Birds and Burns of the Interior West

Descriptions, Habitats, and Management in Western Forests

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ABSTRACT

This publication provides information about prescribed fire effects on habitats and populations of birds of the interior West and a synthesis of existing information on bird responses to fire across North America. Our literature synthesis indicated that aerial, ground, and bark insectivores favored recently burned habitats, whereas foliage gleaners preferred unburned habitats. Cavity-nesting birds responded more favorably than open-cup nesting species. Trees weakened by fire attract bark and wood-boring beetles—an important food source for woodpeckers—and are also more easily excavated for nesting than green trees. Retention of large-diameter trees and snags allows for population persistence of cavity-nesting birds. Overall, a greater percentage of birds, both migrants and residents, showed a response to prescribed burns during the year of the treatment than in the year after. Fewer species responded 1 year after treatments, which suggests that the influence of prescribed fire on these birds may be short term. Responses to prescribed fire were variable for migratory birds, whereas residents generally had positive or neutral responses. We found that prescribed burn treatments not only destroy snags, but also recruit snags of all sizes. Managers are faced with a variety of options for fuels and fire management. Our results indicate that both prescribed burning and fire suppression influence habitats and populations of wildlife.

Keywords: Prescribed fire, avian ecology, migratory birds, woodpeckers, snags, wildlife habitat, cavity-nesting species, fire management.

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INTRODUCTION

The Birds and Burns Network initiated a regional study in 2002 to evaluate the effectiveness of prescribed fire in reducing fuels and to assess the effects of fuel reduction on habitats and populations of birds in ponderosa pine forests throughout the interior West (fig. 1)

Ponderosa pine forest.

(http://www.rmrs.nau.edu/lab/4251/birdsnburns). The primary purpose of this publication is to present information useful to land managers for understanding relationships between fire and avian ecology, conducting environmental analyses, and directing land management activities that maintain or enhance avian habitats while concurrently reducing fuels. Another purpose of this publication is to present a synthesis of existing information on bird responses to fire (wildland fire and prescribed fire) across North America (Saab and Powell 2005), with the intention of helping the public gain a better understanding of the ecological consequences of fire management. The synthesis is based on results for 203 bird species from more than 100 studies that evaluated primarily short-term responses (<6 years after fire) to low- or moderate-severity fires. We first present the synthesis information on bird responses to fire across North America and secondly report results of the Birds and Burns Network study of the interior West.

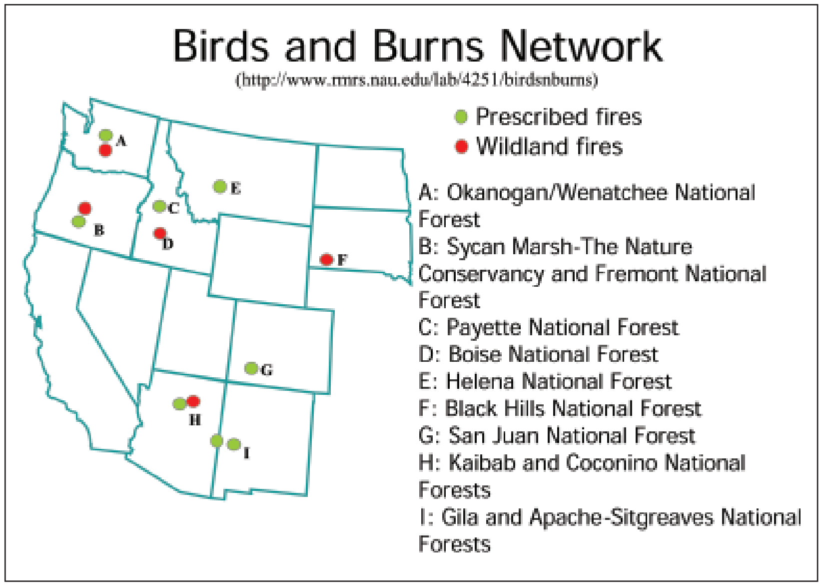


Figure 1—Study area locations for the Birds and Burns Network.

SYNTHESIS OF FIRE AND AVIAN ECOLOGY IN NORTH AMERICA

Fire-created habitat for foraging and nesting

Generally, forest structure and avian communities change rapidly after fire, depending on the severity of the fire (Kotliar et al. 2002, Saab and Powell 2005). Fire creates nesting and foraging habitat for birds by different mechanisms, but the process depends on prefire conditions, such as vegetation types, crown closure, and climate (fig. 2) (Kotliar et al. 2002, Saab et al. 2002). During a fire, if soil temperatures stay below 175 °C, nutrient releases enhance plant growth and vigor (Agee 1993). This regrowth often leads to increased abundance of flowers, seeds, and insects, which brings in aerial insectivores, nectarivores, and seed eaters (Kotliar et al. 2002, Saab et al. 2004). Fire also creates logs and standing dead and dying trees that are susceptible to attack by bark (Scolytidae) and wood-boring (Cerambycidae and Buprestidae) beetles (Werner 2002), primary food sources for many woodpeckers. Large-diameter (generally >23 cm diameter

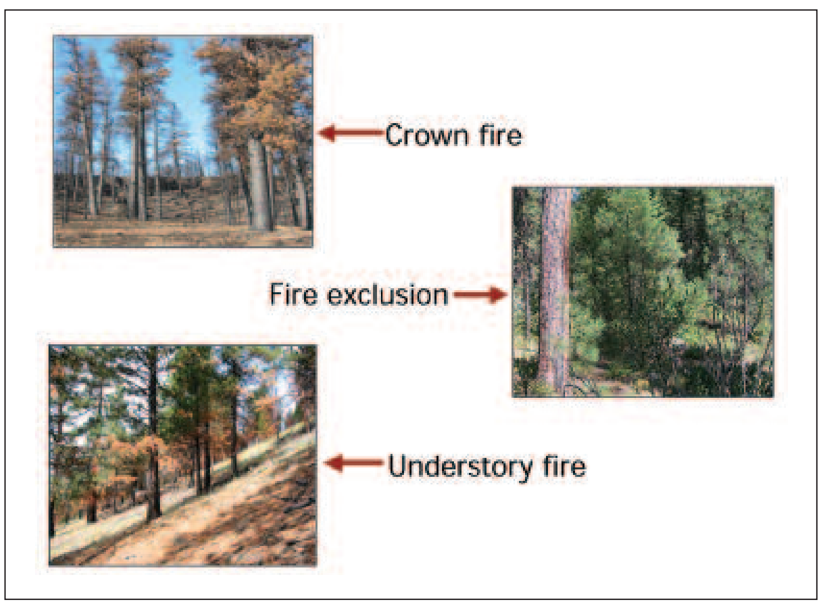
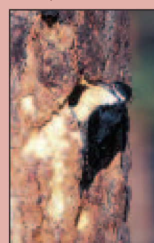


Figure 2—Habitat conditions created by crown fire, fire exclusion, and understory prescribed fire.

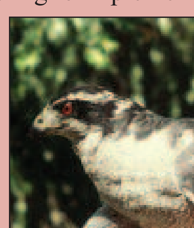
Rationale for studying fire and avian ecology

We study fire and avian ecology because the long-term persistence of many bird species, including several designated as threatened, endangered, or sensitive by federal and state agencies (for example red-cockaded woodpecker [endangered species] and black-backed woodpecker [sensitive and management indicator species] [see "Species list" p. 18]), is dependent on landscape patterns created by fire (e.g., Saab and Powell 2005), whereas other species prefer fire-excluded forests (Bond et al. 2002, Jenness et al. 2005). Many cavity-nesting birds (species requiring cavities in trees), in particular, are dependent on postfire forests, and are responsive to fire, timber harvest, and fuel reduction activities.



