., Montana) have found Black-backed Woodpeckers to be quite uncommon in unburned forests (Hutto 2008); further research to resolve or understand this apparent contrast in results would be helpful.

Figure 8. Locations of Black-backed Woodpecker (*Picoides arcticus*) survey transects with and without detections on National Forests throughout the greater Sierra Nevada forest planning area during 2011-2013. Figure from Fogg et al. (2014).

***Elevation Range in California* –** During broadcast surveys for Black-backed Woodpeckers in burned forests

≤10 years after fire) throughout the Sierra Nevada, southern Cascades, Modoc Plateau, and Warner mountains in 2009 and 2010, 95% of detections were between 1,461 and 2,596 m above sea level, with a mean detection elevation of 1,997 m (SD = 379 m; R. Siegel, unpublished data; see Fig. 9, next page). It should be noted, however, that the surveys included no stations above 2,800 m, so the upper boundary of the range of detection elevations may not be meaningful. The study area spanned hundreds of miles between its southern and northern boundaries and the data suggest an interaction between elevation and latitude that is described in detail in Siegel et al. (2010) and Saracco et al. (2011); in essence, probability of occupancy of a fire area is greater at higher-elevation sites at more northerly latitudes.

In unburned forests, Fogg et al. (2014) and Roberts and Burnett (2016, 2017) conducted surveys for Black-backed Woodpeckers at point-count stations ranging in elevation from 1,000 to 2,800 m throughout the same overall region, which spans ten National Forest units. Black-backed Woodpeckers tended to occur on higher-elevation transects, with most individuals detected above 1700 m in the northern Forests, and above 1900 m in the southern Forests, especially for those transects not associated with fires (>2 km from a fire perimeter).

Figure 9. Elevational distributions of broadcast survey stations in burned forests throughout the Black-backed Woodpecker's range in California where the species was (left of central vertical line) and was not (right of central vertical line) detected in 2009 and 2010 (R. Siegel et al., unpublished data). White tick marks represent survey stations; longer tick marks represent multiple stations at the same elevation. Dark shading indicates the density trace of the data for stations with detections, light shading for stations without detections. Black horizontal lines show mean elevation of survey stations where Black-backed Woodpeckers were detected (left of center) and not detected (right of center). The dashed line shows the mean elevation of all stations surveyed.

Population Size – Population size is an essential measure for identifying species with a high risk of local extirpation because small populations are considered more vulnerable than large ones

(Pimm et al. 1988, Mace and Lande 1991), although even relatively large populations can suffer local extirpation from extreme environmental disturbances (Pimm et al. 1988).

Estimating overall population size for the Black-backed Woodpecker in California is challenging because of the ephemeral and dynamic nature of its burned-forest habitat, and the low density at which the species generally occurs in unburned forests. In general, Black-backed Woodpeckers reach their greatest densities in moderate- and high-severity burned forests, and occur at very low population densities in unburned forests, but because unburned forests comprise a far greater area than recently burned (≤8 year old) moderate- and high-severity burned forest area, birds in green forests likely account for a substantial portion of the total population size (Tremblay et al. 2015a). Three groups of researchers have aimed to provide estimates of population size in different habitats in California using various methods, yielding estimates of several hundred pairs in burned forests on public lands (Hanson and Cummings 2010, Siegel et al. 2010), and several hundred pairs (Hanson and Cummings 2010) to several thousand pairs (Fogg et al. 2012) in unburned forests on public lands.

***Additional Research Needs* – Reliable estimates of population size in various habitats (including recently burned forest, unburned montane forest, and unburned subalpine forest) and across multiple land ownerships types (including not just U.S. Forest Service lands where all systematic survey to date have been conducted, but also on National Park Service lands and private lands) are needed to estimate the size of the overall population in California and assess its risk of extinction, ideally through a formal population viability analysis. In addition, estimating and comparing demographic rates (adult and juvenile survival and reproductive rates) within multiple habitats would elucidate which habitat types drive the overall population growth rate. Finally, estimation of historical (prior to European settlement) population size, based on genetic approaches and/or reconstruction of past habitat availability, could inform conservation needs by providing a comparison with current population size and an assessment of long-term population trend.**

Population Trend – Population trend is another important parameter for assessing population vulnerability. Species with decreasing population trends are generally at greater risk than species with flat or increasing trends; even for species without long-term deterministic population declines, estimating population trends is important because extinction risk is greater in populations that fluctuate substantially over time (Pimm et al. 1988).

Data on population trends of the Black-backed Woodpecker in California are incomplete. The Breeding Bird Survey (BBS), which utilizes passive point counts, indicates a positive increase in Black-backed Woodpecker abundance in the Sierra Nevada between 1966 and 2015 (+4.84, 95% CI [0.66, 9.68]) (Sauer et al. 2017). However, the BBS considers the credibility of the trend estimate low because Black-backed Woodpecker detections are quite infrequent in the data, with a relative abundance of 0.02 individuals encountered per survey route in the Sierra Nevada (Sauer at al. 2017). Detection rates of Black-backed Woodpeckers via passive survey methods

are known to be dramatically lower than those obtained through 'playback' surveys in which vocalizations and/or drumming by the species are broadcast (Saracco et al. 2011).

In 2009 The Institute for Bird Populations and the U.S. Forest Service began monitoring trends in Black-backed Woodpecker occupancy rates in recently burned forest across ten national forests in California as part of the U.S. Forest Service's Management Indicator Species (MIS) program for the Pacific Southwest Region (USDA Forest Service 2007). The project involves annual, broadcast-based sampling within 50 fires selected at random each year from the larger pool of fires that burned within the previous ten years. Between 2009–2016,the proportion of occupied fires and occupied survey points both showed substantial annual variation (Fig. 10). Accounting for uncertainty, there was a weak, non-significant negative linear trend in point-level occupancy from 2009 to 2016 (Fig. 10b; mean ± se = -0.0074 ± 0.0048; $P = 0.17$). No linear trend in fire-level occupancy was evident (Fig. 10a; mean ± se = -0.0054 ± 0.0118; $P = 0.66$).

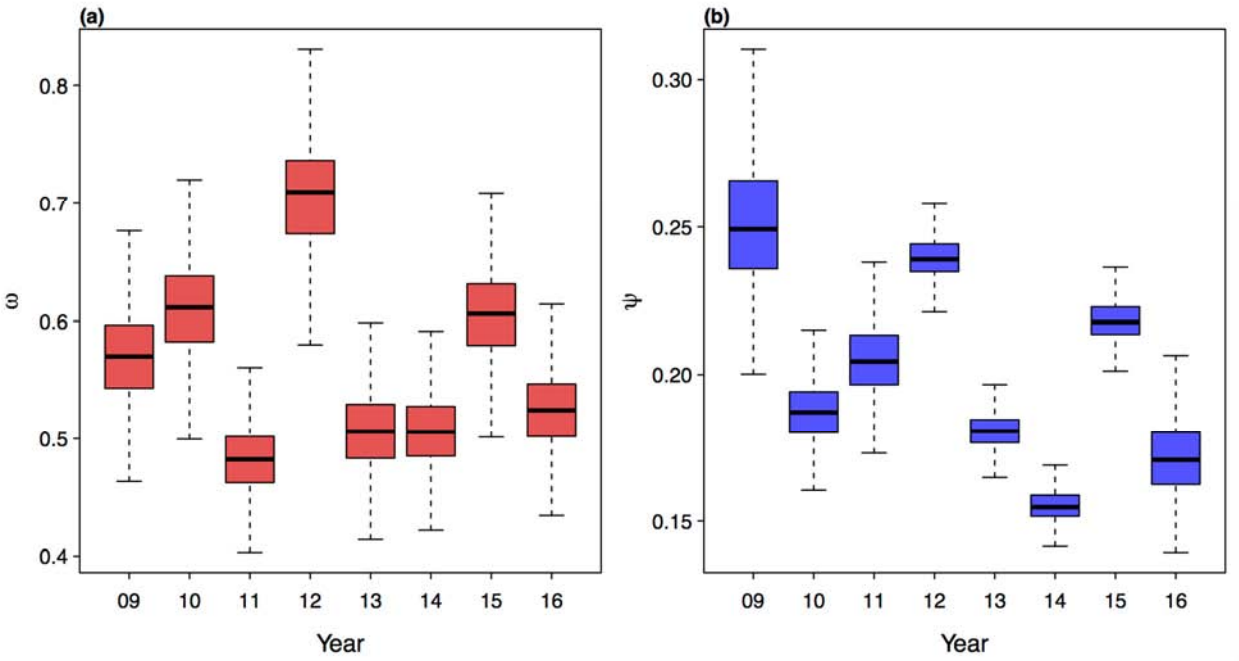


Figure 10. Mean probability of a) fire-level (ω) and b) point-level (ψ) occupancy for Black-backed Woodpeckers as modeled from individual year-based hierarchical models. Plots show median (bold line), 50% (box) and 95% (whiskers) Bayesian credible intervals of posterior distribution of modeled parameters. Figure from Siegel et al. (2017).

In a parallel effort using similar field methods, Point Blue and the U.S. Forest Service initiated broadcast-based occupancy surveys of Black-backed Woodpeckers in unburned forests on national forests in 2011 (Fogg et al. 2014, Roberts and Burnett 2016). Five years of surveys failed to detect any population trend, and suggest that the distribution of the Black-backed

Woodpecker population on actively managed unburned national forest lands in the Sierra bioregion is stable (Fig. 11).

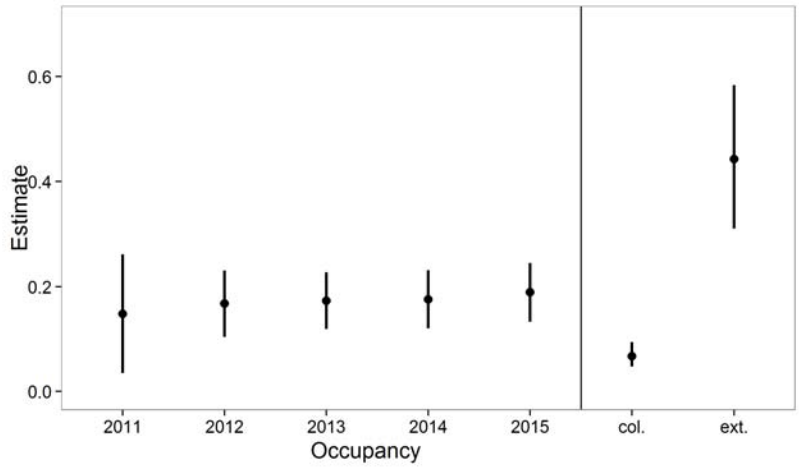


Figure 11. Annual transect occupancy estimates and 95% confidence intervals (left panel), with colonization and extinction probabilities (right panel), for Black-backed Woodpeckers in unburned forest. Detection probability, colonization, and extinction were held constant across years in this multi-season occupancy model. Figure from Roberts and Burnett (2016).

