Response of Birds to Fire Mosaics

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For breeding birds, suitable habitat is comprised of sufficient food resources and adequate shelter from predators for adults and offspring (Cody 1985, *Habitat Selection in Birds*, Academic Press, Orlando FL). In particular, vegetation structure appears to be an important proximate cue for breeding birds to provide foraging and nesting substrates and cover from predators. Foliage height diversity and tree structure and diversity positively influence avian species diversity by providing foraging and nesting substrates (Willson 1974, *Ecology* 55:1017-1029, and Poulson 2002, *Biodiversity and Conservation* 11:1551-1566). Food resources within breeding habitat limits several aspects of avian reproductive ecology, including if and when a bird breeds, clutch size and reproductive success (Martin 1987, *Annual Review of Ecology and Systematics* 18: 453-487). Hansell (2000, *Bird Nests and Construction Behaviour*, Cambridge Univ. Press, Cambridge MA) identified four main factors affecting the selection of nest sites by breeding birds: microclimatic conditions, predator avoidance, food availability, and access to nest materials. Many passerines rely on vegetation cover to provide suitable microclimatic conditions and conceal nests (Collias and Collias 1984, *Nest Building and Bird Behavior*, Princeton University Press, Princeton NJ). For this reason, the alteration or removal of vegetation through anthropomorphic and natural disturbance can significantly alter overall species composition and reproductive viability of individual species.

Breeding Birds in Post-fire Landscapes in the Western U.S.

Wildfires alter forest developmental trajectories and change the plant communities in the affected areas (Bond and van Wilgen 1996, *Fire and Plants*, Chapman & Hall, London UK). For this reason, fire is an important environmental influence in western forests. In the first few years after a fire, the flush of new vegetation can increase the abundance and diversity of wildlife, particularly those associated with early successional habitats. However, species associated with late seral vegetation can be negatively impacted. Studies of bird use in fire-altered forests generally show a shift in the composition of the avian community from foliage- and bark-gleaners to shrub foragers, tree drillers and cavity-nesting species (Kotlier et al. 2002, *Studies in Avian Biology* 25:49–64, Huff et al. 2005, *Studies in Avian Biology*, 30:46-62). The large number of snags created by severe fires also benefit cavity nesting species. Shrub and aerial insectivores also tend to increase because the removal of forest canopy creates habitat dominated by herbs and shrubs.

The suitability of habitat depends on a species' particular foraging and nesting requirements, sensitivity to microclimatic conditions, and pressures exerted via predation and competition. Wildfire simplifies forested habitats by temporarily reducing or eliminating vegetative cover and changing species composition. Therefore, nesting and foraging substrates are reduced by stand-replacing fires, particularly for species associated with mid- and overstory live trees. Some species may be able to forage successfully in severely burned habitats; however, if

suitable nest sites are not available their use of burned patches will be limited to viable distances from suitable nesting habitat. Conversely, some species may be able modify their nesting habits in response to habitat alteration (e.g., Hamas 1983, *Wilson Bulletin* 95:475-477). For other species, nesting suitability increases as the result of fire (e.g., Saab and Dudley 1998, *Research Paper RMRS-RP-11*, USDA Forest Service, Ogden UT, Greene et al. 1996, *The Birds of North America*, No. 232). These species are expected to respond to features of burned forest other than the presence of live trees, such as structural characteristics and ground vegetation.

The spatial context of bird response to fire is poorly understood, and the influences of the mosaic of burned and unburned forest on bird populations are unknown. Additionally, understanding how birds are using burned forest is important when considering post-fire management activities.

During the summer of 2002, wildfires burned hundreds of thousands of hectares in southwestern Oregon. The largest of these fires, the Biscuit Fire, was located in and around the Siskiyou National Forest. It is estimated that this fire covered nearly 200,000 ha, nearly 50% of which was classified as having been severely burned (>75% of vegetation killed). A large-scale mosaic of severely burned patches interspersed with underburned and unburned patches was created. Because of the size and severity of this fire, this site offers an excellent opportunity for investigating how bird communities respond to the juxtaposition of burned and unburned patches of forest.