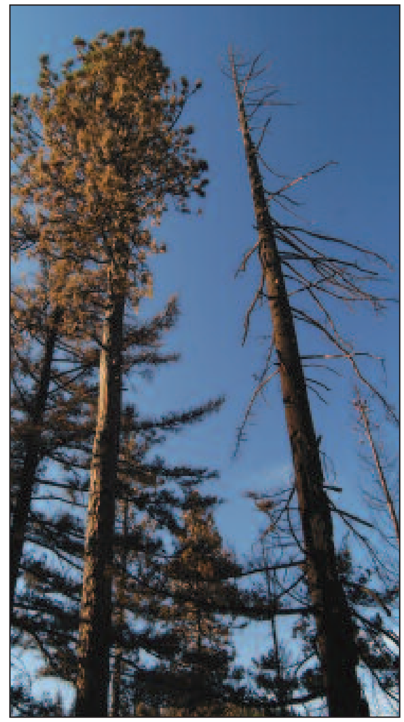
Female black-backed woodpecker.

Alterations in fire regimes of lower elevation forests have increased the risk of stand-replacing wildfire and risks to human communities (Agee 1993, Saab et al. 2005, Schoennagel et al. 2004). Because of these alterations, land management agencies are reducing fuel loads by several methods, including prescribed fire and tree harvest, with an emphasis on treating areas around communities at risk of wildfire. Many of these fuel reduction plans focus on reducing hazards of wildfire, with less consideration given to effects on wildlife populations and their habitats. Furthermore, a lack of scientific information prevents managers from adequately predicting the environmental effects of various fire management activities on bird communities and their habitats. This presents significant legal, scientific, and social ramifications for land management agencies attempting to implement national fire programs. Specifically, fire effects on bird species such as Mexican spotted owl, northern goshawk, and black-backed woodpecker have been included in appeals and litigation claiming violations of requirements under the Endangered Species Act (ESA 1973) and National Forest Management Act (NFMA 1976). In addition, prescribed fire effects on migratory bird species have been incorporated into litigation declaring violations of the Migratory Bird Treaty Act (MBTA 1918).



Northern goshawk.

at breast height [d.b.h.]) snags, trees with decay, and downed logs are particularly important because they are relatively easy for woodpeckers to excavate and they provide roosting, nesting, and foraging habitat for a variety of wildlife (Bull et al. 1997, Hall et al. 1997, Kreisel and Stein 1999, Scott 1979, Szaro et al. 1988). Recently burned forests might also reduce populations of nest predators (Saab and Vierling 2001) such as tree squirrels (*Tamiasciurus* spp.) and weasels (*Mustela* spp.) because their habitats are altered or eliminated (Fisher and Wilkinson 2005). Having fewer predators soon after fires likely allows for higher reproductive success and productivity of cavity-nesting birds (Saab and Vierling 2001).



Snag (standing dead tree) in a pine forest.

Maintenance and recruitment of snags >23 cm d.b.h. is particularly important because these snags have greater longevity and provide wildlife habitat for a longer period than smaller snags (Chambers and Mast 2005, Everett et al. 1999, Morrison and Raphael 1993, Raphael et al. 1987, Russell et al. 2006). Additionally, retention of large-diameter trees and snags is necessary for population persistence of cavity-nesting birds because these forest components are used disproportionately more for nesting and foraging than smaller trees and snags (Bull et al. 1997, Lehmkuhl et al. 2003, Li and Martin 1991, Raphael and White 1984, Saab et al. 2002). Large, older live trees also eventually provide dead wood substrates when they succumb to lightning strikes, beetle infestations, pathogens, or some combination thereof (Boucher et al. 2000). These trees are often referred to as "spike tops" or "living snags" because the tops and other portions of the trees are dead and provide opportunities for cavity excavation. In postfire habitats, management practices that retain

Douglas-fir snag with a nest cavity above created by a northern flicker and a hole below that was created by a common raven. The hole below allowed the ravens to remove and consume the nestling flickers.

dense stands of snags will also promote the longer term persistence of suitable nesting snags for cavity-nesting birds (Russell et al. 2006). Retention of snags <23 cm d.b.h. is also important because they provide valuable foraging substrate as well (Covert-Bratland et al. 2006).

In unburned forests, most cavity excavators select nest and roost sites in snags or trees whose large heartwood centers are decayed and softened by heartrot fungi (Bull et al. 1997). The thin layer of sound sapwood then provides both thermal and protective cover. Ponderosa pine (*Pinus ponderosa* P. & C. Lawson), unlike most conifers, contains a thick layer of sapwood with a hardened exterior shell and is also easily excavated by cavity nesters if the sapwood has undergone decay (Bull et al. 1997). In burned habitats, the initial nest selection process is similar. As decay fungi soften the wood of fire-killed trees, more snags become available for nest sites. The snags and trees preferred for excavating in the first few years after fire are best identified by their large size and broken tops (Hutto 1995, Saab and Dudley 1998).

Several studies suggest protecting nest trees by removing combustible materials around their base prior to burning to reduce losses of suitable nesting and roosting snags (Horton and Mannan 1988, Machmer 2002, Tiedemann et al. 2000). These methods are labor intensive and likely cost prohibitive for large-scale prescribed fire programs, unless large snags are rare or snag protection is required for threatened and endangered species. Rather than removing combustibles to protect existing snags, we found that prescribed fire can be an effective tool to create snags of various sizes (Saab et al. 2006a).

Another important habitat element for wildlife is downed wood. Maintenance of large, downed wood is important ecologically because these structures provide foraging habitat, thermal cover, and concealment for many sensitive wildlife taxa, including reptiles, amphibians, mammals, and birds (Bull et al. 1997, Converse et al. 2006, Szaro et al. 1988). Downed wood can be consumed by low-severity burns depending on wood moistures and the timing of fires (Brown et al. 1985). If maintenance of downed wood is a management objective, seasonality of prescribed burning should be considered for times when moisture contents are higher and fire severity effects are lower (Thies et al. 2005).

Patterns of Guild Responses to Fire

Bird responses to fire can be evaluated by nest type and nest layer guilds (see definitions in sidebar on guilds). Although some patterns exist in guild responses to fire, members of any guild can respond differently to fire severity classes; therefore, we caution against “one severity fits all” for any particular guild. Results from our review of fire and avian ecology in North America indicated that aerial, ground, and bark insectivores clearly favored recently burned habitats (generally within 6 years of low- to moderate-severity fire), whereas foliage gleaners preferred unburned habitats (Saab and Powell 2005). Most cavity-nesting birds responded more favorably to newly burned habitats than species with open-cup nests, and those nesting on the ground and in the canopy layers typically favored burned habitats compared to shrub nesters. Snags are often created in newly burned habitats, providing nesting and foraging for many cavity-nesting birds. Shrub layers, however, are typically reduced immediately after fire, resulting in habitat loss for shrub-nesting species. In contrast, canopy layers may be unchanged by low- to moderate-severity fires, retaining habitat for canopy-nesting species.

Effect of Time Since Fire

Bird population densities vary with time since fire depending on the nesting and foraging requirements of various species. Early postfire forests and associated insect outbreaks attract cavity-nesting birds because of increases in nest sites and food supplies (e.g., Kotliar et al. 2002). The duration of occupancy differs among bird species, presumably owing to differences in preferred prey availability, as well as the size, distribution, and decay of snags. Beetle-foraging woodpeckers (black-backed, hairy, and three-toed woodpeckers [see

What Are Guilds?