***Additional Research Needed* – A meaningful population trend estimate for California overall requires more information on populations in habitats (particularly subalpine forest in the southern Sierra), areas (particularly northwestern California), and land ownerships (particularly national parks and commercial timberlands) that have not been systematically sampled.**

Life History, Ecology, and Breeding Biology

Summary Points

- **Black-backed Woodpeckers in California begin laying eggs as early as April and fledge young as late as July; most observed nesting activity has occurred between May 1 and July 4.**
- **Both sexes incubate and brood 2–6 young.**
- **Black-backed Woodpeckers nearly always excavate a new nest cavity every year.**
- **Nest densities and occupancy in burned forests begin to decrease around 5 years after fire and then continue to decrease throughout the following several years.**
- **Black-backed Woodpeckers primarily eat larvae of wood-boring beetles, but also forage on larvae of bark beetles and other insect prey.**
- **Altitudinal migration or other seasonal movements of the Black-backed Woodpecker in California have not been thoroughly assessed, but they do not appear to be widespread phenomena.**
- **Research from across the species' range, but excluding California, indicates both males and females disperse, but males disperse farther on average than females.**

Nesting – Black-backed Woodpeckers are primary cavity excavators, creating holes in trees in which to lay their eggs and raise their young. The birds usually excavate and occupy a new nest cavity every year, very rarely re-using previous cavities. A study of 210 Black-backed Woodpecker nests in burned forests in Oregon documented only 3 cavities re-used in subsequent years (Forristal 2009). In two fires in western Idaho, no Black-backed Woodpeckers re-used nest cavities over a 13-year study period (n = 46 unique nests; Saab et al. 2009). Cavities made by strong excavators such as Black-backed Woodpeckers provide important nesting opportunities for other bird species that nest in cavities but have limited or no ability to excavate their own cavities ('secondary cavity nesters'); 27% of Black-backed Woodpecker cavities in Idaho were re-used by other bird species in subsequent years (Saab et al.

Figure 12. A Black-backed Woodpecker nestling investigating its surroundings. Photo by Stephen Shunk

2004), and after the Angora Fire in California, other species observed using abandoned Black-backed Woodpeckers nests included Northern Flicker, House Wren, Mountain Chickadee, Western Bluebird, Northern Flying Squirrel, and unidentified chipmunk (*Tamias sp*) (Tarbill et al. 2015). Black-backed Woodpeckers in California have been observed to simultaneously excavate multiple cavities (up to 5 different cavities) prior to nesting, only one of which was used for nesting (R. Siegel unpublished observation). Thus, the importance of Black-backed Woodpeckers to secondary cavity-nesters may be even greater than population densities would otherwise indicate.

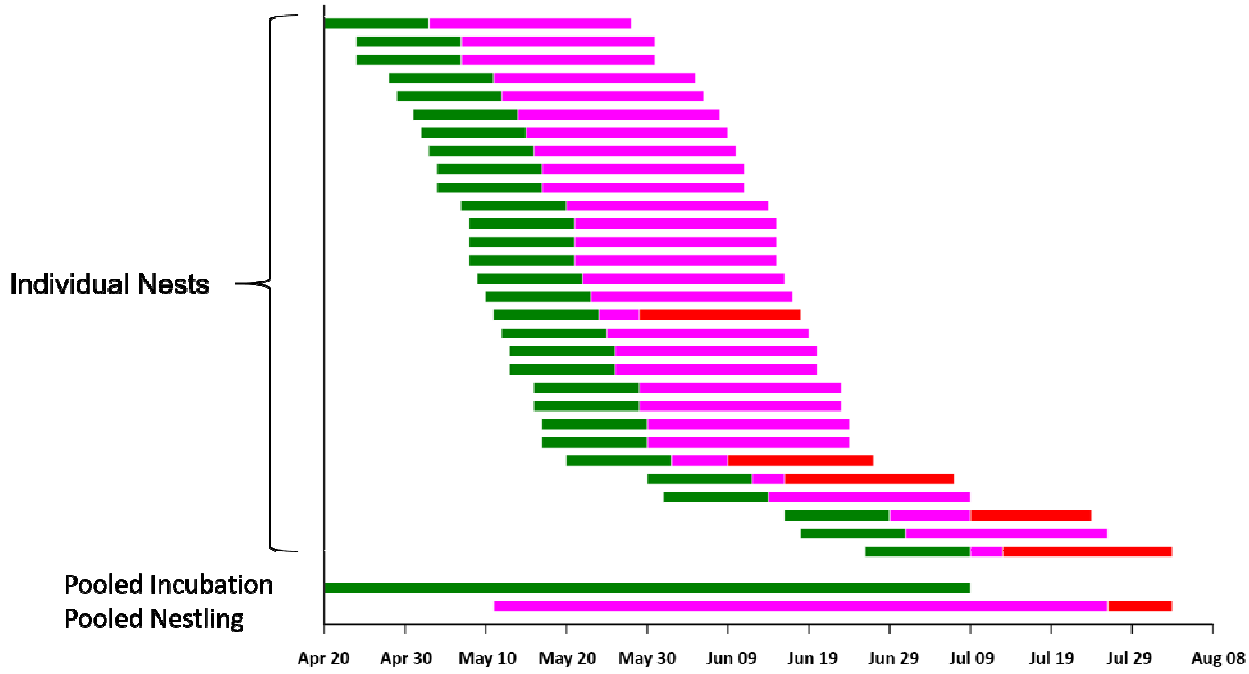


Figure 13. Nesting phenology of 30 Black-backed Woodpecker nests monitored during 2011-2013 in burned forests on Lassen and Plumas National Forest (R. Siegel, unpublished data). Green bars indicate the incubation stage, pink bars indicate the nestling stage, and red bars indicate the expected remainder of the nestling period for nests that failed during the nestling stage.

In California and elsewhere, eggs are laid from April to June and most juveniles fledge during June and July (Tremblay et al. 2016, Forristal 2009, Siegel et al. 2012c). Both sexes incubate and brood 2–6 young, with males usually incubating and brooding at night (Tremblay et al. 2016); from laying of the first egg through fledging, the nesting phase lasts approximately 40 days, with incubation lasting approximately 13 days and approximately 25 days elapsing between hatching and fledging (Ehrlich et al. 1988, Forristal 2009). Nesting phenology of 30 Black-backed Woodpecker nests in burned forests of Lassen and Plumas National Forest in California during three breeding seasons are shown in Figure 13. Nest cavities are usually excavated in snags but can be found in dead portions of live trees, and in unburned forests, are sometimes excavated in live trees (Fogg et al. 2014).

Primary food:
Wood-boring beetle larvae

Wood-boring beetle (*Coleoptera*: *Buprestidae*, *Cerambycidae*) larvae are the primary prey of Black-backed Woodpeckers in burned forests. Wood-borer larvae occur in the bark, phloem, and xylem of standing dead trees, although they spend most of their time in the deeper xylem (Powell 2000). Adult wood-borers detect burning or recently burned habitat by sensing smoke (e.g., the cerambycid *Monochamus*) or heat (e.g., the buprestid *Melanophila*), and lay their eggs on the freshly dead trees (Hart 1998). Larvae remain inside the wood for up to three years, or perhaps even longer under some conditions, before emerging as adult beetles (Linsley 1961).

Figure 14. Wood-boring beetle exit hole in a burned tree. Photo by Monica Bond

Based on nest success data from regions outside California (Goggans et al. 1989, Saab et al. 2007, Bonnot et al. 2008, Vierling et al. 2008, Forristal 2009, Saab et al. 2011, Rota et al. 2014b) nest survival of Black-backed Woodpeckers may be higher in burned than beetle-killed forests, with predation as the major cause of nest failure, but evidence is needed from California ecosystems. Nest success is highest in the first few years after fire and then decreases with number of years after fire (Vierling et al. 2008, Nappi and Drapeau 2009, Forristal 2009 but see Saab et. 2011) or insect outbreak (Bonnot et al. 2008). In a long-term study of the Black-backed Woodpecker in burned forests of Idaho, nest survival increased with increasing distance to unburned forest; daily survival decreased for nests within approximately 100 m from the edge of unburned forests (Saab et al. 2011). Burn severity is another important factor in nest success. Vierling et al. (2008) reported greater nest success in higher-severity burned patches in the Black Hills.

In California, 25 of 30 monitored nests in burned forests on the Lassen and Plumas National Forest fledged young, yielding a naïve nest success rate of 83% (Siegel et al., unpublished data). Eight nests in unburned forest on Sierra National Forest all succeeded (Kathryn Purcell, USFS Pacific Southwest Research Station, unpublished data).

Foraging – Black-backed Woodpeckers feed primarily on larvae of wood-boring beetles (*Cerambycidae* and *Buprestidae*) and, to a lesser extent, the larvae of bark beetles (*Scolytidae*), as well as other insects, wild fruits, mast, and cambium (Villard and Beninger 1993, Murphy and Lehnhausen 1998, Tremblay et al. 2016). The woodpeckers typically forage on snags or downed logs rather than live trees (Villard and Beninger 1993, Villard 1994, Kreisel and Stein 1999, Murphy and Lehnhausen 1998, Tremblay et al. 2010, Hanson 2007, Nappi et al. 2015).

Migration – Black-backed Woodpeckers are primarily resident but may migrate to lower elevations during winter (Tremblay et al. 2016). In the eastern part of its range the species periodically irrupts southwards into New England from its usual boreal forest habitat (Yunick 1985). The California Department of Fish and Game (Zeiner et al. 1988–1990) suggested seasonal altitudinal migration in California, but more recently, Department personnel were

unable to find information that would corroborate this phenomenon (Comrack and Applebee 2011). Anecdotal observations (R. Siegel, unpublished data) confirm that adult Black-backed Woodpeckers can often be found within or near their breeding season home-ranges during winter.

***Additional Research Needs* – Little information exists on seasonal movements and winter habitat use by Black-backed Woodpeckers in California.**

Dispersal – In most bird species, females disperse greater distances than males (Greenwood 1980, Clarke et al. 1997). However, genetic analysis throughout the Black-backed Woodpecker's range, but not including California, indicates male Black-backed Woodpeckers disperse over long distances and unforested habitat at greater rates than females (Pierson et al. 2010, 2013). Very large gaps in forested habitat do form substantial barriers to dispersal even for males; this includes the gaps between the Cascade region, the Black Hills, and the contiguous northern boreal forest (Pierson et al. 2010). Pierson et al. (2013) describe further genetic evidence of male-biased dispersal, and suggest that female Black-backed Woodpeckers likely disperse <110 km (note, though, that no sampling was conducted in California).