Here we report on summary results of a 3-year field study investigating how birds are distributed in large, severely burned patches relative to remnant, unburned, or low-intensity burned forest. Specifically, we are examining potential relationships between the richness and composition of bird communities within severely burned forest and proximity to green forests. In addition, we are examining the distribution and abundance of individual breeding bird species that are present in burned forest. We asked several questions including: 1) Are differences in the composition and abundance of breeding bird communities within severely burned forest associated with proximity to green forests in the early post-fire period? 2) Does proximity to green forest influence the abundance of individual species that use burned forest? 3) To what extent are species that are detected in burned forest also breeding? 4) For species that nest in severely burned forest, what structural components are used for nesting?

METHODS

Study sites

Our study sites are located on the east-central edge of the Kalmiopsis Wilderness in the Siskiyou National Forest, southwestern Oregon, within the burn perimeter of the Biscuit Fire. The elevations of the sites range from 300 to 1350 m. The dominant overstory trees are Douglas-fir (*Pseudotsuga menziesii*), sugar pine (*Pinus lambertiana*), and ponderosa pine (*Pinus ponderosa*). The mid-canopy and understory are composed of conifers such as incense-cedar (*Calocedrus decurrens*), white fir (*Abies concolor*), and grand fir (*Abies grandis*), along with hardwoods such as black oak (*Quercus kelloggii*), Pacific madrone (*Arbutus menziesii*), tanoak (*Lithocarpus densiflorus*), and canyon live oak (*Quercus chrysolepis*). We targeted study sites within the Biscuit Fire boundary that were dominated by mature conifer forest types. We located study sites in severely burned forest

(≥75% canopy death) and low to moderately under-burned forest patches (≤25% canopy death). We randomly chose sites (point-count centers) within these areas stratified by distance from forest-severe burn edges. We placed points from 50 to several hundred meters from the severe-burn forest interface. In 2003, we placed 45 points in severely burned patches and added seven more in 2004. In 2005, 16 point count plots in burned forest were completely or partially salvage logged and 4 were adjacent to salvage units (N = 20, 37% of burned plots). As a result, five completely salvaged plots were not sampled, and three plots were moved to adjacent uncut burned forest. The remaining partially logged and adjacent plots were surveyed in 2005. The effect of salvage logging on bird species was not an objective of this study. We also added 18 new burned sites in 2005 for a total of 53 sites. In addition, we surveyed 26–28 forest sites within the unburned/underburned forest patches between 50 m and >200 m from the burn edge each year. All points were at least 250 m from all others and are treated as independent in analyses.

Vegetation sampling

Vegetation and stand structure were sampled at the point-count centers by using modified BBIRD protocols (Martin et al. 1997, *BBIRD Field Protocol*, Montana Cooperative Wildlife Research Unit, University of Montana, Missoula, Montana, USA). We re-sampled points established in 2003 in subsequent years. In addition, we measured vegetation characteristics at nests. At each nest site we described the nest substrate(s), recorded species, diameter at breast height (DBH), and decay class of all snags and live trees >8 cm DBH located within 11.3 m of the nest. Within 5 m of nests, we estimated percent cover of shrubs, herbaceous vegetation, and bare ground; counted all live stems ≥0.5 m high; and recorded all live trees >8 cm DBH. Live foliage associated with resprouting hardwood trees was included in the percent shrub cover estimate in sampling plots.

Point-count surveys

We conducted point counts for birds at each point, using a variable-radius counting method during point counts. A single observer spent 8 minutes at each point and recorded species, sex, and activity (when possible) of all birds seen or heard and estimated their distances from the observer. In 2003 and 2004, we surveyed each point three times during the peak nesting period in June and early July. Because of logistical constraints, a few points were surveyed only twice in 2005. All surveys were conducted between 0530 and 1100 hours. Two observers sampled 68 points in 2003 and four observers sampled 78 points in 2004 and 81 points in 2005. In all years, observers were rotated among points when possible to minimize observer bias.

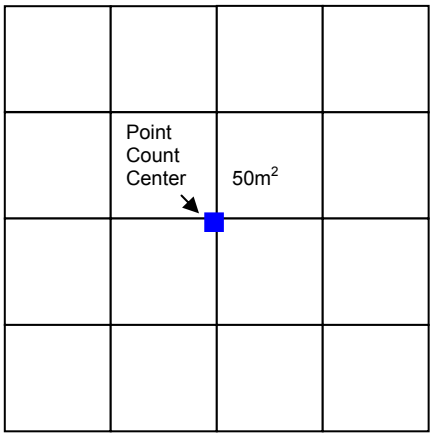

Figure 1. Four (4) ha nest searching plots were established at 35 point count sites in 2004 and 49 sites in 2005 within burned stands. To facilitate searching and recording of nests and birds within plots, plots were further divided into 16 50 m^2 subplots.