A guild is a group of functionally similar species in an ecological community that exploits the same set of resources in a similar fashion, but is not necessarily closely related taxonomically (Root 1967). Birds can be grouped according to nesting or foraging characteristics.

Examples of guilds:

Nest type guild

Cavity: Enclosed nests are located in natural or excavated cavities—often found in old, live trees or snags.

Open: Nests are built in open spaces without enclosures, e.g., on a tree branch.

Nest layer guild

Ground: Placement of the nest is on or very near the ground.

Shrub: Placement of the nest is in a shrub or mid-canopy tree layer (understory).

Canopy: Placement of the nest is in the high-canopy tree layer (overstory).

Foraging guild

Aerial insectivore: Predominantly captures flying insects.

Bark/wood insectivore: Predominantly gleans insects from the boles of trees and from furrows in the bark, or by drilling into bark and sapwood to obtain bark and wood-boring beetles.

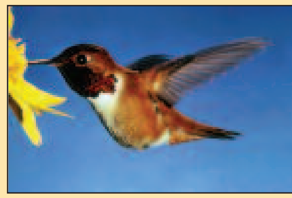
Ground insectivore: Predominantly gleans insects from the ground or substrates near the ground. For example, the American robin.

Foliage insectivore: Predominantly gleans insects from foliage.

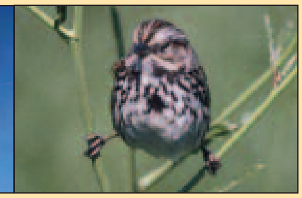
Carnivore: Captures and eats vertebrate prey. For example, the northern goshawk.

Nectarivore: Feeds on nectar produced by flowering plants. For example, the rufous hummingbird.

Omnivore: Feeds on a variety of foods, including invertebrates, fruits, seeds. For example, the song sparrow.



Male rufous hummingbird.



Song sparrow.

Examples of species by guild:

Cavity-nesting species
- Hairy woodpecker
- Western bluebird
- Northern flicker

Mountain bluebird.

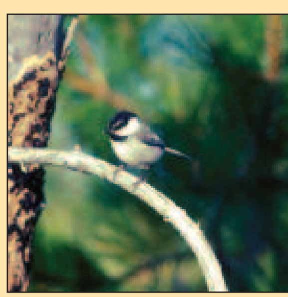
Open-cup nesting species
- Yellow warbler
- Warbling vireo
- Chipping sparrow

Bark/wood foragers
- Black-backed woodpecker
- Three-toed woodpecker
- Hairy woodpecker

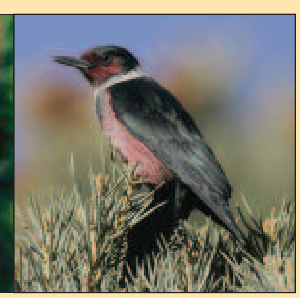
Foliage gleaners
- Mountain chickadee
- Ruby-crowned kinglet
- Swainson's thrush

Aerial insectivores
- Lewis's woodpecker
- Olive-sided flycatcher
- Mountain bluebird

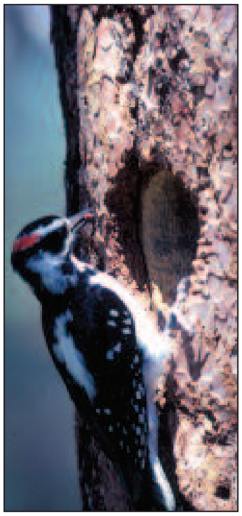
American robin.



Mountain chickadee.



Lewis's woodpecker.



Male hairy woodpecker.

"Species list" p. 18]) rapidly colonize stand-replacement burns within 1 to 2 years after fire. These woodpeckers typically remain at high densities 2 to 4 years after fire, then decline as beetle abundance declines (Covert-Bratland et al. 2006, Murphy and Lehnhausen 1998, Saab et al. 2007) (fig. 3). Within 5 years postfire, beetle-foraging woodpeckers become rare, presumably owing to declines in bark and wood-boring beetles. In contrast, aerial insectivores such as Lewis's woodpecker and mountain and western bluebirds are abundant in both recent burns (2 to 4 years) and older burns (10 to 25 years) (Saab and Vierling 2001, Saab et al. 2007) (fig. 3).

Depending on severity (Agee 1993), regrowth of understory vegetation and plant colonization within a few years after a fire often lead to increased abundance of flowers, seeds, and insects, which brings in aerial and ground insectivores, nectarivores, and seed eaters (Hannon and Drapeau 2005). Aerial insectivores often use burned forests up to 20 years after fires, presumably in response to improved conditions for aerial foraging owing to decreases in canopy cover and increases in flying insects associated with shrub regrowth (Saab and Vierling 2001, Saab et al. 2004). Many species absent immediately postfire begin to increase in mid-successional stages (30 to 80 years) as snags decay and fall, and canopy cover increases. Foliage gleaners reach peak abundance in mid-successional mature forests (Hannon and Drapeau 2005, Huff and Smith 2000, Raphael et al. 1987) (fig. 4).

Habitat Selection by Fire-Associated Cavity-Nesting Birds

Cavities can be created by decay-causing organisms (fungi) or by excavators such as woodpeckers, which are known as primary cavity excavators (Gibbons and Lindenmayer 2002). Secondary cavity nesters are those that depend on existing cavities created either by decay or by primary cavity excavators (Raphael and White 1984). Many other species of vertebrates and invertebrates use cavities as diurnal or nocturnal shelter sites,

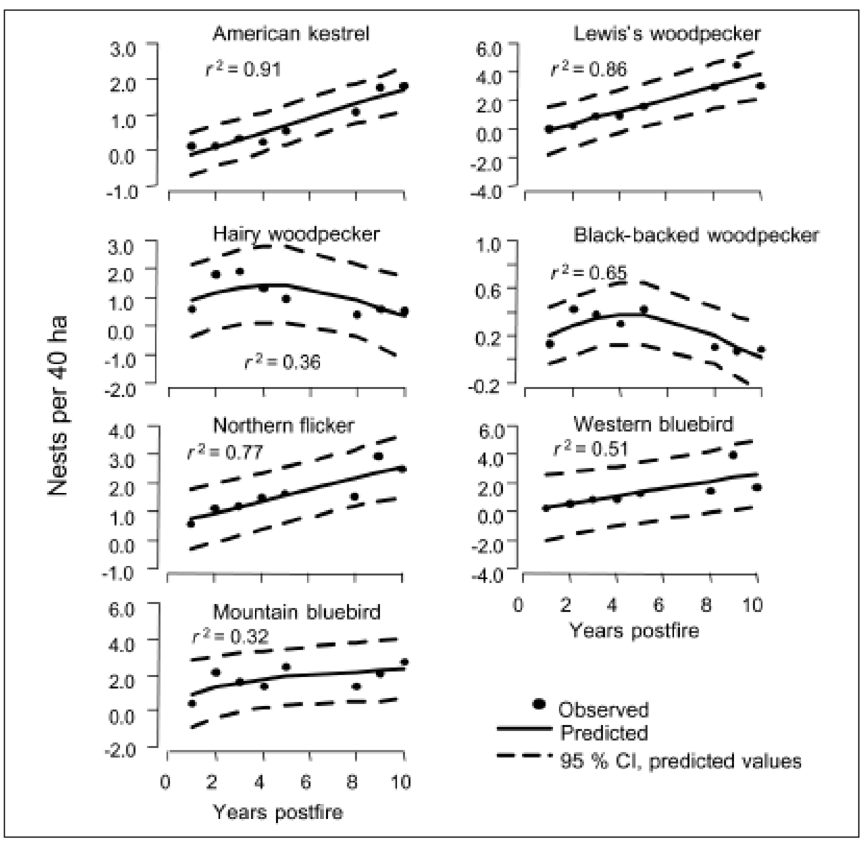


Figure 3—Observed and predicted nest density trends (nests per 40 ha) for seven species of cavity-nesting birds in the Star Gulch Burn 1 to 10 years after fire (1995 to 2004) in western Idaho (from Saab et al. 2007). Hairy and black-backed woodpeckers are beetle foraging species, whose nesting densities peaked about 4 to 5 years after fire.