Relatively little is known about adult and juvenile dispersal of Black-backed Woodpeckers through forested habitats. In Canadian boreal forests, Black-backed Woodpeckers apparently traveled approximately 50 km to occupy newly burned forests, as no birds were detected within this distance from a burn perimeter (Hoyt and Hannon 2002). In California, Siegel et al. (2016b) captured adult Black-backed Woodpeckers in 6 burned areas between 1 and 8 years after fire to determine whether colonization of newly burned areas is driven primarily by breeding dispersal of adults or natal dispersal by young birds. The authors used patterns of multiple feather generations retained among primary coverts, secondaries, and secondary coverts to assign birds to 1 of 5 age classes (second-, third-, and fourth-calendar-year; after-third-calendar-year; and after-fourth-calendar-year), revealing that population age structure varied dramatically across burned areas, with a preponderance of second-calendar-year birds in the 1-year and 2-year postfire areas and a preponderance of birds at least 3 years old in the older postfire areas (Fig. 15). These findings indicate that natal dispersal is the primary means by which Black-backed Woodpeckers colonize recently burned areas in western forests, that breeding dispersal is uncommon, and that the decline of Black-backed Woodpecker populations 6–10 years after fire likely reflects the lifespan of individual birds that colonized the burned area, or of offspring that they produced in the early postfire years. Although work was not based on sampling in California, Pierson et al (2013) report an increase in genetic relatedness over time in individual burned areas, and, , suggest that observed patterns in genetic population structure may be explained in part by delayed dispersal of juveniles where resources remain abundant, and counter to the conclusions of Siegel et al. (2016b), individuals disperse multiple time during their lives when resources are not abundant.

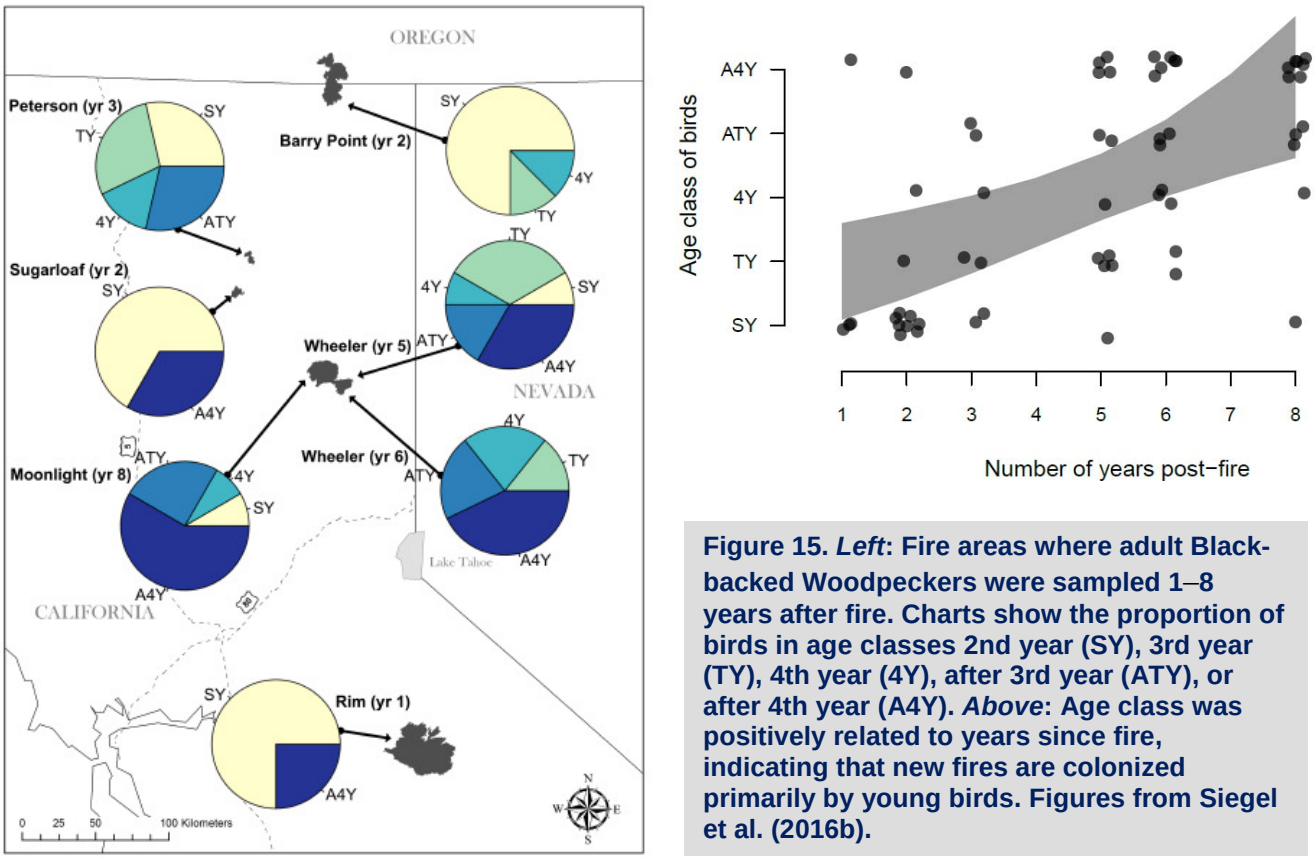


Figure 15. ***Left*****: Fire areas where adult Black-backed Woodpeckers were sampled 1–8 years after fire. Charts show the proportion of birds in age classes 2nd year (SY), 3rd year (TY), 4th year (4Y), after 3rd year (ATY), or after 4th year (A4Y).** ***Above*****: Age class was positively related to years since fire, indicating that new fires are colonized primarily by young birds. Figures from Siegel et al. (2016b).**

Additional Research Needs **– More study of demographics, dispersal, and possible metapopulation dynamics are needed to understand how new fire areas are colonized, and why some fire areas are colonized by many more individuals than others.**

Habitat Needs

Summary Points

- **Density of Black-backed Woodpecker populations is substantially higher in forests recently burned (1–8 years post-fire) at high and moderate severity with high densities of snags, than in unburned forests and forests burned at low severity.**
- **In burned forests, nest cavities are nearly always excavated in snags, but in unburned forests they can be found in living trees.**
- **Nests are excavated in conifer trees, with little if any preference for particular conifer species. Size of nest trees in burned and unburned study sites in California ranged from 16–158 cm in diameter. Average dbh of nest snags in three studies of birds nesting in recent fire areas in California was 33, 35, and 36 cm, respectively.**
- **Elsewhere in the species' range, increased snag density and average snag size, pre-fire canopy cover, fire patch size, and fire severity were positively correlated with increased probability of nesting within a stand.**
- **Nest success of Black-backed Woodpeckers in burned forest in Idaho increased with greater distance from the burned-unburned forest edge.**
- **Abundance of wood-boring beetle larvae is a predictor of nest-stand and foraging-habitat selection in the Rocky Mountains.**
- **Black-backed Woodpeckers preferentially selected larger snags (>50 cm diameter) for foraging in a study of 3 fire areas in the Sierra Nevada.**
- **In burned boreal forest, increasing snag density, snag size, snag intactness, and burn severity were positively correlated with increased use of a stand for foraging.**
- **Black-backed Woodpeckers foraged primarily in >80 year-old stands in unburned forests in Canada, and selected mature forests over younger stands for foraging in beetle-killed forests in Oregon.**
- **In recent fire areas in the northern Sierra Nevada, Black-backed Woodpecker home ranges averaged 89 ha (range = 24 – 304 ha), as measured by movement-based kernel estimation. Home-range size varied negatively and exponentially with average snag basal area across the home range, with snag basal area across the home range exceeding 17 m^2/ha for all individuals that foraged primarily within burned areas.**

Black-backed Woodpeckers are not strongly associated with any particular tree species or forest type (Hutto 1995, Saracco et al. 2011), but are found most frequently in older coniferous forests

comprised of relatively high densities of larger trees, most often burned but also less commonly in unburned forest (Saab et al. 2002, Smucker et al. 2005, Russell et al. 2007, Hanson 2007, Vierling et al. 2008, Hanson and North 2008, Forristal 2009, Nappi and Drapeau 2009, Saab et al. 2009, Fogg et al. 2014). In unburned forests of the Sierra Nevada, Black-backed Woodpeckers avoided lower-elevation west-side pine-hardwood (Fogg et al. 2014) in favor of higher-elevation forests, particularly stands dominated by lodgepole pine.

Figure 16. Male Black-backed Woodpecker with a wood-boring beetle larva. Photo by Monica Bond

The species also has also been found to use forest stands killed by bark beetles in Oregon (Goggans et al. 1989) and the Black Hills (Bonnot et al. 2008, Rota et al. 2014). No systematic data exist on correlations between beetle outbreaks and Black-backed Woodpecker numbers within California, but the birds have been observed in smaller groups of beetle-killed trees in the Tahoe Basin (R. Burnett, personal communication). Based on work elsewhere in the species' range, Powell (2000) surmised that forests with bark-beetle outbreaks may support lower wood-borer beetle abundance than burned forests because trees in bark-beetle outbreaks are killed over several years, so many snags are in the advanced stages of decay less favorable for wood-boring beetles. Moreover, in trees killed by bark beetles, much of the nutrient-rich phloem is consumed by these beetles, so later-arriving wood-boring beetles (which produce larger larvae favored by Black-backed Woodpeckers) face heavy competition. Also, bark beetles are host-tree-specific, so outbreaks in mixed-species forests rarely kill all the trees, which may result in lower total snag density than in a high-severity burned forest of similar tree species composition. These hypotheses were largely confirmed by Rota et al. (2014a) who reported substantially larger Black-backed Woodpecker home ranges in unburned stands with bark beetle infestations, compared with early (1–2 year) post-fire stands, where a range of infestation intensities and fire severities occurred across the study areas. Furthermore, adult (n = 140), juvenile (n = 72), and nest survival (n = 95) were all highest in the habitat created by summer wildfire, followed by mountain pine beetle infestations, and lowest in fall prescribed fire habitat (Rota et al. 2014b); population growth rates were positive in habitats created by summer wildfire but negative in both mountain pine beetle infestations and fall prescribed burn habitats. Powell (2000) also noted lower densities of Black-backed Woodpecker pairs in beetle-killed than burned forests in both the northern Rockies and eastern Cascades, suggesting that forests with bark beetle outbreaks may have less capacity to

support Black-backed Woodpeckers than do burned forests, though this likely depends on fire severity, infestation severity, and other forest attributes.

