



Bird Community Monitoring for Bandelier National Monument

2015 Summary Report

Natural Resource Report NPS/SCPN/NRDS—2016/1068



ON THE COVER
Western tanager (*Piranga ludoviciana*)
Photography by: NPS

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1 Introduction

The National Park Service (NPS) Inventory and Monitoring Program was designed to determine the current status and monitor long-term trends in the condition of park natural resources, providing park managers with a strong scientific foundation for making decisions and working with other agencies and the public for the protection of park ecosystems. The Southern Colorado Plateau Network (SCPN) of the NPS has identified bird communities as a vital sign for network parks (Thomas et al. 2006). The goal of bird community monitoring is to provide status and trends data on bird communities in several predominant habitats where integrated upland or riparian vegetation monitoring is also occurring.

For Bandelier National Monument (BAND), Southern Colorado Plateau Network (SCPN) and monument staff selected the Mixed Conifer ecological site as an important ecosystem for vegetation and bird community monitoring. At the initiation of bird monitoring in 2008, this ecological site represented large areas of the monument. Then, in June, 2011, the Las Conchas Fire burned over 156,000 acres of the monument. All of the major watersheds within the monument were heavily impacted, and much of the mixed conifer forest was burned. This large-scale disturbance resulted in long-lasting changes in forest structure and composition. Continued monitoring of the mixed conifer bird community required that we modify the original sampling frame. We assessed burn severity for each of the original 100 monitoring plots and identified 48 plots with no evidence of fire or with low canopy burn severity, exhibiting little to no changes in vegetation structure. These plots now comprise the BAND mixed conifer sampling frame for bird community monitoring.

In 2015, through a Colorado Plateau Cooperative Ecosystems Studies Unit agreement with SCPN, we continued monitoring the upland bird community of the target mixed conifer habitat in BAND, which had been initiated in 2008, and continued in 2009 and 2012. In this report, we document monitoring activities of the 2015 field season and summarize the data that were collected.

2 Methods

2.1 Sampling frame

A sampling frame is the area within which we randomly locate our monitoring sites, and hence, the area to which statistical inferences can be made based on monitoring data. We derived the sampling frames for vegetation and bird community monitoring at BAND from maps of ecological sites developed by the U.S. Natural Resources Conservation Service (NRCS; See Appendix A of DeCoster et al. 2012). Ecological sites are landscape divisions with characteristic soils, hydrology, plant communities, and disturbance regimes and responses, and are based on soil survey data (Butler et al. 2003).

When we developed the sampling frame, a soil survey update had recently been completed for the monument (Hibner 2000), but ecological site data were not updated. So, in 2007, as the integrated upland protocol (DeCoster et al. 2012) was being developed SCPN created initial soil-based sampling frames that consisted of those soil units most strongly correlated with the occurrence of mixed conifer vegetation. The initial soil-based draft sampling frame was overlapped with a draft vegetation map (published as Muldavin et al. 2010), and we identified soils that were well correlated with mixed conifer vegetation. These comprised the Mixed Conifer ecological site, which is henceforth referred to as mixed conifer habitat.

To complete the bird community monitoring sampling frame, we modified the map of the sampling frame using Geographical Information System (GIS) technology to eliminate

- areas that were not within the target habitat (roads, buildings, and infrastructure)
- areas that were expected to differ substantially from the norm for the target habitat, such as areas that have experienced fire of moderate to high burn severity, because these areas would have increased ecological variation, making it more difficult to detect trends

- areas with slopes $\geq 30\%$ to prevent erosion from occurring as a result of the field work

We created a set of spatially distributed sampling plots in a simple grid sampling design. BAND staff reviewed the sampling plots and rejected those plots that landed in the proximity of archeological sites. Next, the bird monitoring crew evaluated the accessibility of each plot in the field and rejected those that were deemed inaccessible. Sites were rejected as inaccessible if (1) they required greater than 2 hours travelling time (by car and foot) from the Juniper Campground, and (2) they did not constitute a group of 9 to 10 plots that could be accessed and sampled within a single morning. The crew then assessed each sampling plot to ensure that it (1) fell within the target habitat, (2) had a slope of less than 30%, and (3) did not contain a major disturbance. Any plots that did