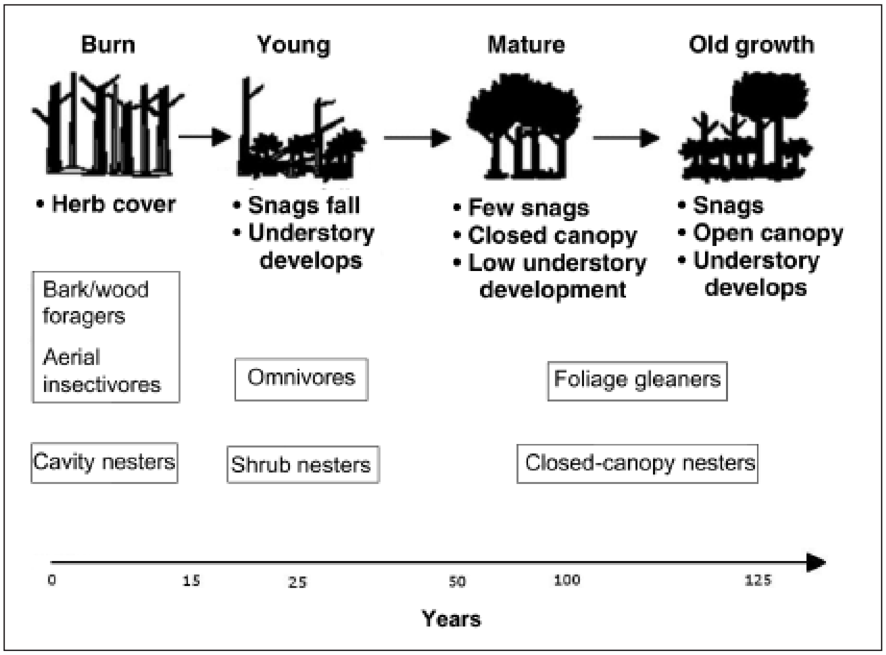


Figure 4—Changes in vegetation and bird communities in relation to time since fire (from Hannon and Drapeau 2005).

for rearing young, for feeding, and for thermoregulation (Bull et al. 1997, Martin and Eadie 1999, McComb and Noble 1982). For many species, the use of cavities is obligate: no other habitat resource represents a feasible substitute (Gibbons and Lindenmayer 2002).

Habitat requirements of cavity-nesting birds differ by species. The range of tree diameters and densities used by cavity nesters varies by availability in both burned and unburned habitats. When they are available, large (>23 cm d.b.h.), moderately decayed snags and areas of higher snag densities are used disproportionately more than small, less decayed snags and areas of lower snag densities (Lehmkuhl et al. 2003, Li and Martin 1991, Mannan et al. 1980, Raphael and White 1984, Saab et al. 2002). For example, in forests of

Fire and Mexican Spotted Owls

Sometimes, avian habitat can be destroyed after fire. For example, fires can negatively affect the Mexican spotted owl, a carnivorous species that mostly feeds on small mammals. Stand-replacement fire can eliminate spotted owl nesting and roosting habitat, which is composed of structurally complex forests with a variety of age and size classes, a large tree component, many snags and logs, and high canopy closures (Bond et al. 2002, Jenness et al. 2005). However, fire at less than stand-replacing severity may enhance these habitats. Moderate-severity wildfire creates snags, and low-severity prescribed fire reduces fuel loads and decreases the likelihood of future fire events, including stand-replacing fires (Jenness et al. 2005).

Fire and Sage Grouse

Prescribed fire has been promoted widely as a tool to improve habitat quality for nesting and brood-rearing of the omnivorous sage grouse, although direct evidence is lacking (Knick et al. 2005). The primary management objective for using fire is to create a mosaic of shrub, forb, and grass patches at various spatial scales. In mountain big sagebrush (*Artemisia tridentata vaseyana* Rydb.), burns may be conducted to limit the expansion of fire-prone juniper (*Juniperus* spp.) and pinyon pine (*Pinus* spp.), while restoring the integrity of shrubsteppe habitats. Burning in shrubsteppe can also reduce potential perches for raptors, and subsequently, potential depredation of sage grouse. The outcomes of fire on sage grouse habitat may be a function of site potential, site condition, functional plant groups, and pattern and size of burn (Knick et al. 2005).

western North America, Lewis's woodpecker and black-backed woodpecker are strongly associated with habitat components resulting from mixed-severity or stand-replacement burns (Saab et al. 2002, 2004). Black-backed woodpeckers selected nest sites (n = 46) with high snag densities (mean = 319 ± 24 SE snags/ha) of relatively smaller diameter (mean = 40 ± 2 SE cm d.b.h.), whereas Lewis's woodpecker selected nest sites (n = 184) with moderate snag densities (mean = 230 ± 13 SE snags/ha) of large diameters (mean = 52 ± 2 SE cm d.b.h.) (Saab et al., in press). Nest-site selection by these two species in burned forests of Idaho represents a range of conditions that likely incorporate the habitat needs of other members in the cavity-nesting bird guild (Saab et al. 2002).

Bird Associations With Different Burn Severities: Examples From Interior Western Forests

Few studies have compared avian abundances across various burn severities in reference to unburned forests in the Western United States (Bock and Block 2005b; Covert-Bratland et al. 2006; Kotliar et al. 2002; Russell et al., in press; Saab et al. 2005, Smucker et al. 2005). We can, however, extrapolate from existing information on habitat requirements of birds to make some predictions about their responses to burn severity. We use forest landscapes of the interior West to illustrate these

High severity, stand-replacement burn.

Understory prescribed burn.

Regrowth of understory vegetation after a prescribed burn.

Forest without fire for several decades.

Crown fire event.

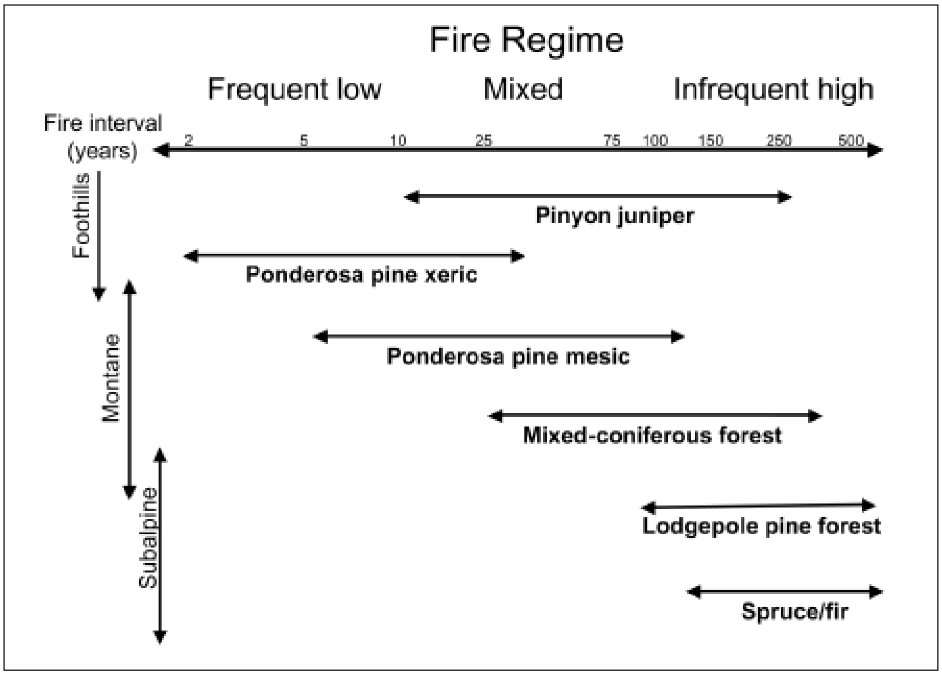


Figure 5—Range of fire regimes across forest community types in Rocky Mountain forests of the Western United States (from Saab et al. 2005).