***Additional Research Needs* – Research is needed to assess the relative importance of tree mortality due to drought and bark beetle outbreaks compared with burned forests for the Black-backed Woodpecker in California**.

Population densities of Black-backed Woodpeckers are greatest in burned forest stands during the first several years after fire (*Canada*: detected 3, 4, 8 but not 16 years post-fire, Hoyt and Hannon 2002; *Idaho:* nest densities peaked 4–5 years post-fire and rapidly declined, Saab et al. 2007; *California*: occupancy probability declined 6 years post-fire, Saracco et al. 2011), especially in the most severely burned areas that had high pre-fire canopy closure (*Idaho*: Russell et al. 2007, *Oregon*: Forristal 2009) and contained high densities of dead trees (*Canada*: Hoyt and Hannon 2002; *Idaho*: Saab et al. 2009; *Oregon*: Forristal 2009; *Black Hills*: Vierling et al. 2008, Rota et al. 2014a,b; *California*: Hanson 2007, Hanson and North 2008, Tingley et al. 2014, White et al. 2016). Prescribed fire also can create suitable habitat for Black-backed Woodpeckers; prescribed fire treatments that resulted in a ~30% increase in snags >23 cm resulted in increased occupancy rates of Black-backed Woodpeckers relative to unburned forest in eastern Washington (Russell et al. 2009a). Black-backed Woodpeckers were detected in prescribed fires, some <50 ha in size, in the Sierra Nevada; after one prescribed fire on the Eldorado National Forest that produced numerous red fir and lodgepole pine snags, nesting was confirmed in 2011 and continued at least through the 2017 breeding season (A. Fogg, personal communication).

Hanson and North (2008) found preferential foraging on large snags (>50 cm) in a study of 3 fire areas in the Sierra Nevada. Nappi et al. (2003) found Black-backed Woodpeckers preferentially foraged on larger, less-deteriorated snags in burned boreal forests in Quebec, Canada. In burned forests of southwestern Idaho, Dudley et al. (2012) found that the most important variables for modeling foraging habitat selection were foraging tree diameter and tree density within a 0.4 ha plot. Working within the footprint of the Angora fire in the Lake Tahoe Basin White et al. (2016) found that Black-backed Woodpecker occurrence probability declined rapidly when snag densities decreased below 100–150 stems/ha.

Not all newly burned forest habitat is colonized by Black-backed Woodpeckers. Black-backed Woodpeckers were detected at fewer than 6% of 3,128 point counts in recently burned forests in the northern Rockies (Hutto 2008). Between 30 and 50% of 1- to 8-year old burned stands were occupied by Black-backed Woodpeckers in Canada (Hoyt and Hannon 2002). In 2009 the proportion of survey stations occupied by Black-backed Woodpeckers in recent fire areas (<10 year old) in the Sierra Nevada was 0.25 (Saracco et al. 2011), with somewhat lower values in subsequent years (Siegel et al. 2017 see Fig. 10, above). The probability of woodpeckers occurring at a point count station was greater in more recent fires and with increasing latitude and elevation (Saracco et al. 2011). Much apparently suitable habitat at two recent ‘megafires’ in

the Sierra Nevada, the 2013 Rim Fire and the 2014 King Fire) appears to have gone uncolonized in the early years after fire (A. White, in preparation), for reasons that remain unresolved.

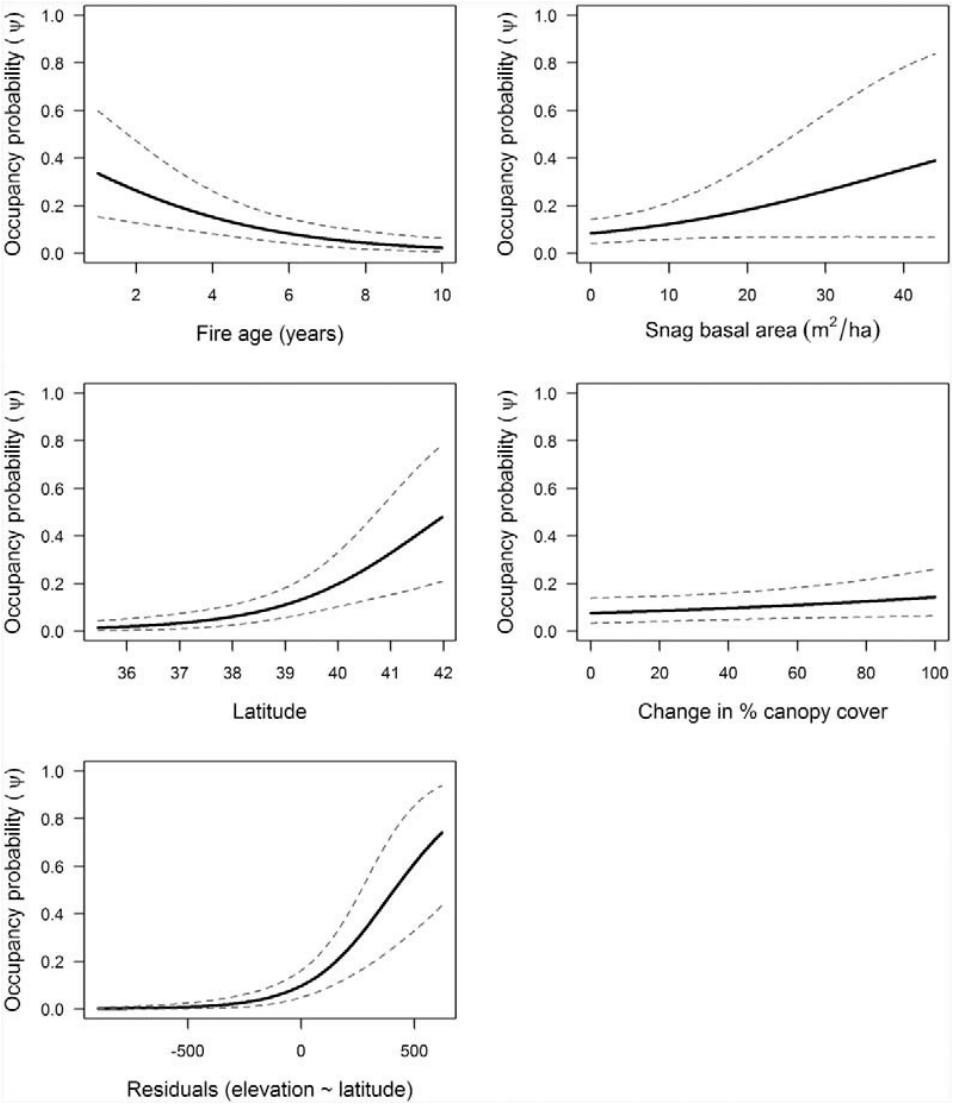


Figure 17. Predicted point-level occupancy probability and 95% credible intervals in relation to individual covariates included in a hierarchical occupancy model based on surveys of 51 recent fire areas in the greater Sierra Nevada in 2009. Figure from Saracco et al. (2011).

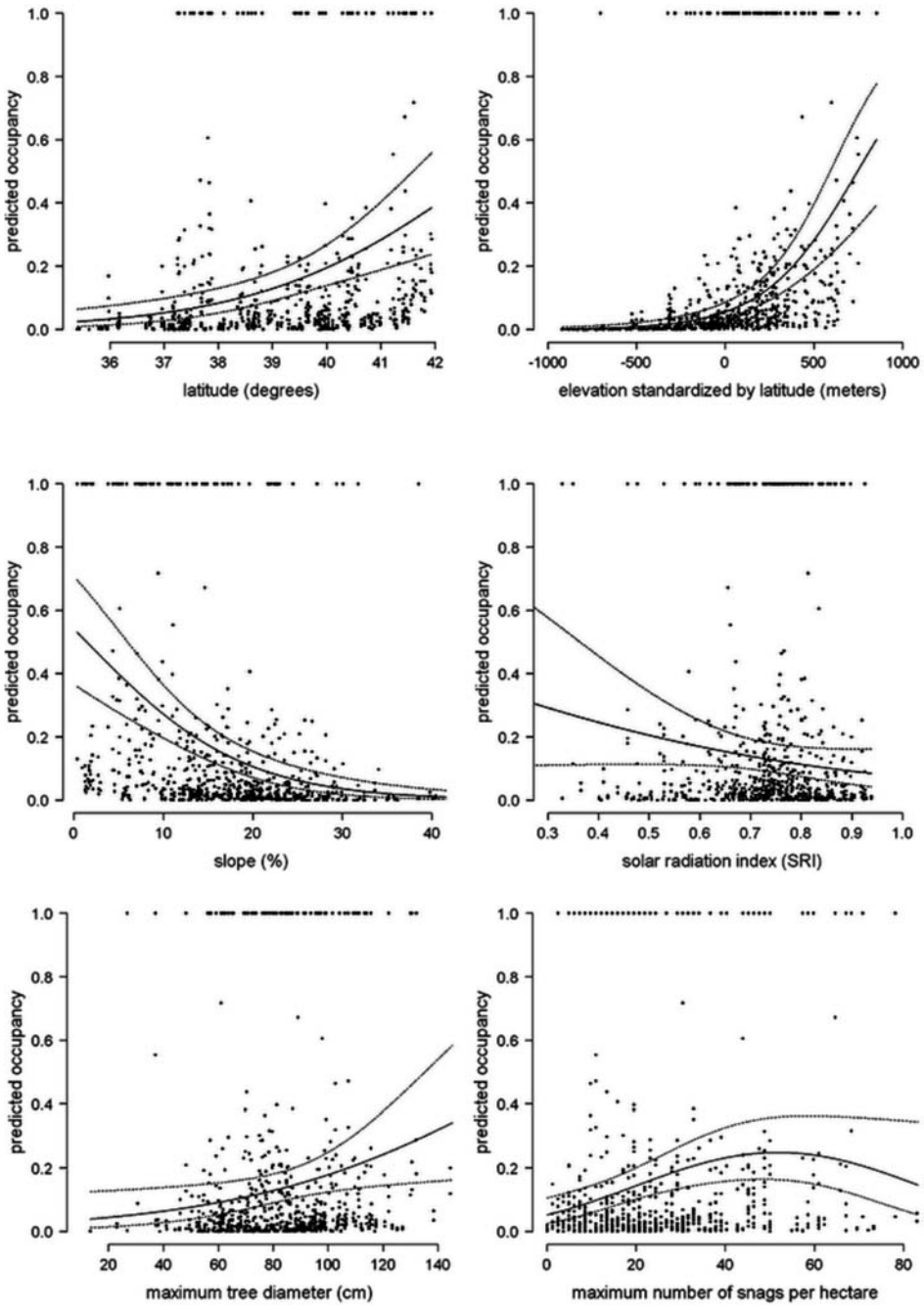


Figure 18. Model-predicted associations between Black-backed Woodpecker occupancy and six topographical and vegetation covariates in unburned forest in California. Predicted occupancy was calculated for a range of values of the plotted variable while holding all other model covariates at their mean values, except for elevation, which was set at the third quartile value (because of a highly positive relationship). Transects where Black-backed Woodpeckers were detected received a predicted occupancy value of 1.0. Figure adapted from Fogg et al. (2014).