Nest searching

In addition to point-count sampling, we searched for nests on 35 burn plots in 2004 and 49 plots in 2005. Plots were 4 ha in size and were centered on point-count sites. To facilitate searching, plots were divided into 16 50-m^2 subplots with flagging and/or wooden stakes (Figure 1). Two observers surveyed each 4-ha plot twice per season, spending between 2 and 5 hours during each survey period (approximately 30 minutes–1 hour per 50-m^2 subplot).

Observers recorded birds encountered in plots and recorded their positions on the map. Species, sex, age, and activity were recorded whenever possible. We observed adult males for 10 minutes or until the bird went to a nest or was lost from view. We observed adult females encountered on the plots until they either went to a nest or were lost from view. Observers searched for nests by scanning substrates and by observing adult bird behavior for parental cues, including carrying food, nesting material, or fecal sacs, and antagonistic behavior towards conspecifics or other species. Bird observations and nests were recorded on a grid for later analysis of patterns of bird use and nest placement in burned stands.

PRELIMINARY RESEARCH RESULTS AND MANAGEMENT IMPLICATIONS

Vegetation Regrowth

Forbs, herbaceous vegetation and resprouting hardwoods comprised most of the live vegetation in the severely burned plots. Between 2003 and 2005, the mean percent shrub cover increased by approximately 10 percent each year, and all green vegetation cover (forbs, shrub and herbaceous cover) increased between 15 and 20 percent each year. In areas where knobcone pine (*Pinus attenuate)* was common, seedlings were present in 2003 and many had grown to above 50 cm in height during the course of the study. Seedlings of Douglas-fir, sugar and ponderosa pine were also present in our plots, mainly in 2004 and 2005; however, we did not quantify seedlings shorter than 50 cm in our plots. Few snags $\geq$ 8cm dbh measured in 2003 in our sampling plots had fallen by 2005.

Bird Detections 2003-2005

We recorded 68 bird species during point counts between 2003 and 2005. We identified seven species of woodpeckers. Hairy Woodpecker was the common species followed by Northern Flicker, Pileated Woodpecker, Downy Woodpecker, Acorn Woodpecker, Red-breasted Sapsucker and White-headed Woodpecker. Of these, only the White-headed Woodpecker is rare in this area and we encountered a single pair on adjacent plots in 2004 and 2005 north of Onion Camp with one confirmed nest in 2004. We did not detect the Black-backed Woodpecker, also a rare species in this area, during the course of this study. We detected two nesting raptor species on our burned plots (American Kestrel, Red-tailed Hawk) and two on our under-burned forest plots (Cooper's Hawk, Northern Goshawk).

We sampled 40 plots using point counts in all years. Dark-eyed Juncos were the most commonly encountered species on both the burned and forested point counts in all three years. The percent plots where we encountered at least one junco stayed the same in 2003 and 2004 (90%) and decreased slightly in 2005 (80%). In general, we saw decreases in detections for species associated with live forest (Figure 2). We saw a marked decrease in Olive-sided flycatchers detected within 75 m of our points between 2003 and 2004 (32% in 2003, 15% in 2004). However,

we did not see this decline when we included all detections. We saw increases in detections for species that are associated with early successional and shrubby habitats and/or cavity nesters (Figure 3).