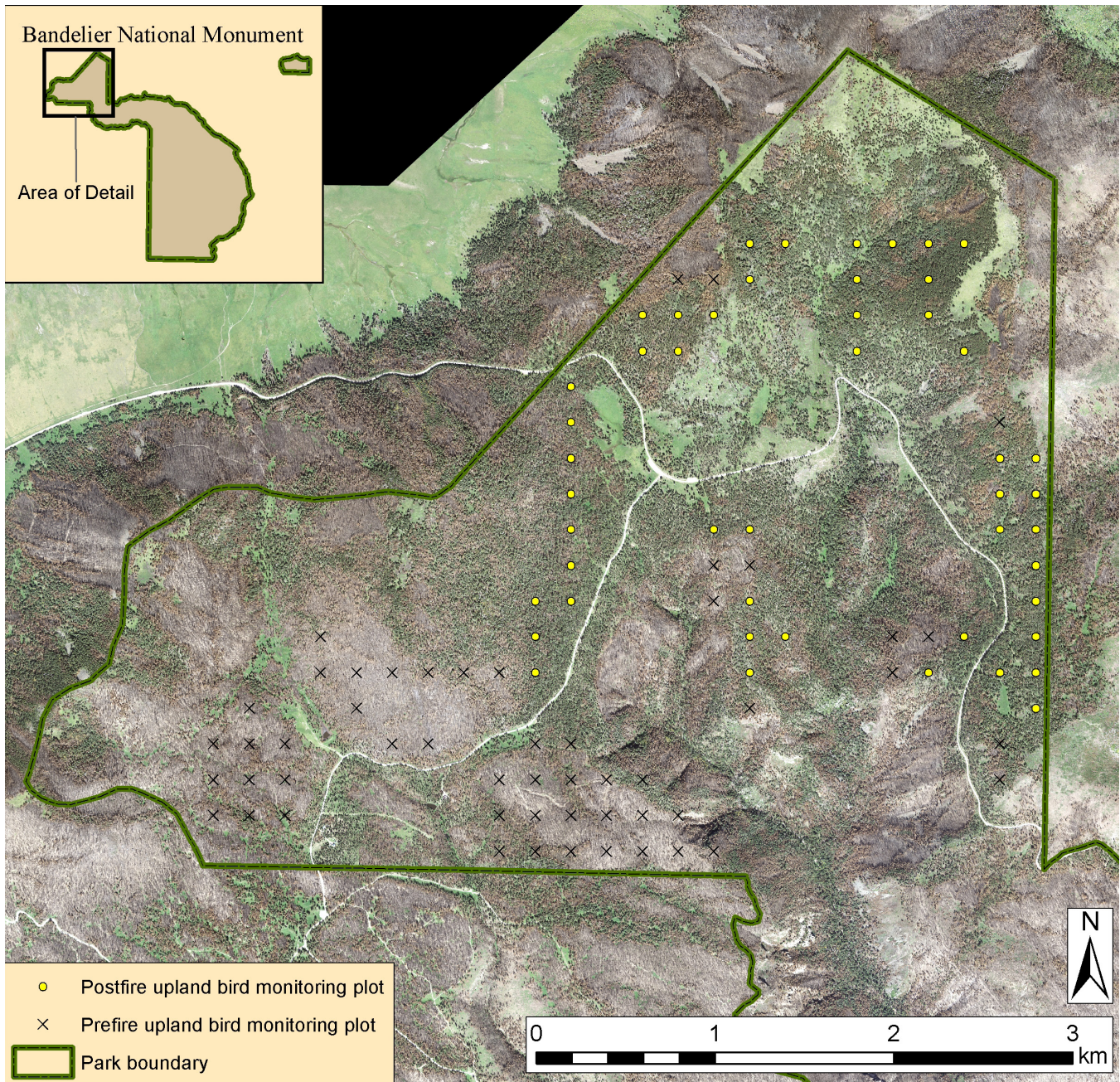


Figure 1. Bird monitoring sampling frame for mixed conifer habitat in Bandelier NM, showing all plots in the original sampling frame. Yellow circles are the current sampling frame plots (post-Las Conchas Fire), and black "x"s are the plots that were excluded because of significant alteration from the 2011 Las Conchas Fire. The underlying image is from aerial photography taken after the fire.

not meet these criteria were rejected. We selected 100 sampling plots in the mixed conifer habitat (Figure 1) and rejected 145. The mixed conifer habitat at BAND was monitored in 2008 and 2009 using this original sampling frame.

Then, in June, 2011, the Las Conchas Fire occurred. The major watersheds within the monument were heavily impacted, and much of its mixed conifer habitat was burned. This large-scale disturbance resulted in long-lasting changes in forest structure and composition. Continued monitoring of the mixed conifer bird community required that we modify the original sampling frame in the following manner.