In the boreal forest, dense stands of larger-sized trees are important Black-backed Woodpecker habitat not only after fire but also in unburned stands. Studies of Black-backed Woodpeckers in unburned Canadian boreal forests suggest the birds depend upon stands of forest ≥80 year old for persistence (Setterington et al. 2000, Hoyt and Hannon 2002, Tremblay et al. 2009), and that the amount of old coniferous habitat proximal to Black-backed Woodpeckers nests positively influenced weight gain in nestlings (Tremblay et al. 2014). Although sample sizes were small, times between parental visits were longer in unburned than burned habitats (Tremblay et al. 2016), perhaps reflecting more dispersed food availability in the home range. Black-backed

Woodpeckers in unburned balsam fir forests in Newfoundland were detected significantly more in 80-year old stands where tree densities averaged 1,253 stems/ha, than in forests of younger ages (Setterington et al. 2000). Presence of Black-backed Woodpeckers was positively associated with density of snags >20 cm and negatively associated with the total number of snags in the Newfoundland study. In Alberta, Black-backed Woodpeckers were detected in unburned forests with significantly higher densities of standing trees than where the birds were not detected: the mean density of standing trees where Black-backed Woodpeckers were detected was 5,650.0/ha [95% CI = 4,099.4–7,200.5/ha] and where they were absent was 4,635.6/ha [95% CI = 4,191.1–5,080.1/ha] (Hoyt and Hannon 2002). In unburned forest in Québec, breeding Black-backed Woodpecker home-ranges had at least 35 m^3/ha of dead wood, of which 42% (15 m^3/ha) comprised dead wood at the early decay stage (Tremblay et al 2009).

Nesting Habitat: Nest Trees – Several studies have collected data on attributes of Black-backed Woodpecker nests in California (Raphael and White 1984, Siegel et al. 2012c, Seavy et al. 2012, Tarbill et al. 2015, R. Burnett unpublished data, K. Purcell unpublished data; see Table 1 below for summary). Reported mean nest-tree sizes in California (Table 1) are similar to those in other parts of the range (e.g., *Idaho*: 39.7 ± 2.1 cm, Saab et al. 2002; *Idaho*: 32.3 ± 2.8 cm, Saab and Dudley 1998; *Oregon*: 27.7 ± 0.8 cm, Forristal 2009). Bull et al. (1986) suggested that the species may prefer nesting in trees <50 cm because trees of this size contain a higher percentage of sapwood than do larger trees, and this species often excavates nests in sapwood. Nest-tree size remained consistent for the first three years post-fire in Oregon, but increased in year four (Forristal 2009). Finally, anecdotal information suggests that when nesting in unburned forest, the species frequently excavates cavities in the trunks of living trees (Gaines 1992, Fogg et al. 2014), where they often remove the bark from the area around the cavity entrance, resulting in copious sap around the entrance and dripping down the tree bole (A. Fogg, personal communication).

Table 1. Summary data on Black-backed Woodpecker nest-tree characteristics in burned and unburned forests of California.

	Raphael and White (1984); burned and unburned	K. Purcell (unpublished data); unburned	R. Burnett (unpublished data); unburned	Seavy et al. (2012); burned	R. Siegel (unpublished data); burned	Tarbill et al. (2015); burned
Nest Tree Diameter						
Mean[1]	45 cm	53 cm	46.4 cm	33±7 cm	36±18 cm	35±9 cm
N	7	7	15	31	107	39
Range	Not reported	33-77 cm	18-136 cm	18-50 cm	16-158 cm	Not reported
Nest Tree Height						
Mean[1]	16.8 m	16.0 m	17.42 m	Not reported	13.8.0±7.4 m	16.5±6.2 m
N	7	7	13	Not reported	103	39
Range	Not reported	12.0-27.7 m	8.5-35 m	Not reported	3-37 m	Not reported
Nest Height						
Mean[1]	2.8 m	5.8 m	4.84 m	Not reported	4.0±2.7 m	4.7±3.0 m
N	7	7	16	Not reported	114	39
Range	Not reported	1.7-11.3 m	1-14 m	Not reported	0.5-11.8 m	Not reported

Forristal (2009) reported that 90% of nests were in lodgepole pine and ponderosa pine snags at a study site in eastern Oregon, and the birds gradually switched from nesting primarily in lodgepole pine to ponderosa pine as years since fire increased. The author noted that lodgepole pine experienced high post-fire decomposition rates, which may offer a potential explanation for the switch.

Lorenz et al. (2015) studied wood hardness of Black-backed (and other) Woodpecker nests in a variety of habitats (including burned and unburned forest) in Washington, and found that the birds select trees with much softer interior wood than trees sampled at random. The softer internal conditions were generally not evident from the outward appearance of the tree, and the authors suggest that soft interior wood is often caused by wood decay fungi, the prevalence of which may be a limiting factor for nesting opportunities in some stands.

Nesting Habitat: Nest Stands – In California, Manley et al. (2012) studied nest site selection after the Angora Fire near South Lake Tahoe, and reported that high snag density (>260 snags/ha) was a feature of nest sites. Siegel et al. (2012c) documented Black-backed Woodpeckers nesting in moderate- and high-severity (but not low-severity) patches of two recent fire areas on the Lassen National Forest in the southern Cascades. Some nests were in rather small (approximately 0.5 ha) higher-severity patches and were only tens of meters from the edges of low-severity areas, unburned areas, or post-fire clearcuts. In burned forests of the northern Sierra Nevada, Seavy et al. (2012) reported Black-backed Woodpeckers selected nest stands with significantly higher snag densities than random stands; mean number of snags >15 cm per 11.3 m radius plot surrounding the nest tree was 13.3 (range 1–29), equating to 332 snags/ha.

Looking more broadly at studies across the species, range, distance to unburned forest is an important factor in nest-site selection and nest success in burned forests. Vierling et al. (2008) documented that Black-backed Woodpecker nests in the Black Hills were farther from the edge of the fire, and Saab et al. (2011) reported greater nest survival with increasing distance to the unburned edge in post-fire forests in Idaho (Fig. 19). Saab et al. (2011) suggested that unburned forests may be a source of nest predators and may also indicate lower-quality habitat. Taken together these, findings may suggest that larger retained patches of burned forest are likely to be more conducive to successful woodpecker nesting than smaller patches, as they should provide more nesting opportunities farther from the unburned forest edge. In contrast, Black-backed

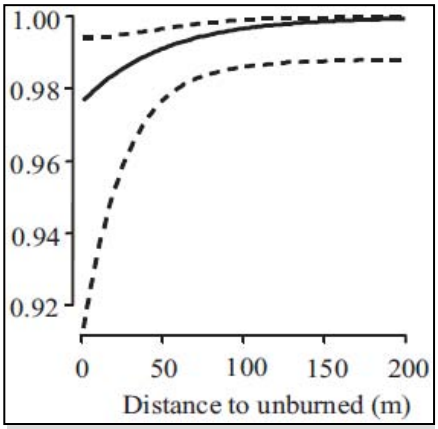


Figure 19. Daily nest survival rates of Black-backed Woodpeckers in burned forests of Idaho, 1994-2004 (from Saab et al. [2011]).

Woodpeckers foraged less frequently in the interior of a fire area in Alaska (Murphy and Lehnhausen 1998).

Some types of timber harvesting may reduce habitat suitability and nesting densities, but may not completely preclude nesting. Saab and Dudley (1998) documented 13 Black-backed Woodpecker nests in unlogged burned forests, and 2 nests in "standard salvage" stands in which the majority of merchantable trees were harvested, and 2 nests in "wildlife salvage" treatments in which about half of the merchantable trees were harvested. In unburned boreal forests of Quebec, Canada, Black-backed Woodpeckers were observed nesting in recent cuts subjected to uneven-aged stand management, where large snags suitable for nesting were left standing (Tremblay et al. 2015b). In unburned beetle-killed lodgepole pine forests in Oregon, "mature and overmature" stands were preferentially selected for nesting but 26% of the nests (n = 35) were located in harvested stands; 5 were in partial cuts, one was in a stand being converted to a shelterwood cut where only live trees >25 cm were removed, one was in a shelterwood cut, and two were adjacent to shelterwood cuts (Goggans et al. 1989). In both Goggans et al. (1989) and Tremblay et al. (2009) studies, Black-backed Woodpeckers were occasionally documented nesting in and around harvested stands, but preferentially foraged in older forests not recently subjected to timber harvest.

Figure 20. Male Black-backed Woodpecker excavating a nest cavity. Photo by Joseph Leibrecht

Snag density and size, pre-fire canopy closure, patch area, and burn severity were important factors in nest-stand selection in the Rocky Mountains. Several publications have emerged from a long-term research project conducted by the Rocky Mountain Research Station in two burned areas in western Idaho (Saab and Dudley 1998, Saab et al. 2002, Saab et al. 2004, Russell et al. 2007, Saab et al. 2009). This project has consistently documented that Black-backed Woodpeckers selected nest stands with the highest tree densities of all cavity-nesting bird species (average of 316 trees >23 cm per ha; Saab et al. 2009). Saab et al. (2002) found that high pre-fire crown closure was the most important variable in predicting presence of nests in stands of severely burned Douglas-fir forest. Probability of nest occurrence was highest in stands with high pre-fire crown closure (>70% crown closure pre-fire) covering >30 hectares. The best model describing Black-backed Woodpecker nest locations in Idaho included higher pre-fire crown closure, higher burn severity, larger diameter of trees, higher large-snag densities, and larger patch area of similar pre-fire vegetation type (Russell et al. 2007). Saab et al. (2009) again confirmed the best model for nesting habitat included greater patch area, large tree diameter, and

higher snag density, as well as greater area of medium (40–70%) or high (70%) pre-fire crown closure in a 1-km area surrounding the nest.