relationships. Forests of the interior West provide good examples for assessing avian responses to burn severity because the landscapes are structured by a complex interplay of climate, topography, soils, and disturbance, consequently affecting fire characteristics. Many western fire regimes have been altered since Euro-American settlement owing to fire suppression, logging, livestock grazing, and in some cases, climate change (Schoennagel et al. 2004). The range of fire severities creates different habitats used by various species, and a mosaic of these conditions is needed to maintain a full diversity of species that use western forests (Saab et al. 2005). Every fire-created condition is temporary. Each condition creates ephemeral habitats that are dynamic and change with plant succession.

Pileated woodpecker.

Bird responses to these changes differ by species, forest type, and fire severity (fig. 5). Typically, canopy nesters such as kinglets and chickadees are foliage gleaners that nest in unburned forests; shrub-nesting species such as lazuli buntings are found in both green and mixed-severity burns; and ground nesters such as spotted towhees often use mixed- to high-severity burns where regrowth of ground vegetation is rapid.

Species that prefer unburned forests are predicted to decline as fire severity increases. For example, the pileated woodpecker relies heavily on logs where it forages for carpenter ants (*Camponotus* spp.) (Bull and Jackson 1995). As fire severity increases, logs and ants are more likely to be consumed. In contrast, species associated with burned forests will generally increase with increasing moderate severity because many of them (especially black-backed woodpeckers) forage on beetle larvae in the bark and wood of burned trees (Dixon and Saab 2000). Most foliage gleaners are less abundant in burned forests because as burn severity

Management Implications Across North America

Any management action, including fire exclusion, affects bird populations. Management considerations for avifauna include burn season, size, severity, and distribution, and time since last disturbance. Implementing burns during the "natural" fire season is expected to benefit the native avifauna of a given place. However, one of our biggest challenges is assessing the tradeoffs among different species and implementing different seasonal and landscape patterns of prescribed fire. The scale at which fire affects wildlife habitat and their populations differs; habitat is gained by some and lost by others, but the impact on population persistence may be negligible. The benefits of a fire mosaic to biodiversity might outweigh the losses. For this reason, analysis conducted at multiple spatial scales is important—ranging from the project to the landscape—to more fully understand effects of a treatment on populations of all species of interest.

Species are adapted to natural fire that occurs during a specific time of the year. Fires occurring outside of this period may not have the same effects on bird populations. Most of what we've learned about seasonal fire effects comes from the Midwest and Eastern United States (Artman et al. 2005, Engstrom et al. 2005, Reinking 2005). Less is known about seasonal fire effects in the Western United States (Bock and Block 2005a, Huff et al. 2005, Saab et al. 2005). In the Northwest, prescribed burning is often implemented in spring, although burning historically took place in late summer and fall. In contrast, naturally occurring fires burned during spring in the Southwest, whereas prescribed burning is frequently implemented in fall. Burning during the breeding season likely has short-term effects (1 to 3 years) on birds (Tiedemann et al. 2000), but more information is needed to fully understand the impacts of spring vs. summer vs. fall burning in the Western United States (Huff et al. 2005).

In the Southeastern United States, use of growing-season prescribed fire has improved habitat structure for the red-cockaded woodpecker, northern bobwhite, and other grassland birds, but can negatively affect bird species associated with hardwoods (Engstrom et al. 2005). Dormant-season fire in the Southeast, particularly midwinter, removes cover and foraging substrate for species that are active close to the ground. Growing-season fire can cause direct mortality to nestlings and fledglings (Lyon et al. 2000), although it may enhance the reproductive effort of others through improved brood habitat. Until we gain better understanding of these relations, it seems practical to adopt a strategy of application of fire that is diverse in time and space.

Efforts to achieve the "natural" fire regime may be unrealistic. Mimicking nature may be impossible when the relative influences of anthropogenic and natural fires are impossible to separate. A more practical approach would be to measure the response of organisms, populations, and communities to experimentally imposed fire regimes and to set goals based on those results (Agee 1993).

Habitat patch size requirements are species-dependent, and little information is available on the size or distribution of burns necessary for habitat use, particularly in Western North America (Hoyt and Hannon 2002, Saab et al. 2005). Species with large home ranges, like most woodpeckers, may require larger burns around 300 to 400 ha per two to three individuals or pairs of birds (cf., Covert-Bratland et al. 2006, Dixon and Saab 2000), whereas songbirds like bluebirds might use much smaller burns (Germaine and Germaine 2002). Proximity of burned patches is most likely critical for determining habitat use, but this topic is difficult to study and has rarely been investigated (Hannon and Drapeau 2005, Hoyt and Hannon 2002). Evidence suggests that black-backed woodpeckers, a species strongly tied to stand-replacement burns, are seldom found in unburned habitats (Raphael et al. 1987), unless those habitats are within 50 km of burned forest (Hoyt and Hannon 2002). Limited information on burn severity and patch sizes suggests that a range of severities and burn patch sizes will provide for a diversity of bird species (Kotliar et al. 2002, Saab and Powell 2005, Smucker et al. 2005).

increases, so does foliage loss (Kotliar et al. 2002, Smucker et al. 2005).

Cavity-nesting species that usually eat the seeds of pine cones, such as white-headed woodpecker, or glean the bark of live trees, such as nuthatches and creepers, may respond positively to low- and moderate-severity burns that increase availability of snags and decayed trees for nesting, but retain live trees for foraging. Based on our long-term studies and the existing literature (Bock and Block 2005a, Kotliar et al. 2002, Saab et al. 2005, Smucker et al. 2005), we conclude that a mosaic of fire conditions, habitats, and patch sizes is needed to maintain bird diversity and source habitats throughout dry forests of the interior West.

Summary of Findings for Fire and Avian Ecology in North America

- Bird responses to fire differ. Some benefit, some don't.
- Low- to high-severity, mixed-severity, and stand-replacement fires are natural in different landscapes and provide critical wildlife habitat, especially for several cavity-nesting birds.
- A mosaic of habitat patch sizes and range of severities, is needed to maintain source habitats of native avifauna.

Left: White-breasted nuthatch.
Above: White-headed woodpecker.

Tom Iraci

Song sparrow nest.

Preliminary Results From the Birds and Burns Network

What Is the Birds and Burns Network?

Our study areas are located in seven states encompassing much of the range of ponderosa pine in the United States (Arizona, Colorado, Idaho, Montana, New Mexico, Oregon, and Washington) (fig. 1). As of 2005, study areas in Arizona and New Mexico (Southwest study area; SW), and Idaho and Washington (Northwest study area; NW) have received prescribed fire treatments. At these locations, we analyzed changes in downed wood, forest structure (trees and snags), and bird populations measured within 1 year after fire treatments.