First, our original bird monitoring plots were overlaid on a soil burn severity map developed in 2011 by the Department of the Interior National Interagency Burned Area Emergency Response Team (DOI BAER 2011) and each plot was classified by soil burn severity.

Second, we assessed vegetation burn severity using high resolution aerial photography showing each plot before and after the fire. We classified 44 plots as having high or moderate vegetation burn severity; 56 plots were classified as unchanged or with minimal structural change.

Third, we made field visits to the 56 plots classified as unchanged or having low burn severity to further assess vegetation burn severity and accessibility. From this assessment we identified 48 bird monitoring plots where the majority of the plot was assessed as having low to low-moderate burn severity. We hereafter refer to these as “postfire upland bird monitoring plots” and they now comprise the revised BAND mixed conifer sampling frame for bird community monitoring (Figure 1).

2.2 Field methods

In order to approach our target sample size of 150 to 200 Variable Circular Plot (VCP) counts each sampling year (Holmes 2007), we conducted bird sampling at the 48 permanent sampling plots (Figure 1) over the course of 3 survey periods, for a total of 144 counts in 2015 (Table 1). A brief description of the field methods we employed is provided here. A more detailed description can be found in Holmes et al. (2015).

At each sampling plot, we conducted a VCP count, noting all birds seen or heard during an 8-minute sampling period, regardless of the distance from the observer. We recorded (1) the species, (2) method of detection, (3) gender (if known), and (4) distance from the sampling plot center to the individual bird. Distances were estimated to the nearest meter using a laser range finder. During a single morning, one technician conducted approximately ten VCP counts.

We characterized burn severity from the Las Conchas Fire at each 50 m radius macroplot centered on a VCP sampling plot. Using a modified Braun-Blanquet cover class scale, we made ocular estimates of the percentage of the macroplot’s canopy and understory in each of 4 burn severity classes (low, low-medium, medium-high, and high). We also recorded burn heterogeneity (low, medium, or high) across the macroplot.

We conducted habitat sampling on a 50 m radius macroplot centered on a VCP sampling plot, and in four sub-plots within the macroplot. First, for the macroplot, we estimated and recorded the area occupied by vegetation

Table 1. Survey periods and sampling effort for bird community monitoring at Bandelier NM in 2015. Includes the dates that VCP counts were conducted and the number of plots sampled.

Survey period	Dates (2015)	Number of VCP counts
1	21 May–23 May	48
2	17 June–19 June	48
3	20 June–22 June	48
Total		144

and other land cover types, if present. For the four subplots, we recorded foliar vegetation cover by functional group (e.g. forbs, shrubs), canopy closure, and tree and snag density and basal area. We measured basal area using a Cruz-All (a type of angle gauge), and canopy closure using a spherical densiometer. Ocular estimates of foliar cover were made using a modified Braun-Blanquet cover class scale.

2.3 Data summary

2.3.1 Variable Circular Plot count data

We summarized the following data for the target mixed conifer habitat at BAND. The sample unit for bird data is the VCP.

- Observed species richness (unadjusted for detectability) is the number of species detected within a given area and specified time.
- Mean number of individuals detected for each species is reported as the average number of individuals detected per 8-minute VCP count. To calculate mean number of individuals detected for each species in mixed conifer habitat with a simple grid sampling design, the data for all plots are averaged across the 3 survey periods, and a mean number of individuals detected and standard deviation are calculated for the target habitat. Detectability-based density estimates are not reported here, but they will be derived for multi-year trend reports.
- Frequency is the proportion of plots in which each species was detected. To calculate species frequency, we calculated the proportion of plots in the target habitat in which the species was detected. For example, if a particular species was detected on 28 of the 48 plots in the target habitat, during one, two, or all visits to that plot, the proportion of plots occupied in the target habitat would be 0.58 (58%).

2.3.2 Habitat data

We will use habitat data and bird sampling data to examine bird-habitat relationships. For BAND, habitat data were collected within a circular 0.8 ha macroplot which contained four subplots and was centered on each bird sampling plot. Data were summarized at two levels: the macroplot and the target habitat. The means and standard deviations for the target habitat were calculated from the macroplot data.

Following the Las Conchas Fire, only unburned and low burn severity plots, which we call postfire plots, were retained within the mixed conifer sampling frame. To characterize the postfire status of these plots, three additional, field-based burn metrics were employed.