A study conducted in two burned areas in the Oregon Cascades also found significantly greater number of snags per hectare and significantly higher burn severity at Black-backed Woodpecker nests (n = 210) compared with random sites (Forristal 2009). The odds of nest occurrence nearly doubled for every 50 additional snags over 23 cm within a 50-m radius around the nest tree. Odds ratios indicated that Black-backed Woodpeckers selected nest sites in areas with higher snag densities and larger burned areas; tree density increased odds of nesting only if it coincided with increasing area of moderate or high burn severity. Vierling et al. (2008) documented that Black-backed Woodpeckers in burned forests of the Black Hills, South Dakota, selected larger-than-available trees for nesting that were farther from the edge of the burn, with less low-intensity fire and a greater snag density surrounding the tree than randomly sampled potential nest sites. The number of Black-backed Woodpecker nests was higher in sites with greater pre-fire canopy cover; 95% of nests were in areas where pre-fire canopy cover was medium (40–70%) or high (70–100%). Finally, Nappi and Drapeau (2009) found that Black-backed Woodpecker nest density and reproductive success were higher where high-severity fire occurred in old stands (canopy height >7 m), rather than in young stands (canopy height <7 m), in burned boreal forests of Quebec, Canada.

High tree densities appear to be important for nest-site selection in beetle-killed forests as well. In beetle-killed forests in Oregon, most Black-backed Woodpeckers nested in unlogged areas (silvicultural treatments were shelterwood cuts converted to stocking rate of 30 trees/acre prior to overstory removal), and selected mature or multi-storied stands for nesting (Goggans et al. 1989). In beetle-killed forests in the Black Hills, Bonnot et al. (2009) found the most important predictors of nest-site selection at the nest-area scale (12.5 m around nest) were increasing density of all pine and aspen snags >15 cm (used areas averaged 267.8 snags/ha) and decreasing diameter of those snags (average diameter = 22.3 cm). At a larger territory scale (20 ha around nest), the overriding feature of nest-site selection was a high abundance of wood-boring insects.

Foraging Habitat – In 3 fire areas in the Sierra Nevada, Black-back Woodpeckers preferentially selected larger snags (>50 cm) for foraging (Hanson 2007) and were observed foraging exclusively in high-severity burned patches that were not subject to post-fire snag removal (Hanson and North 2008). In burned areas on the Lassen National Forest, Siegel et al. (2012c) found a strong positive correlation between snag size and probability of use for foraging. In the same study, other factors that correlated with probability of use for foraging included the degree of scorch on the trunk and the amount of bark retained on the trunk, indicating that the woodpeckers selected trees that had been severely burned but had not yet decomposed substantially (Siegel et al. 2012b). At the spatial scale of a 10-m radius circle, Siegel et al. (2012b) found that the following factors, in decreasing order of importance, predicted stand-level

use for foraging: abundance of large (>60 cm dbh) snags, abundance of medium snags (30–60 cm), abundance of small (10–30 cm) snags, abundance of live trees, and abundance of logs.

Results are similar in other areas of the birds' range. Probability of foraging increased with increasing density of snags >25 cm in burned forests of Idaho (V. Saab, unpublished data). Foraged-upon snags were significantly larger than available snags in burned forests in Idaho and Montana, but the woodpeckers foraged in patches with higher-than-average densities of >30 cm snags only in one of two fire sites (Powell 2000). In the Black Mountains of South Dakota, the relative probability of Black-backed Woodpeckers foraging upon a tree was greater for dead than live trees and positively associated with dbh; the greatest probability of use were in trees that were both burned and infested with mountain pine beetles (Rota et al. 2014a). The relative probability of using an unburned tree was nearly 0 when any category of burned tree was available. In addition, relative probability of using a tree increased as the basal area of the surrounding of forest increased (Rota et al. 2014a).

In burned black spruce boreal forests of eastern Canada, the probability that a snag was used by foraging Black-backed Woodpeckers increased with a higher diameter and a lower deterioration value (Nappi et al. 2003). Larger, less-deteriorated snags were linked to greater availability of wood-boring beetle larvae. Black-backed Woodpeckers at two fire areas in the northern Rockies chose foraging locations with high prey densities at the individual-tree level, but not at the larger patch scale (Powell 2000). Powell suggested that the woodpeckers tracked prey density of individual trees when deciding where to forage.

Murphy and Lehnhausen (1998) postulated that Black-backed Woodpeckers may have foraged less frequently in the interior of a fire area in Alaska because trees were heavily scorched by the fire, resulting in relatively low larval survival there due to rapid desiccation of sapwood. However, Powell (2000) counted many wood-borers and signs of woodpecker foraging on completely scorched trees in the northern Rockies, and surmised that as long as moisture remained in the phloem, severely burned trees can contain high larvae densities and thus high foraging value for woodpeckers. Differences in woodpecker foraging between the study in Alaska and the northern Rockies might be attributable to bark thickness; thicker-barked trees that burn may retain more moisture in the phloem than thinner-barked trees.

In unburned boreal forests of eastern Canada, Black-backed Woodpeckers foraged mostly in coniferous stands >90 years old, and never in defoliated or old cut stands (Tremblay et al. 2009, 2010). At the home-range scale, the birds avoided recent (<5 year-old) cuts. "Cut stands" consisted of both even- and uneven-aged timber harvesting.

Roosting Habitat – Siegel et al. (2014b) located 14 unique night-time roosts of Black-backed Woodpeckers that were marked with radio-transmitters for a home-range study on the Wheeler Fire, Plumas National Forest. At nine roosts confirmed visually, none of the birds roosted in excavated cavities. Rather, they roosted in sheltered spaces within burned-out hollows of trunks

(5 instances), in the crook of a forked trunk (1 instance), wedged between adjacent trunks of two closely spaced trees (1 instance), in a deep, natural bark furrow (1 instance), and clinging to a trunk directly above a horizontal branch (1 instance). Eleven of the 14 roosts (79%) were in dead trees. The authors suggest that Black-backed Woodpeckers may benefit if, during salvage logging in burned forests, emphasis is placed on retaining snags with burned-out hollows, forked trunks, or other relatively unusual structures that may create crevices or other opportunities for shelter.

Home-Range Size – Home-range sizes of Black-backed Woodpeckers are relatively large. However, size appears to vary with habitat characteristics. Tingley et al. (2014) radio-tracked and estimated the home-range size and the relationship between home-range size and snag basal area for Black-backed Woodpeckers nesting in 3 recent fire areas in the northern Sierra Nevada in 2011 and 2012. Adjacent home ranges typically overlapped by <25%. Of the 15 woodpeckers with a large enough sample size of locations to estimate home-range size, the average home-range was 89 ha (24–304 ha) using a full (95%) kernel method. Three woodpeckers that foraged in primarily unburned forest had larger home-range sizes than the 12 woodpeckers that foraged primarily within burned forest. As snag basal area increased, home-range sizes exponentially decreased. Models of snag basal area also explained 54–62% of the variation in Black-backed Woodpecker home-range size while covariates (age of fire, age and sex of bird) were not competitive predictors of home-range size. Birds in the Tingley et al. (2014) study that foraged primarily in burned forest all had home ranges with an average snag basal area of at least 17 m^2/ha (measured across the entire home range), and the authors suggest this may be an appropriate guideline for management of recently burned forests for Black-backed Woodpeckers, although they also note that burned stands with greater snag basal area may support more Black-backed Woodpeckers because of smaller home-range sizes yielding greater population density.

Average home-range size of 2 males in 6-year-old post-fire forests, and 2 males in 8-year-old post-fire forests in Idaho was 429 ha (range = 150–766 ha) using 100 percent minimum convex polygon, and 207 ha (range = 115.6–420.9 ha) using fixed-kernel estimates (Dudley and Saab 2007). While sample sizes were small, home ranges were significantly larger 8 years than 6-years after fire, suggesting that woodpeckers forage over larger areas as the beetle population decreases over time.

Goggans et al. (1989) reported the median minimum convex polygon home-range size for 3 individual woodpeckers was 175 ha (range = 72–328 ha) in beetle-killed forests of Oregon; larger home ranges had smaller proportions of unlogged (i.e., not subjected to shelterwood cuts) and mature habitats, suggesting a need to range farther in areas of lower-quality habitats, although sample size was small. Minimum convex polygon home-range sizes of 7 Black-backed Woodpeckers in unburned boreal forests of eastern Canada averaged 151 ha (range = 100–256 ha), with a home-range size of 358.8 ha for a female whose breeding attempt failed (Tremblay et al. 2009).

In the Black Hills of South Dakota, Rota et al. (2014a) used radio-tracking to assess Black-backed Woodpecker home ranges in a variety of habitats, and reported that home range size was smallest in 1–2 year post summer wildfire habitat (mean home range size = 79 ha) and 2-year post fall prescribed fire habitat (mean home range size = 143 ha). Home range size was intermediate in mountain pine beetle infestations (mean home range size = 307 ha) and was greatest in 3–4 year post fire habitat (mean summer wildfire home range size = 430 hectares, mean fall prescribed fire home range size = 460 ha). The authors suggest 1–2 year post summer wildfire habitat are relatively more important to Black-backed Woodpecker populations than unburned, beetle-infested stands.

Potential Threats

Summary Points

- **Forest management practices including fire suppression, forest thinning and post-fire logging, may eliminate or reduce suitability of Black-backed Woodpecker habitat.**
- **Probability of occupancy and nesting by Black-backed Woodpeckers in burned forest is positively correlated with snag density.**
- **Most studies show that even partial or less-intensive post-fire snag removal that eliminates some but not all standing snags reduces occupancy and nesting density of Black-backed Woodpeckers.**

Forest management practices including fire suppression, forest thinning to reduce risk of high-severity fire, and post-fire logging, may be threats to Black-backed Woodpeckers.

Figure 21. Postfire forest management that removes most snags (as was the case in the treatment pictured above) is incompatible with Black-backed Woodpecker occupancy and reproduction, but management prescriptions that retain sufficient density of snags may support continued occupancy and reproduction by the species. Photo by Joanna Wu

Salvage Logging and Other Management Involving Post-fire Snag Removal –

Wildfire in forested environments is sometimes followed by the removal of dead or dying trees, in pursuit of one or more of many possible management goals. Often referred to as 'salvage' or 'salvage logging', it may be done to capture the economic value of wood products or for other reasons. Strictly speaking, as defined by the Society of American Forester's *Dictionary of Forestry*, salvage refers to "the removal of dead trees or trees damaged or dying because of injurious agents other than competition, to recover economic value that would otherwise be lost." Other reasons for post-fire snag removal may include:

- mitigating hazards associated with roads, trails, administrative sites, and/or other sites where people may find themselves in unacceptably hazardous situations.