QUESTIONS WE ARE ADDRESSING INCLUDE:

- What are the population responses of birds to changes in fuels and other vegetation after prescribed fire?
- What is the effectiveness of prescribed fire in reducing fuels and changing forest structure?
- Which fire conditions (exclusion or prescribed) are favored habitats for local populations of sensitive species?

Also, we plan to evaluate the ecological tradeoffs for selected wildlife species of managing for different fire conditions (wildland fire vs. prescribed fire vs. fire exclusion) by using additional data from our ongoing studies of wildland fire effects on habitats and populations of cavity-nesting birds.

The results from the Birds and Burns Network study are intended to assist managers in planning scientifically sound and legally defensible prescribed fire projects that will reduce fuels and also maintain and enhance wildlife habitat. Our preliminary observations of prescribed fire effects on birds and fuel patterns are generally consistent with results synthesized from studies across North America (Fernandes and Botelho 2003, Saab and Powell 2005).

Implementing a prescribed fire.

Bird Responses to Prescribed Fire

The effect of fire on birds can be beneficial, neutral, mixed, or adverse depending on the species, length of time since fire, and burn severity (fig. 6). Generalizing the effect of fire on birds in western forests is challenging: short-term responses may differ from long-term

Figure 6—Example of bird species associated with burn severity in dry coniferous forests of the interior Western United States (photos by Evelyn Bull, Catherine Raley, and Charlie Chrisafulli).

Table 1—Preliminary results for species population density responses to prescribed fire at the Birds and Burns Network northwest sites

Species	Year of burning	One year after burning	Guild: Foraging	Guild: Nest layer	Guild: Nest type
Migrant					
Northern flicker (short-distance migrant)	+	0	OM	CA	C
Hammond's flycatcher	-	-	AI	CA	O
Gray flycatcher	0	+	AI	SH	O
Dusky flycatcher	+	+	AI	SH	O
Cassin's vireo	0	0	FI	CA	O
Red-breasted nuthatch	0	-	BI	CA	C
Western bluebird	+	0	AI	CA	C
Townsend's solitaire	0	-	AI	GR	O
American robin	+	0	GI	CA	O
Yellow-rumped warbler	-	-	FI	CA	O
Western tanager	0	0	FI	CA	O
Chipping sparrow	0	0	OM	SH	O
Dark-eyed junco	0	0	OM	GR	O
Brown-headed cowbird (short-distance migrant)	+	0	OM	Various	P
Cassin's finch	0	0	OM	CA	O
Pine siskin	-	0	OM	CA	O
Resident					
Hairy woodpecker	0	+	BI	CA	C
Mountain chickadee	0	0	FI	CA	C
White-breasted nuthatch	+	0	BI	CA	C

Note: Statistically significant changes in population densities are indicated by the signs + (positive) or – (negative). All zeros indicate no statistical change in population densities from pre- to posttreatment. Columns represent foraging guild (AI = aerial insectivore, GI = ground insectivore, FI = foliage insectivore, OM = omnivore, BI = bark insectivore), nest layer (CA = canopy, SH = shrub, GR = ground), and nest type (C = closed, O = open, P = parasitic). Species are listed in taxonomic order, an order that reflects the evolutionary relationships among birds.

Pygmy nuthatch.

responses, responses by resident bird species may differ from migratory species, and effects observed at the stand scale may differ from those at the regional or landscape scale. Also, fire that benefits one species may harm another. Ultimately, managing for particular fire conditions—including wildland fire, prescribed fire, or fire exclusion—entails ecological tradeoffs among selected wildlife species and habitats.

The results of our prescribed burn study illustrated some of these complexities, although we can discern some patterns of response. In the combined study areas (NW and SW), all but one of the eight resident species had a positive or neutral response to burning treatments (tables 1 and 2) (figs. 7 and 8). The one exception, the pygmy nuthatch (in the SW study area), showed a negative response the year of burning, but showed a neutral response the following year.

Migrants showed mixed responses (tables 1 and 2) (figs. 7 and 8). Some, like western bluebirds, experienced positive changes in density, whereas others, such as yellow-rumped warblers, showed declines in response to fire treatments. Overall, at both study sites, a greater percentage of birds, both migrants and residents, showed some decline during the same year as the fire, but were back to prefire abundances (i.e., neutral to prescribed burns) 1 year after the fire (fig. 7 and 8). **These preliminary results suggest that the effects of prescribed fire on birds may be short term.** However, monitoring for additional years after treatments is needed to fully address this issue of short-term losses for long-term gains (Saab et al. 2006b). This is particularly important because we also observed several migratory species that showed no response during the year of prescribed fire, but showed a decline in the year after treatment.

Table 2—Preliminary results for species population density responses to prescribed fire at the Birds and Burns Network southwest sites

Species	Year of burning	One year after burning	Guild: Foraging	Guild: Nest layer	Guild: Nest type
Migrant					
Northern flicker (short distance)	+	0	OM	CA	C
Western wood-pewee	0	0	AI	CA	O
Gray flycatcher (3 sites only)	0	-	AI	SH	O
Plumbeous vireo	0	0	FI	CA	O
Brown creeper	0	0	BI	CA	C
Western bluebird	+	+	GI	CA	C
Grace's warbler	-	0	FI	CA	O
Yellow-rumped warbler	-	0	FI	CA	O
Western tanager	0	0	FI	CA	O
Chipping sparrow	0	0	OM	SH	O
Dark-eyed junco	0	0	OM	GR	O
Black-headed grosbeak	0	0	OM	SH	O
Brown-headed cowbird (short distance)	-	-	OM	Various	P
Resident					
Hairy woodpecker	+	+	BI	CA	C
Steller's jay	+	+	OM	CA	O
Mountain chickadee	0	0	FI	CA	C
White-breasted nuthatch	0	0	BI	CA	C
Pygmy nuthatch	-	0	BI	CA	C

Note: Statistically significant changes in population densities are indicated by the signs + (positive) or – (negative). All zeros indicate no statistical change in population densities from pre- to posttreatment. Columns represent migratory status, foraging guild (AI = aerial insectivore, GI = ground insectivore, FI = foliage insectivore, OM = omnivore, BI = bark insectivore), nest layer (CA = canopy, SH = shrub, GR = ground), and nest type (C = closed, O = open, P = parasitic). Species are listed in taxonomic order, an order that reflects the evolutionary relationships among birds.

These were the gray flycatcher (in the SW), and the red-breasted nuthatch and Townsend's solitaire (in the NW).

Red-breasted nuthatch.

Response by Foraging and Nesting Guilds

At both study sites, foliage insectivores were the only species that did not respond positively to the burns; rather they responded negatively or neutrally. Generally, bark insectivores responded positively or neutrally to fire. Only the pygmy nutchatch in the SW responded negatively. Aerial insectivores had mixed responses to burning, but overall they responded more positively than negatively.

Open-cup, canopy nesters were the only nesting guild to contain species that responded negatively to fire during the year of burning (Hammond's fly-catcher, yellow-rumped warbler, pine siskin, and Grace's warbler). Most cavity-nesting species responded positively to burn treatments, except for the pygmy and red-breasted nuthatches. Species that showed consistent positive responses at both study sites (western bluebird, northern flicker, and hairy woodpecker) were all cavity nesters. Most species nesting in the canopy layer (including cavity nesters) generally had positive responses to prescribed fire. We detected no significant changes for shrub- and ground-nesting species. See tables 1 and 2 for more detail.