Canopy burn severity. We classified burn severity of the canopy into four severity classes as shown in Table 2. For each burn severity class we calculated

- mean percent cover and standard deviation, by calculating the mean cover in each burn severity class across macroplots (using the cover class midpoints)
- frequency, by reporting the number of macroplots where a specific burn severity type had been recorded, as a proportion of the total number of macroplots

Understory burn severity. We classified burn severity of the understory into four severity classes as shown in Table 2. For each burn severity class we calculated

- mean percent cover and standard deviation, by calculating the mean cover in each burn severity class across macroplots (using the cover class midpoints)
- frequency, by reporting the number of macroplots where a specific burn severity type had been recorded, as a proportion of the total number of macroplots

Burn heterogeneity. We classified burn heterogeneity of the macroplot, a measure of the “patchiness” of burn severity, into three types as shown in Table 3. For each burn heterogeneity type we calculated the frequency by reporting the number of macroplots where a specific burn heterogeneity type had been recorded, as a proportion

Table 2. Canopy and understory burn severity classes in postfire (post-Las Conchas Fire) plots in mixed conifer habitat at Bandelier NM.

Burn severity class	Canopy burn severity	Understory burn severity
Low	0 to <25% scorched canopy	Most foliage and twigs remain intact, small organic material on ground is scorched but not entirely consumed; mineral soil rarely exposed.
Low-medium	25 to <75% scorched canopy and needle consumption.	Majority of shrub/herbaceous layer and woody debris is scorched to partially burned; most fine organic materials are partially burned; mineral soil intermittently exposed.
Medium-high	75–99% scorched canopy and needle consumption	Most woody debris <7.5 cm diameter is entirely consumed; most organic matter is entirely consumed. Mineral soil is exposed, but remains intact. Possible vigorous vegetative regrowth.
High	100% complete consumption of needles	All woody debris is entirely consumed, with the exception of an occasional large log; all litter and duff are consumed, exposing bare mineral soil. Substantial soil erosion may be evident.

Table 3. Burn heterogeneity types in postfire plots in mixed conifer habitat at Bandelier NM.

Burn heterogeneity type	Description
Low	Uniformly affected by burn
Medium	2 or 3 areas of differing severities
High	Patchy distribution of differing severities

Table 4. Vegetation cover types in post-Las Conchas Fire (2011) plots in mixed conifer habitat at Bandelier NM.

Cover type	Description
Mixed Conifer Forest (wet)	The overstory is a mixture of conifers (Douglas-fir [<i>Pseudotsuga menziesii</i>], white fir [<i>Abies concolor</i>], blue spruce [<i>Picea pungens</i>], southwestern white pine [<i>Pinus strobiformis</i>], limber pine [<i>Pinus flexilis</i>], and ponderosa pine [<i>Pinus ponderosa</i>]). White fir and blue spruce tend to dominate the overstory. May also contain quaking aspen (<i>Populus tremuloides</i>); if so it comprises less than 75% of the total tree cover. Understory is variable, including montane bunchgrasses, luxuriant forbs, and mesic shrub species, such as Rocky Mountain maple (<i>Acer glabrum</i>) gooseberry (<i>Ribes</i> spp), rock spirea (<i>Holodiscus dumosus</i>) and snowberry (<i>Symphoricarpos oreophilus</i>). Generally occupies positions on north-facing slopes and ridgelines.
Mixed Conifer Forest (dry)	The overstory is a mixture of conifers (Douglas-fir, white fir, blue spruce, southwestern white pine, limber pine, and ponderosa pine), along with quaking aspen, which can comprise between 25% and 75% of the total tree cover. Understory is variable, Gambel oak (<i>Quercus gambelii</i>) and common juniper (<i>Juniperus communis</i>) may be well represented. Herbaceous layer tends to be sparse, with much less cover than in the wet type. Tends to occur on south-facing slopes.
Aspen Forest	Overstory is dominated by aspen (exceeds 75% of total tree cover). Understory is variable, usually dominated by either bunchgrasses or a diverse suite of herbs. Few shrubs are present.
Ponderosa Pine Forest	Overstory tree canopy is relatively continuous (>60%) and dominated by ponderosa pine, which exceeds 75% of total canopy.
Ponderosa Pine Woodland/Savanna	Overstory tree canopy is 10–60% total cover. The canopy is dominated by ponderosa pine (exceeds 75% of total tree cover). May also include pinyon-juniper component. Understory is usually represented by a variable mix of bunchgrasses and forbs, however, Gambel oak and New Mexico locust (<i>Robinia neomexicana</i>) may be well represented.
Gambel Oak Shrubland	Shrub canopy dominated by Gambel oak, Apache plume (<i>Fallugia paradoxa</i>) or New Mexico locust. May also contain Fendler ceanothus (<i>Ceanothus fendleri</i>). Shrub cover exceeds 25%. Tree canopy is absent or sparse (<10%).
Post-fire Herbaceous Shrub Disturbance Vegetation	Areas that have experienced evident stand replacement fire, and remaining live conifer cover is less than 10%. Understory is a diverse mix of native and exotic grasses and native and exotic forbs. When present, Gambel oak and New Mexico locust cover doesn't exceed 25%.
Montane Grassland	Overstory trees are absent, or comprise <10% cover. Sites are characterized by a herbaceous layer dominated by perennial bunchgrass species, including Parry's oatgrass (<i>Danthonia parryi</i>) and Thurber fescue (<i>Festuca thurberi</i>).