- reducing hazards in areas where accelerated restoration of forested environments is desired for multiple reasons, including, for example, wildlife habitats that would otherwise be delayed without prompt reforestation actions.

- reducing hazards to fire-fighters and fire-fighting efforts during future wildfire events.

- reducing long-term fuel levels that could increase fire risk and jeopardize human safety or property, particularly within the wildland-urban interface (often referred to as the 'WUI") or could make loss of forest stands to subsequent wildfires more likely.

The specific number and arrangement of trees removed can vary greatly, depending on the site-specific ecological context and management objectives. However, 'salvage' does not necessarily mean extensive and complete removal of snags from an area. This variation in the intensity and design of projects involving post-fire snag removal complicates comparisons of studies that evaluate the effects of salvage or other management activity involving snag removal on Black-Backed Woodpeckers, particularly when metrics are not available on how many snags were removed and/or retained on the landscape. **Below we summarize research on the effects of post-fire logging on Black-backed Woodpeckers, but we caution that snag removal treatments, including treatments described as 'salvage', vary substantially between studies In many cases more detail about specific forest treatments is provided in the cited reports and publications.**

Black-backed Woodpecker abundance and reproductive success were lower in areas affected by post-fire snag removal in the Rocky Mountains, Canada, and Oregon (Saab and Dudley 1998, Hutto and Gallo 2006, Saab et al. 2007, Koivula and Schmiegelow 2007, Hutto 2008, Cahall and Hayes 2009, Saab et al. 2009). Saab and Dudley (1998) documented nest densities in Idaho were more than four times greater in unlogged postfire stands versus both "standard salvage" and "wildlife salvage" treatments (13 nests in unlogged, and 2 each in both logged treatments), despite partial snag retention in the treatments. Saab et al. (2007) reported that nest densities (n = 51) were more than 5 times higher in unlogged post-fire areas than in partially logged (40% of snags >23 cm were removed after the fire) post-fire area. In the first breeding season following the completion of salvage logging activity on USFS lands in the Chips Fire in the Northern Sierra Nevada, Black-backed Woodpecker abundance decreases significantly with increasing area salvaged within 100 m of a point count circle (Campos and Burnett 2015).

In Montana, Hutto and Gallo (2006) found 10 nests in 148 ha of burned stands not salvage logged, but 0 nests in 275 ha of stands where all merchantable fire-killed trees >15 cm had been removed. In recently burned forests of Alberta, Canada, 30 of 32 Black-backed Woodpecker

nests were in stands not subjected to salvage logging; treatments within salvage-logged stands ranged from 20 to 70% of merchantable trees removed (Koivula and Schmiegelow 2007). Burnett et al. (2011) did not find any Black-backed Woodpecker nests in two years of nest searching on heavily salvaged private lands where many merchantable trees were removed, while they found 0.61 nests per 20-ha plot on adjacent unsalvaged lands in the Moonlight Fire. In the eastern Oregon Cascades, Cahall and Hayes (2009) found that densities of Black-backed Woodpeckers were greater in unlogged compared to moderate and heavily salvage-logged stands. Moderate salvage logging retained 30 snags >35.6 cm per ha, and heavy salvage logging retained 5–6 snags >50.8 cm per ha. However, in the eastern Oregon Cascades, Forristal (2009) found that treatments retaining at least 25 snags/ha of various diameters, often leaving more standing snags, especially snags <23 cm, did not significantly reduce densities of snags— particularly lodgepole pine— at a landscape scale (1 km surrounding nest site) and did not negatively impact occurrence of Black-backed Woodpecker nests or nest survival. In the boreal forest, Schwab et al. (2006) reported reduced presence or complete absence of Black-backed Woodpeckers in response to varying-intensity salvage logging (25–100% of snags) within 2.5 ha areas of 10-ha plots.

Data from California also suggest that post-fire snag removal may decrease foraging habitat suitability for Black-backed Woodpeckers. Using passive surveys in 3 fire areas in the Sierra Nevada, Hanson and North (2008) detected Black-backed Woodpeckers only in high-severity burned stands that were not subject to any post-fire snag removal. Using broadcast methods in a larger sample of fires, Siegel et al. (2008, 2010) identified strong associations with the most intensely burned forests but also detected woodpeckers in moderately burned and, rarely, in low-intensity burned stands and occasionally in areas that had been previously treated with some degree of snag removal. Results from radio-telemetry studies indicate that Black-backed Woodpeckers strongly avoid foraging in areas where most of the snags had been removed in post-fire forest in California (Siegel et al. 2012a) and beetle-killed forests in Oregon (Goggans et al. 1989). Working at the Angora fire, near South Lake Tahoe, Tarbill et al. (*in press*) found that nest densities at the stand scale declined significantly in areas that were salvage logged in the fourth year after fire, but increased in 'snag islands' and other peripheral unlogged areas. Even though the snag islands were relatively small (54 ha, ~4% of the total burned area). The authors concluded that even though Black-backed Woodpeckers are sensitive to the effects of salvage logging, individuals will nest in areas adjacent to or even within logged areas, if the appropriate habitat characteristics are available.

***Additional Research Needs* – Further research could quantify the relative effects post-fire snag removal treatments of differing intensity and configuration on Black-backed Woodpecker occupancy and reproduction in California forests**.

Figure 22. Post-fire fuelwood cutting during May-July can destroy active nests. The stumps in this picture taken on Lassen NF were cut for firewood in early June, close to a Black-backed Woodpecker nest (indicated by red arrow) with week-old nestlings. Photo by Monica Bond

Fuelwood-cutting for Personal Use in Recent Fire Areas – Although systematic data on the effects of fuelwood cutting on nesting Black-backed Woodpeckers are not available, anecdotal observations (see image, left) indicate that small-scale harvesting of fuelwood by the public for personal use, from recent fire areas as well as unburned lodgepole pine forests, can destroy active Black-backed Woodpecker nests. Nests are commonly active between early May and early July (less commonly late April to late July), and felling of nest trees with nestlings during that period will cause nest failure.

Thinning or other Logging of Unburned Forests – Elsewhere in the range of the Black-backed Woodpecker, high densities of trees (*Alberta, Canada*: occupancy sampled in 191 stands using broadcast methods, Hoyt and Hannon 2002) and medium- and large-sized snags (*Eastern Oregon Cascades*: 395 foraging bouts from 3 radio-tagged birds, Goggans et al. 1989) have been correlated to Black-backed Woodpecker occupancy in unburned forests. In unburned boreal forest, some timber harvest prescriptions appear to reduce Black-backed Woodpecker occupancy; Tremblay et al. (2015) provide guidance for tailoring harvest prescriptions so that partially harvested stands of boreal forest can still support Black-backed Woodpeckers. In areas where Black-backed Woodpeckers occur in unburned forests in California, it seems likely that thinning or removal of medium- and large-sized snags may decrease habitat suitability, although some anecdotal evidence suggests that Black-backed Woodpeckers increase in abundance in aspen forests after conifers have been removed (R. Burnett, personal communication 2012). It should be noted, however, that the amount of dense forested habitat in the Sierra Nevada has increased substantially over the last century (e.g., Dolanc et al. 2014a,b; Stevens et al. 2016, Safford and Stevens *in press*), suggesting that conditions in many present-day dense stands may have been unusual prior to European settlement.

Thinning of unburned forest may also affect Black-backed Woodpecker habitat suitability after thinned areas subsequently burn. Pre-fire tree densities and canopy cover are correlated with high post-fire occupancy rates and nest densities (Russell et al. 2007, Vierling et al. 2008, Forristal 2009, Saab et al. 2009, Siegel et al. 2012b). Consistently with the correlations, Black-backed Woodpecker abundance in forests that were commercially thinned and then later burned in wildfire was lower than in burned forests that were not thinned before fire in the Rocky Mountains (Hutto 2008).

Climate Change and Forest Fire Trends – An analysis of Christmas Bird Count (CBC) data suggests that the center of abundance of Black-backed Woodpeckers during the winter has significantly shifted 100 miles north and over 130 miles inland throughout its North American range over the past 40 years, corresponding with increases in temperature (Audubon 2009). The Black-backed Woodpecker was listed as at-risk to climate change based on a California-wide vulnerability assessment for birds (Gardali et al. 2012), although a separate analysis by Siegel et al. (2014a), specific to the Sierra Nevada, classified the species as 'presumed stable' in response to climate change.

Modeled shifts in distribution of the Black-backed Woodpecker in California due to climate change (not accounting for changes in fire regime) predict range contractions of the species across the Sierra Nevada and southern Cascades. The most prominent decreases in occurrence are predicted in the northern portion of the species' range in California (Stralberg and Jongsomjit 2008), where the species is most common (Saracco et al. 2011), so the predicted range contraction in this region could signify cause for concern. The most important variables influencing current and projected distribution were annual mean temperature and precipitation in the Maxent and GAM distribution models, as well as vegetation in the Maxent distribution model (Stralberg and Jongsomjit 2008). It is important to note, however, that these climate envelope models do not take into account dynamic processes such as fire and, therefore, might underestimate the suitable habitat for disturbance-dependent species like the Black-backed Woodpecker. Furthermore, most of the data upon which these models were built were from unburned habitats.

Many species worldwide have shifted their ranges upslope in response to climate change (Pounds et al. 1999, Root et al. 2003, 2005). In the Sierra Nevada, numerous bird species already have responded to climate change by shifting their ranges to track preferred temperature or precipitation conditions (Tingley et al. 2009). If the Black-backed Woodpecker follows this pattern and shifts its range upslope as a result of climate change, even if the overall areal extent of habitat in California is reduced, substantial areas of coniferous forests are likely to be available for colonization at higher elevations, through predominantly in the southern Sierra Nevada where there is more high-elevation land mass.

The primary way climate change is likely to affect the Black-backed Woodpecker is not directly through temperature and precipitation changes per se, but rather through altered fire regimes, given that the species reaches its greatest abundance in moderate- and high-severity fire areas. There is a large and growing scientific literature on trends in wildlife size and severity in western forests, which is beyond the scope of this Conservation Strategy to synthesize in detail. Most studies (e.g., Miller et al. 2009, Westerling et al. 2011, Yue et al. 2013, Mallek et al. 2013, Miller and Safford 2012, 2017; Restaino and Safford *in press,* Safford and Stevens *in press*) indicate frequency and patch size of high-severity fire is increasing and will continue to do so in the future due to the interaction between climate warming, increased vegetation from past fire suppression, and more profound fire-season drought resulting from anthropogenic climate

change. If this is the case, Black-backed Woodpeckers are likely to benefit, at least in the short-term. Other studies (e.g., Odion et al. 2014; Hanson and Odion 2013; Baker 2014, 2015) have challenged the low- to moderate-severity fire paradigm for yellow-pine mixed conifer forests, suggesting high severity fire was more prevalent historically than currently, although in some cases methods or interpretation of results have been challenged by others (for examples see Fulé et al. 2014, Stephens et al. 2015, Stevens et al. 2016, Levine et al. 2017, Miller and Safford 2017).