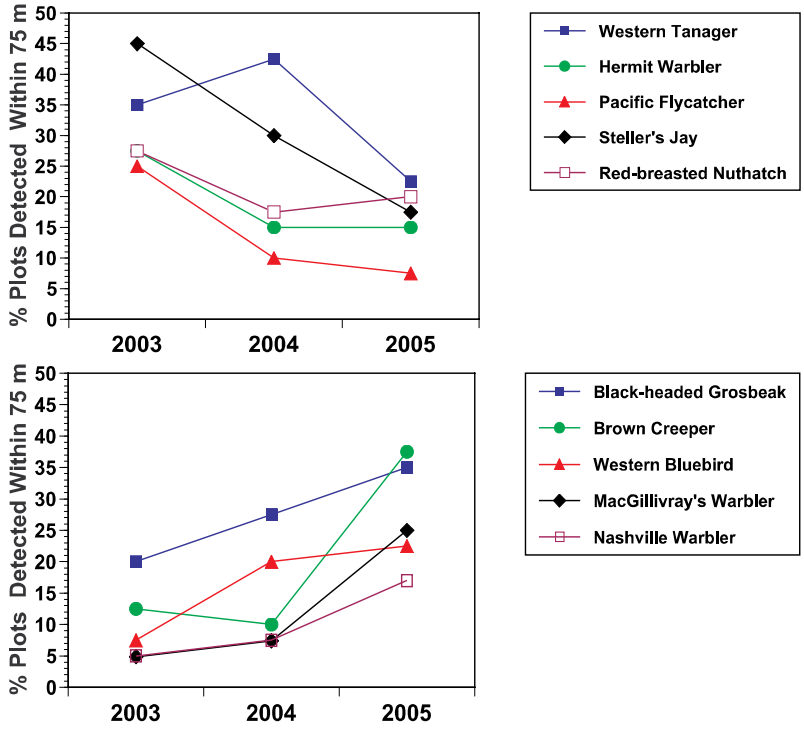

Figure 2: Top Panel: Five species that showed declines in the number of plots where detected between 2003 and 2005. Bottom Panel: Five species that showed increases in the number of plots where detected between 2003 and 2005. Only plots that were surveyed in all three years were included (N = 40). These charts do not indicate changes in abundance for these species across the study area.

When distance from live forest was considered as an explanatory variable alone, we found only a slight and non-significant decline in the mean species richness from the burn edge to the burn interiors (>400 m). We detected some species, like Red-breasted Nuthatches and Western Tanagers more often in burned forest within 100-200 m of green forest patches relative to the interiors of burns. Our preliminary models show that the percent live vegetation estimated in our plots explained more of the variation in overall and individual species' use patterns than any other factor. Resprouting hardwoods and forbs provided the only live vegetation in most of our burned plots and were an important source of insect prey for breeding birds (pers. obs. but see also Hagar and Starkey, 2003, *CFER Annual Report* for discussion of trophic relationships among birds, arthropods and shrubs in unburned Western Oregon forest).

In 2004, we detected 219 pairs of 36 species on 35 plots. In 2005, we detected 449 pairs of 43 species, 30 of which we also found nests or fledglings on 45 plots. In addition, we found European Starlings nesting in one plot near the Illinois River. This species was not detected in point counts and this was the only plot we found it. We found at least 10 nests for 12 species in 2004-2005. Dark-eyed Junco, Lazuli Bunting, House Wren, Black-headed Grosbeak, Hairy Woodpecker and Western Bluebird were the most common species for which we found nests or adults with fledglings (>20 each in 2005). Of the 39 species for which we found nests over two seasons, 14 (37%) use cavities and 25 (63%) build open-cup nests (Figure 3). These numbers reflect only the species for which we found nests so is not indicative of all species that may have nested in burned forest in this area. For example, we found White-breasted Nuthatch, Mountain Chickadee and Yellow-breasted Chat in some plots but did not find any nests, even though probable parental behavior was detected. We also did not find nests of Mountain Quail, Ruffed Grouse or

Purple Finch but did see adults with fledglings in our plots.