Top: Townsend's solitaire.
Bottom: Hammond's flycatcher.

Nesting Densities in Response to Prescribed Fire in Both Regions

We calculated nesting densities of cavity-nesting birds before and after fire treatments in both regions. We detected only one statistically

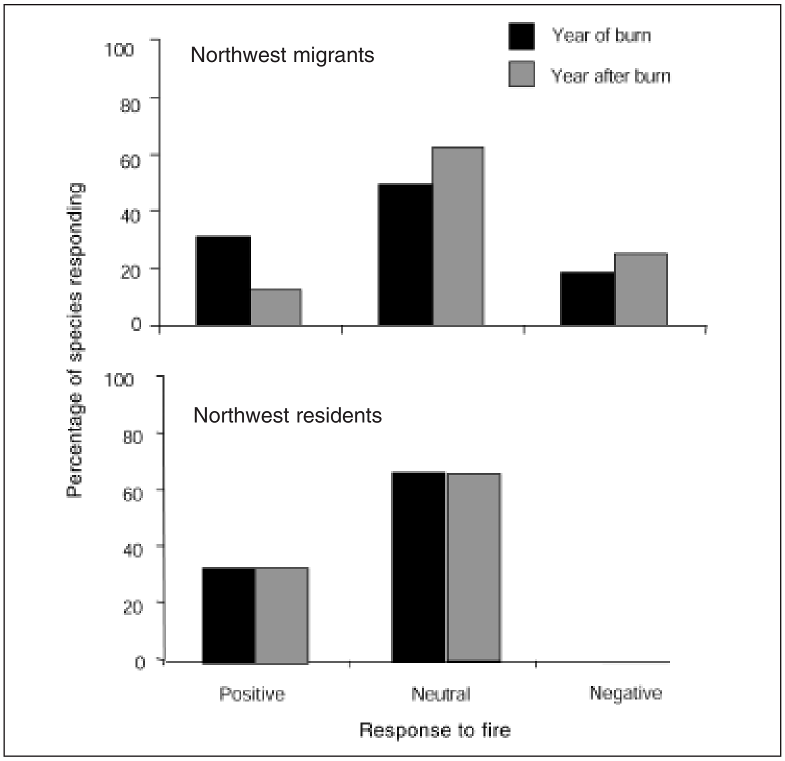


Figure 7—Responses of migrant (n = 16) and resident (n = 3) species in the Northwest to prescribed fire treatments in the Birds and Burns Network.

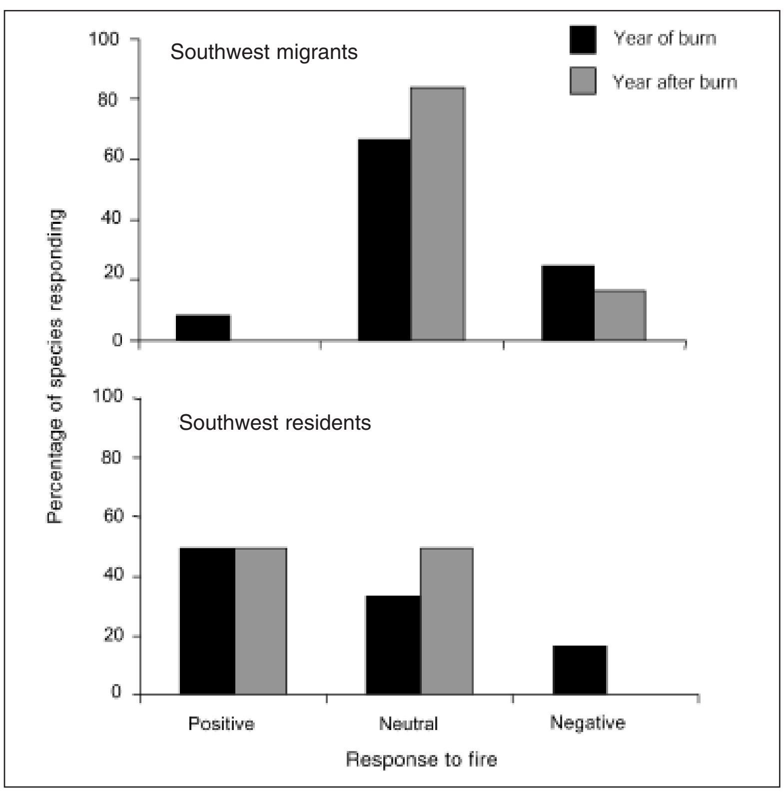
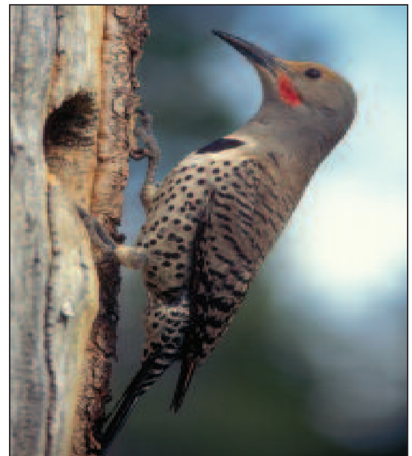
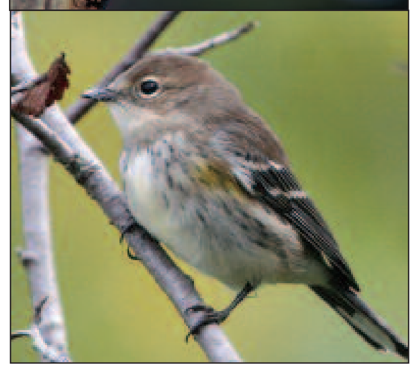


Figure 8—Responses of migrant (n = 13) and resident (n = 5) species in the Southwest to prescribed fire treatments in the Birds and Burns Network.





Top: Male northern flicker.
Bottom: Yellow-rumped warbler in nonbreeding plumage.

significant change in nest numbers for either region: increases in western bluebird (migrant) densities in the NW region. Also in the NW, we observed nesting by black-backed woodpeckers (five nests) and three-toed woodpeckers (three nests) after prescribed fires in locations where they previously had not been observed. Postfire nesting by these two species is an ecologically significant finding because both are designated as sensitive species by state and federal agencies and both are strongly associated with fire-maintained habitats. Although no statistically significant changes were detected in the SW, we observed a pattern of increased nesting densities for one resident (hairy woodpecker), and two migrants (northern flicker and brown creeper).

Field biologist using an electronic cavity viewer to observe the contents of a northern flicker nest.

Lone snag in a burned forest.

Changes in Fuels and Forest Structure (Nesting and Foraging Habitat) After Prescribed Fire

In our study plots, we found that nearly half of downed wood ≥23 cm diameter at the large end was consumed by prescribed fire in both regions (fig. 9) (Saab et al. 2006a). Drought conditions, followed by low wood moistures prior to fire treatments, may have contributed to the large loss of downed wood. When moisture contents are less than 15 percent, fire generally consumes about half of large down woody materials (Brown et al. 1985). Efforts to retain these large structures may require seasonal adjustments so as to burn when moisture contents are higher and fire severity effects are lower (Thies et al. 2005), although large logs historically may have been a limited resource in ponderosa pine forests, which had low-severity fire regimes (Agee 2002). This short-term decline, however, might be offset in the longer term with new logs developing as snags fall.