An emerging question requiring further study is how fully the apparent habitat provided by particularly large 'megafires' that have occurred throughout the region in recent years will be utilized by Black-backed Woodpeckers. Although some relatively large fires in recent years were heavily colonized by Black-backed Woodpeckers (e.g., the Chips, Reading, and Barry Point fires in 2012; Tingley et al. 2016), the 2013 Rim Fire and the 2014 King Fire are examples of recent megafires that appear to have been only very sparsely colonized, at least initially, for reasons that remain unclear (A. White, in preparation).

***Additional Research Needs* – Conduct population viability assessments under varying climate and forest management scenarios.**

Bark Beetle Management – Black-backed Woodpeckers are specialized to forage upon larvae of wood-boring beetles and, to a lesser degree, bark beetles. Efforts to reduce impacts of bark and wood-boring beetles through insecticide applications, forest thinning, planting genetically modified tree stock, and salvaging beetle-infected trees may also reduce prey for Black-backed Woodpeckers, though no published information is available.

Disease – To our knowledge, information on disease in Black-backed Woodpeckers comes from only a single study (Siegel et al. 2012a). For an investigation of Black-backed Woodpecker home-range size and foraging ecology, 9 birds were radio-tagged on Lassen National Forest (Shasta and Lassen Counties, California) during the 2011 breeding season. One of the marked birds was found dead after being tracked for a 10-week period in which it successfully nested. A necropsy of the dead bird revealed that it was emaciated and autolyzed, with the presumptive cause being numerous spiruroid nematodes of the genus *Procyrnea* in the gizzard. The life-cycle of *Procyrnea* requires arthropods as intermediate hosts, which are then consumed by the definitive host, where the nematodes parasitize the upper gastrointestinal tract. Apparent intermediate hosts of *P. pileata* include pillbugs (*Armadillidium vulgare*) and earwigs (*Euborellia annulipes*) (St. Leger, unpublished data), neither of which are likely to be consumed by Black-backed Woodpeckers foraging by excavating the larvae of wood-boring beetles and bark beetles from within dead or ailing trees. However, during 1,198 observations of Black-backed Woodpecker foraging bouts, the gleaning of prey items from the outer surface of tree bark was noted as part of 113 bouts (9.4%). Gleaning prey items from the surface of tree trunks and logs introduces the potential for more frequent consumption of arthropods that could be *Procyrnea* vectors.

The observation of *Procyrnea* nematodes in a Black-backed Woodpecker is notable because the *Procyrnea* infection was considered lethal and because *Procyrnea* has been implicated in substantial die-offs in other bird species, including woodpeckers (Foster et al. 2002, Siegel et al. 2012a). While the Black-backed Woodpecker fatality reported by Siegel et al. (2012a) is only an anecdotal incident, it has been suggested that disease from helminth parasites may be severe enough to regulate bird populations in some cases (Peterson 2004).

DECISION SUPORT TOOLS

Summary Points

- **Several well-vetted decision support tools are available to help land managers incorporate Black-backed Woodpecker habitat considerations into forest management decisions that are likely to affect the species.**

Defined loosely here as 'data-driven models and explicit analytical approaches to inform decisions about habitat management', decision support tools (especially tools that have been well-vetted and undergone scientific peer review) can provide help and guidance to land managers grappling with how to best balance competing objectives in the management of burned forests. Below we describe four currently available tools, particularly those based on data from California ecosystems; in recent years the U.S. Forest Service in California has relied most heavily on the first two. We encourage land managers to explore the use of additional or further refined tools as they become available.

1. The California Wildlife Habitat Relationships system (CWHR; Mayer and Laudenslayer 1988) is widely used by Sierra Nevada land managers to assess habitat suitability for species of conservation interest. Based on the information summarized above, we suggest that within recently burned forest, large snags indicative of preferred foraging habitat for Black-backed Woodpeckers correspond roughly to CWHR class 4M, 4D, 5M, or 5D (where size class 4 indicates dbh = 11–24", size class 5 indicates dbh >24", M indicates pre-fire canopy closure of 40–59%, and D indicates pre-fire canopy closure >59%). Medium- and smaller-diameter snags typical of nesting habitat roughly correspond to CWHR size class 4M or 4D, or occasionally 3M or 3D (where size class 3 indicates dbh = 6–11"). However, size class selection for foraging and nesting is somewhat fluid; birds may also nest in class 5 stands, and forage in class 3 stands. Recognizing this fluidity, we suggest that land managers assessing habitat suitability of burned forests within the Black-backed Woodpecker's range in California should consider stands with the following pre-fire CWHR classifications to be at least potentially suitable Black-backed Woodpecker habitat after fire: 3M, 3D, 4M, 4D, 5M, or 5D.

2. Tingley et al. (2015, 2016) developed and validated a spatially explicit Black-backed Woodpecker Abundance (BWA) model (sometimes informally referred to as the 'Tingley model') for predicting the likely effects of spatially explicit harvest scenarios on local Black-backed Woodpecker populations. The model, which has been routinely used in recent years by U.S. Forest Service personnel designing and evaluating post-fire forest management plans,

utilizes widely available geospatial environmental data to make predictions, and can therefore be implemented just weeks to months after a fire has burned.

The model requires only widely available, remote-sensed environmental information as inputs, so targeted surveys for Black-backed Woodpeckers are not required to predict abundance. The model takes fine-scale environmental variables covering the entire footprint of a fire and converts them to a predicted Black-backed Woodpecker abundance surface at an approximate resolution of 30x30-m. Our code (see section below) for the BWA model provides one of two output options. The model itself is the direct product of three component models. The first component, an occupancy model, estimates the probability of occupancy at a particular location, as a function of a variety of environmental covariates, and indicates the general suitability of a post-fire landscape for Black-backed Woodpecker occupancy. To estimate abundance, the occupancy component is multiplied by a second component, which predicts the density of Black-backed Woodpecker territories in occupied habitat. This second component of the model is derived from work examining the variation of home-range sizes of Black-backed Woodpeckers (Tingley et al. 2014b), which determined that home-range size scales exponentially with the basal area of snags within occupied territories. Black-backed Woodpeckers occupying territories with greater densities of snags have smaller home ranges. The final component of the model predicts the snag basal area expected in each pixel based on remotely-sensed pre-fire and post-fire environmental conditions. This final component is necessary in order to implement the home-range size model, which requires snag basal area as an input.

3. Casas et al. (2016) provide a more nuanced spatially explicit approach for predicting which areas of a burned forest are likely to be most valuable for Black-backed Woodpeckers – a determination that could be used to select retention areas when post-fire logging is to occur. The authors used Airborne Laser Scanning (ALS) to detect and characterize individual conifer snags across the footprint of the 2013 Rim Fire in the central Sierra Nevada, and then estimated pixel-scale snag basal area, and then, based on conifer snag basal area across Black-backed Woodpecker home ranges studied by Tingley et al. (2014), mapped contiguous areas with potential (i.e., snag basal area > the lowest mean basal area observed across any Black-backed Woodpecker home range) or optimal (i.e., snag basal area > the 50th percentile of average basal area values observed across any Black-backed Woodpecker home range) habitat. Optimal and potential habitat for Black-backed Woodpecker comprised 53.7 km^2 and 58.4 km^2, respectively, representing 5.1 and 5.6% of the footprint of the Rim Fire. The resulting maps of potential and optimal habitat could then be used to help select individual stands for retention or harvest, based on their likely value to Black-backed Woodpeckers if retained.

4. Latif et al. (2013) developed ensemble habitat suitability models for Black-backed Woodpeckers in 20 recently burned (≤ 6 years) dry mixed conifer forest areas of Montana using nest locations from fires in Idaho, Oregon, and Washington and then later (Latif et al.

2016) explored factors that constrain the transferability of woodpecker habitat suitability models between fires or regions. Latif et al. suggest models developed at any one wildfire location are unlikely to be generally applicable across the entire range of Black-backed Woodpeckers, and conclude that generally applicable models to inform post-fire forest management likely require integration of data from multiple wildfire locations.

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Appendix A: Habitat Photo Gallery

Part 1: Black-backed Woodpecker occupied habitat and nests in burned forests in California.

Figure A1. Rich Fire, Plumas National Forest. Photo by Joanna Wu

Figure A2. Mud Fire, Stanislaus National Forest. Photo by Dayna Mauer

Figure A3. Mountain Fire, Stanislaus National Forest. Photo by Dayna Mauer

Figure A4. Broder Beck Fire, Sequoia National Forest. Photo by Dayna Mauer

Figure A5. Clover Fire, Sequoia National Forest. Photo by Dayna Mauer

Figure A6. Sugarloaf Fire, Lassen National Forest. Photo by Joseph Leibrecht

Figure A7. Bassets Fire, Tahoe National Forest. Photo by Eric Huston

Figure A8. Fletcher Fire, Modoc National Forest. Photo by Eric Huston

Figure A9. Crater Fire, Inyo National Forest. Photo by Stephen Shunk

Figure A10. Moonlight Fire, Plumas National Forest. Photo by Eric Huston

Figure A11. Black-backed Woodpecker nest stand in burned forest, Sugarloaf Fire, Lassen National Forest. Photo by Anna Szeitz

Figure A12. Black-backed Woodpecker nest stand in burned forest, Angora Fire, Lake Tahoe Basin Management Unit. Nest cavity visible on snag in the forefront. Photo by Stephen Shunk

Figure A13. Black-backed Woodpecker nest cavity, Peterson Fire, Lassen National Forest. Photo by Stephen Shunk

Figure A14. Black-backed Woodpecker nest cavity, Angora Fire, Lake Tahoe Basin Management Unit. Photo by Stephen Shunk

Part 2: Black-backed Woodpecker occupied habitat and nests in unburned forests in California.

Figure A15. Black-backed Woodpeckers are sometimes found in unburned lodgepole pine forests far from recently burned areas, as was the case in this stand in Yosemite National Park. Photo by Bob Wilkerson

Figure A16. Black-backed Woodpecker nest in unburned forest, Sierra National Forest. Photo by Vincent Weber, courtesy of Point Blue

Figure A17. Black-backed Woodpecker nest in unburned forest, Lassen National Forest. When Black-backed Woodpeckers nest in live trees they often remove bark from around the cavity entrance, as pictured. Photo by Ryan Burnett, courtesy of Point Blue