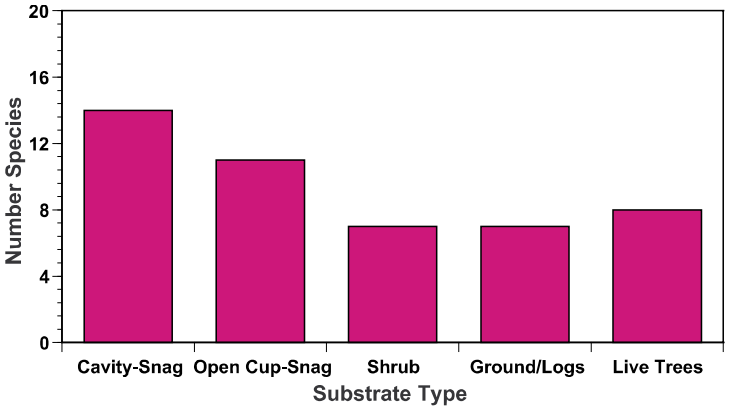

Figure 3: Nest substrates used by 39 bird species nesting within the Biscuit Fire in 2004-2005. Cavity-Snag indicates species that used primary or secondary cavities. Open-cup Snags are species that built cup nests in snags. The total for all columns exceed 39 because some species used more than one substrate. For example we found Yellow-rumped Warbler and American Robin nests in snags and live trees, and Dusky Flycatchers using snags and shrubs (see Table 1). A European Starling nest was found in a woodpecker cavity on one plot in 2005 but was not included in the total.

Open-cup Nesting Species

Species that build cup nests used snags, residual live trees, resprouting hardwoods, and other ground vegetation and downed wood on our burned forest sites (Table 1). We detected several species that are generally identified as mid-story/canopy nesters using conifer and hardwood snags as nesting substrates on burned sites (Table 1). Although American Robins generally nest in live under- and mid-story trees in unburned forest, most of the nests we found were in hollows (see photo at left) or on the branches of large conifer snags in plots with dense forbs and shrub vegetation. Yellow-rumped Warblers exhibited similar behavior on our plots by nesting on the branches of large conifer snags or using the sloughed bark on smaller snags as nesting platforms. The ability to use snags as nesting substrates made more of the severely burned forest available to these species. Other species that nested in conifer and/or hardwood snags included: Cassin's Vireo, Western-wood Pewee, Olive-sided, Pacific-slope and Dusky flycatchers, Townsend's Solitaire, Steller's Jay and Red-tailed Hawk

The resprouting hardwood species (most commonly, Pacific madrone, black oak, and tanoak) provided nesting substrates for several shrub-nesting species (Table 1). Lazuli Buntings and Black-headed Grosbeaks, in particular, tended to be concentrated in areas with high densities of large resprouting hardwoods. Western Tanagers nested primarily in live conifers on our plots. However, in four plots without live trees, we found tanagers nesting in resprouting hardwood and in one plot a tanoak snag. We observed tanagers taking insects on the branches of large conifer snags, as well as in resprouting hardwoods, even in plots where we did not detect nests or fledglings. Additionally, we found nests of MacGillivray's and Black-throated Gray Warblers, American Goldfinch, Song and White-crowned Sparrows and Cassin's Vireo in shrub and herbaceous vegetation. Ground nesting species that

Four nearly fledged American Robin nestlings in a hollow of a large (55 in. DBH) ponderosa pine snag.

nested under on our plots included: Dark-eyed Junco, Townsend's Solitaire, Rufus-sided Towhee, and Orange-crowned and Nashville warblers.

Cavity-Nesting Species

We found nests of 14 primary or secondary cavity-nesting species in our burned plots, including six woodpecker species (Table 1). We also encountered Acorn Woodpeckers on a few plots but did not detect breeding activity. Nesting substrates ranged from <10 in. (<25 cm) hardwoods to >30 in. (>76 cm) conifer snags. Hairy Woodpecker was the most common primary cavity-nesting species we encountered on our plots (72% of point count sites), and we detected nests or fledglings on 59% of our 49 nest searching plots in 2005. The nest holes constructed by Hairy Woodpeckers provided nest sites for secondary cavity nesters, particularly the Western Bluebird.

We found Western Bluebirds most often in burned forest with little vegetation regrowth. Western Bluebird detections increased between 2003 and 2005, particularly in 2004 (Figure 2). We often observed bluebirds gleaning insects from snags and on the ground. Although the detection of males via point counts was positively associated with the presence of breeding activity on plots (Φ Coefficient .5), on 50% of the 16 plots where we found nests or fledglings in 2005, we did not detect bluebirds in our point count surveys. Male Western and Mountain bluebirds are not as vocal as many other passerines we encountered. The Western Bluebird is identified as a Species of Concern in the Biscuit Recovery Plan (*Biscuit Fire Recovery Project Final Environmental Statement*, U.S.F.S.), and surveys that only include point count sampling may underestimate bluebird presence in this area. We also encountered Mountain Bluebirds on a few plots and found 3 nests in 2004-05.