Overall, tree densities in the SW were significantly reduced after fire treatments. Although we observed a pattern of decreased tree densities in the NW, no statistical differences were detected in densities measured before and after prescribed fire. However, observed changes in tree densities were important ecologically. For example, in both regions we observed the greatest reduction of tree densities in the smallest size class (<8 cm d.b.h.), followed by reductions in the medium size class (≥8 to <23 cm d.b.h.), with little change in large (≥23 cm d.b.h.) tree densities (fig. 10). Small-diameter trees function as ladder fuels in dense stands by carrying flames into the crowns of mature trees, where the potential for larger tree mortality increases (Pollet and Omi 2002). Indeed, prescribed fire programs that remove small-diameter trees can reduce the likelihood and cost of stand-replacing fires (Arno 1980, Fernandes and Botelho 2003, Pollet and Omi 2002).

We observed increases in snag densities, including the large-diameter size class in both regions (increases of 49 to 101 percent) (fig. 10). In other words, whereas prescribed fire consumed some wildlife snags, it also recruited snags. Snags ≥23 cm d.b.h. increased after fire treatments by 29 percent and 72 percent in the NW and SW study areas, respectively (Saab et al. 2006a). This pattern is important ecologically because the result has implications for the creation of wildlife snags by using prescribed fire. Maintenance and recruitment of larger diameter snags is particularly

Management implications

In response to prescribed burning, some bird species increased, whereas others decreased. In general, foliage-gleaning species showed negative responses, whereas bark insectivores and cavity nesters showed positive responses.

Neotropical migrants responded in different ways to prescribed fire. Most responses—both positive and negative—were detected during the year of burning treatments. Fewer species responded 1 year after treatments, which suggests that responses were short term. Longer term monitoring is needed to better understand response time of migrants.

With our prescribed burn treatment, downed wood was significantly reduced. Retaining these structures for wildlife habitat, if desired to meet management objectives, may require conducting prescribed burns at times when moisture contents are higher.

We found that rather than solely destroying snags, prescribed burn treatments also recruited snags of all sizes in the SW and NW study areas from 49 to 101 percent, respectively.

We suggest that protecting nest trees from fire is labor intensive and most likely cost prohibitive for large-scale prescribed fire programs.

Fuel treatments affect wildlife habitat. Choices by fuel managers in planning and implementing treatments can result in positive or negative effects on habitats and populations of birds.

important because large snags have greater longevity and provide wildlife habitat for a longer period than smaller snags (Everett et al. 1999, Raphael et al. 1987, Russell et al. 2006).

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Species list

Sage grouse *Centrocercus* spp.
Northern bobwhite *Colinus virginianus*
Northern goshawk *Accipiter gentilis*
American kestrel *Falco sparverius*
Mexican spotted owl *Strix occidentalis lucida*
Rufous hummingbird *Selasphorus rufus*
Lewis's woodpecker *Melanerpes lewis*
Hairy woodpecker *Picoides villosus*
Red-cockaded woodpecker *Picoides borealis*
White-headed woodpecker *Picoides albolarvatus*
Three-toed woodpecker *Picoides dorsalis*
Black-backed woodpecker *Picoides arcticus*
Northern flicker *Colaptes auratus*
Pileated woodpecker *Dryocopus pileatus*
Olive-sided flycatcher *Contopus cooperi*
Western wood-pewee *Contopus sordidulus*
Hammond's flycatcher *Empidonax hammondii*
Gray flycatcher *Empidonax wrightii*
Dusky flycatcher *Empidonax oberholseri*
Plumbeous vireo *Vireo plumbeus*
Cassin's vireo *Vireo cassinii*
Warbling vireo *Vireo gilvus*
Steller's jay *Cyanocitta stelleri*
Common raven *Corvus corax*
Mountain chickadee *Poecile gambeli*
Red-breasted nuthatch *Sitta canadensis*
White-breasted nuthatch *Sitta carolinensis*
Pygmy nuthatch *Sitta pygmaea*
Brown creeper *Certhia americana*
Ruby-crowned kinglet *Regulus calendula*
Western bluebird *Sialia mexicana*
Mountain bluebird *Sialia currucoides*
Townsend's solitaire *Myadestes townsendi*
Swainson's thrush *Catharus ustulatus*
American robin *Turdus migratorius*
Yellow warbler *Dendroica petechia*
Yellow-rumped warbler *Dendroica coronata*
Grace's warbler *Dendroica graciae*
Western tanager *Piranga ludoviciana*
Spotted towhee *Pipilo maculatus*
Chipping sparrow *Spizella passerina*
Song sparrow *Melospiza melodia*
Dark-eyed junco *Junco hyemalis*
Black-headed grosbeak *Pheucticus melanocephalus*
Lazuli bunting *Passerina amoena*
Brown-headed cowbird *Molothrus ater*
Cassin's finch *Carpodacus cassinii*
Pine siskin *Carduelis pinus*

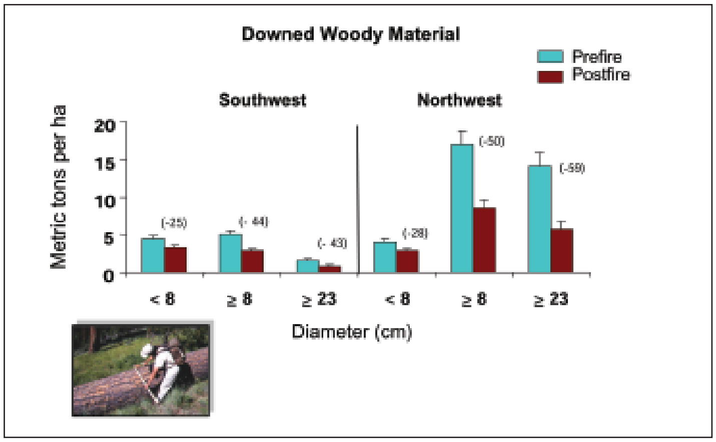

Figure 9—Changes in down woody material after prescribed treatments conducted for the Birds and Burns Network. Numbers in parentheses are the percentage change in measurements taken after prescribed fire.

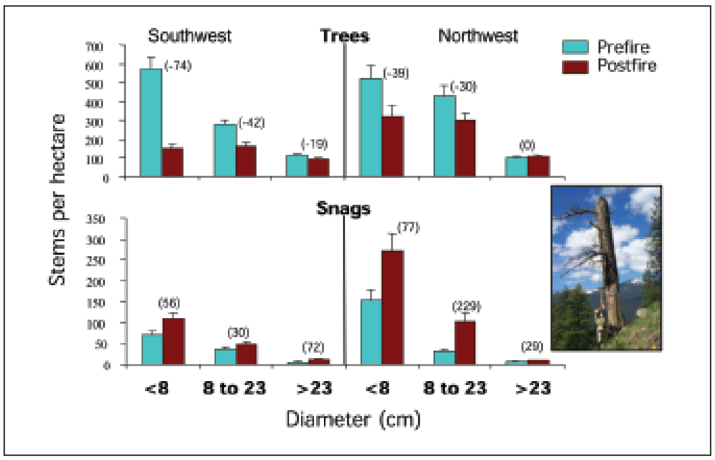

Figure 10—Changes in forest structure after prescribed treatments conducted for the Birds and Burns Network. Numbers in parentheses are the percentage change in measurements taken after prescribed fire.

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METRIC EQUIVALENTS

When you know:	Multiply by:	To find:
Centimeters (cm)	0.394	Inches
Meters (m)	3.28	Feet
Kilometers (km)	0.621	Miles
Hectares (ha)	2.47	Acres
Degrees Celsius (°C)	1.8 and add 32	Degrees Fahrenheit

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