The species encountered in this study comprise a wide variety of foraging and nesting strategies. The associations between the presence of breeding species and forb and shrub cover in our preliminary analyses indicate that this component of the system is important to the early post-fire reestablishment of bird populations following stand replacing events. Our data suggests that post-fire management of resprouting hardwoods and herbaceous/forb vegetation should consider potential impacts to bird species that nest and forage in burned forests.

STUDY TIMELINE

The final analyses of bird abundance and vegetation patterns will be completed in fall and winter of 2006/2007. Preparation of publications describing the research and full results is anticipated in 2007.

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Species	Forest Type	Nest Type*	Nest Location	Food Taken	Forage Type	Nest Locations in this study
Hairy Woodpecker (Picoides villosus)	Mature and open forest/ Burns	C	Snags	Insects	Bark/driller	Conifer/ Hardwood Snags
Downy Woodpecker (Picoides pubescens)	Mixed conifer/ Deciduous forest	C	Snags	Insects	Bark/driller	Conifer/ Hardwood Snags
Northern Flicker (Colaptes auratus)	Open Forest/Burns	C	Snags	Insects	Driller/ground glean	Conifer/ Hardwood Snags
Pileated Woodpecker (Dryocopus pileatus)	Mature conifer forest	C	Snags	Insects	Bark/driller	Large conifer snag
White-headed Woodpecker (Picoides albolarvatus)	Montane conifer forests	C	Snags	Insects	Bark/wood probe	Large conifer snag
Red-breasted Sapsucker (Sphyrapicus ruber)	Mixed conifer/ decide	C	Live hardwoods	Insects	Bark/driller	Cavity in live madrone
Mourning Dove (Zenaida macroura)	Open Forest and edges	O	Conifer/ Ground	Seeds	Ground Glean	Conifer snag
Red-tailed Hawk (Buteo jamaicensis)	Woodland/ Open Forest	O	Large trees/cliffs	Primarily Rodents	Swoop Hunter	Large conifer snags
American Kestrel (Falco sparverius)	Open and semi-open forest	C	Secondary cavities	Insects	Hawks/Swoop Hunter	Natural cavities in conifers and hardwoods
Dusky Flycatcher (Empidonax oberholseri)	Open woodland Brushy	O	Varied /Shrub	Insects	Hawks	Conifer snag, Hardwood resprouts,
Pacific-slope Flycatcher (Empidonax difficilis)	Mixed conifer/ Deciduous forest	O	Conifer Hardwoods	Insects	Hawks	Downed wood, bank, conifer snag
Olive-sided Flycatcher (Contopus cooperi)	Open montane conifer/ Mixed forest	O	Conifers	Insects	Hawks	Branches of live conifer, conifer snag
Western Wood Pewee (Contopus sordidulus)	Open/riparian forest	O	Conifer	Insects	Hover/Glean	Branches of hardwood snags

Steller's Jay (Cyanocitta stelleri)	Conifer Mixed	O	Conifer/shrubs	Omnivore	Foliage/ground Glean	Live conifer, live oak, conifer snag
American Robin (Turdus migratorius)	Open forest early successional	O	Under/mid-story trees	Insects/Fruit	Foliage Glean/Ground	Hollows in large conifer snags, tanoak snags and live trees
Townsend's Solitaire (Myadestes townsendi)	Open/steep forest types	O	Snag Log Ground	Insect Seeds	Foliage Glean/Ground	Hollows in ground, conifer snags
Western Bluebird (Sialia mexicana)	Open/burned forest	C	Snag	Insects/fruit	Hawk/ Bark Glean	Woodpecker cavities in conifer/hardwood snags
Mountain Bluebird (Sialia currucoides)	Open/burned forest	C	Snag	Insects/fruit	Hawk/ Bark Glean	Woodpecker cavities in conifer snags
Cassin's Vireo (Vireo cassinii)	Conifer/mixed woodlands	O	Live trees /shrubs	Insects	Hawk/ Bark Glean	Tanoak snags, madrone resprout
Chestnut-backed Chickadee (Poecile rufescens)	Conifer/mixed forest	C	Snag	Insects /seeds	Foliage Glean	Cavity in snags surrounded by live forest
Red-breasted Nuthatch (Sitta canadensis)	Conifer/mixed Forest	C	Snag	Insects /Seeds	Bark Glean	Cavities in large and small conifer snags
Brown Creeper (Certhia americana)	Mature conifer forests	C	Snag/live trees	Insects	Bark Glean	Under bark and in cavities of large conifer snags
House Wren (Troglodytes aedon)	Open woodland Shrubby	C	Snag	Inverts	Foliage Glean	Hardwood natural cavities, woodpecker cavities in conifer snags
Bushtit (Psaltriparus minimus)	Open woodland Shrubby	O	Shrubs/small trees	Insects	Bark/foliage Glean	Live oak (live)
Tree Swallow (Tachycineta bicolor)	Open Forest Burned	C	Secondary cavities	Insects	Aerial	Woodpecker cavities in conifer snags
Black-headed Grosbeak (Pheucticus melanocephalus)	Woodland/ deciduous/ Mixed forests	O	Conifer Hardwood	Insects	Foliage Glean	Hardwood resprouts, live trees, tanoak snag
American Goldfinch (Carduelis tristis)	Early successional forest	O	Shrubs/Trees	Seeds/ insects	Ground Glean	Hardwood resprout

Yellow-rumped Warbler (Dendroica coronata)	Conifer/mixed Forest	O	Midstory/ Conifers	Insect Fruit	Hawk Hover/Glean	Conifer/Hardwood snags, live conifers
Black-throated Gray Warbler (Dendroica nigrescens)	Open conifer/mixed forest	O	Small trees/shrubs	Insects	Foliage glean	Live oak shrubs/trees
Nashville Warbler (Vermivora ruficapilla)	Dry woodland Scrub	O	Ground	Insects	Foliage Glean/Hawks	Ground under live resprout
Orange-crowned Warbler (Vermivora celata)	Riparian/mixed woodland w/undergrowth	O	Ground	Insects	Foliage Glean/Hawks	Ground under live resprout
MacGillivray's Warbler (Oporornis tolmiei)	Forest edge	O	Ground/Shrub	Insects	Bark/Ground Glean	Hardwood resprouts
Dark-eyed Junco (Junco hyemalis)	Varied Often conifer forests	O	Ground	Insect/ Seeds	Ground glean/ Hawks near ground	Ground under hardwood resprouts or logs
Lazuli Bunting (Passerina amoena)	Open woodland Brushy early successional	O	Tangle/Brush	Insect Seeds	Foliage Glean	Hardwood respouts, shrubs
Western Tanager (Piranga ludoviciana)	Conifer/ Mixed forest	O	Conifer Hardwood	Insects/fruit	Hawks	Live conifers, tanoak snag, Hardwood resprouts
Spotted Towhee (Pipilo maculatus)	Varied forest w/dense, shubby growth	O	Ground under vegetation	Insects/ Seeds	Ground Glean	Ground under hardwood resprouts
Song Sparrow (Melospiza melodia)	Varied/often riparian/dense undergrowth	O	Ground/shrubs w/dense cover	Insects/ Seeds	Ground/Foliage Glean	Grass/Bracken fir near water
White crowned Sparrow (Zonotrichia leucophrys)	Forest w/shrubs grasssy cover near water	O	Shrubs	Insects/ Seeds	Ground glean/ Hawks near ground	Deer brush
Chipping Sparrow (Spizella passerina)	Shubby/early succesional conifer	O	Trees/shrubs Conifers	Insects/ Seeds	Ground Glean	Douglas fir (live) White Oak (live)

* Nest types: C = cavity O = open cup.

Table 1. Breeding bird species found nesting in burn plots in 2004-2005. Entries represent typical habitat, nesting and foraging characteristics for these species in western forests. The last column contains nest substrates used by these species in this study. Primary sources for species characteristics: The Birds of North America, various issues (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

The Cooperative Forest Ecosystem Research (CFER) program was developed to facilitate sound management of forest ecosystems, with emphasis on meeting priority research information needs of the Bureau of Land Management (BLM) and the Oregon Department of Forestry (ODF) in Western Oregon.

The information contained in this document is preliminary in nature and has not been peer-reviewed. The data are not guaranteed to be correct or complete. Users are cautioned to consider carefully the provisional nature of the information.

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