of the total number of macroplots.

Vegetation cover types. We classified vegetation into 5 cover types for the BAND mixed conifer habitat as shown in Table 4. For each vegetation type we calculated

- mean percent cover for each vegetation type and other land cover types in the target habitat (using the cover class midpoints) and standard deviation
- frequency, the number of macroplots where a specific cover type had been recorded, as a proportion of the total number of macroplots

Basal area. We calculated tree basal area (m^2/ha) for each species, and basal area for all snags. We calculated mean basal area for the macroplot, and mean basal area and standard deviation for the target habitat.

Sapling density. We calculated density (stems/ha) for each species and size class, and for all species within a size class. We calculated mean density for the macroplot, and mean species density and standard deviation for the target habitat.

Foliar cover of functional groups. We calculated the mean foliar cover for each functional group for the macroplot, using the cover class midpoints, and then the mean and standard deviation for the target habitat.

3 Results

3.1 Summary of bird community data

In 2015, we conducted a total of 144 VCP counts in post-Las Conchas Fire plots in mixed conifer habitat at BAND and detected 1,963 individuals of 42 species (Table 5). The most commonly detected species were yellow-rumped warbler, dark-eyed junco, and warbling vireo. Together these species comprised nearly a third (30.06%) of the total number of individuals detected.

The mean number of individuals detected per species during a VCP count, and the frequency of detections for each species detected in BAND mixed conifer habitat are presented in Table 6. The yellow-rumped warbler had the highest mean number of individuals, with an average of 1.77 individuals detected during an 8-minute count. Most of the abundant species, such as yellow-rumped warbler, dark-eyed junco, warbling vireo, western tanager, and hermit thrush, were also widespread. Most species with low abundance, such as downy woodpecker, Townsend's solitaire, and plumbeous vireo, were not widespread. A few species, like the hairy woodpecker, had a relatively low abundance, but were fairly widely distributed (Table 6).

Table 5. Bird species and number detected during VCP counts in post-Las Conchas Fire (2011) mixed conifer habitat at Bandelier NM in 2015. Species are listed in descending order of the total number of individuals detected.

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
yellow-rumped warbler	<i>Setophaga coronata</i>	255	12.99
dark-eyed junco	<i>Junco hyemalis</i>	187	9.53
warbling vireo	<i>Vireo gilvus</i>	148	7.54
house wren	<i>Troglodytes aedon</i>	129	6.57
western tanager	<i>Piranga ludoviciana</i>	124	6.32
hermit thrush	<i>Catharus guttatus</i>	91	4.64
Hammond's flycatcher	<i>Empidonax hammondi</i>	84	4.28
ruby-crowned kinglet	<i>Regulus calendula</i>	80	4.08
mountain chickadee	<i>Poecile gambeli</i>	77	3.92
northern flicker	<i>Colaptes auratus</i>	75	3.82
chipping sparrow	<i>Spizella passerine</i>	73	3.72
hairy woodpecker	<i>Picoides villosus</i>	63	3.21
brown creeper	<i>Certhia americana</i>	52	2.65
white-breasted nuthatch	<i>Sitta carolinensis</i>	51	2.60
Cordilleran flycatcher	<i>Empidonax occidentalis</i>	49	2.50
pine siskin	<i>Carduelis pinus</i>	47	2.39
Williamson's sapsucker	<i>Sphyrapicus thyroideus</i>	45	2.29
American robin	<i>Turdus migratorius</i>	35	1.78
western wood-pewee	<i>Contopus sordidulus</i>	35	1.78
common raven	<i>Corvus corax</i>	29	1.48
pygmy nuthatch	<i>Sitta pygmaea</i>	28	1.43
Steller's jay	<i>Cyanocitta stelleri</i>	26	1.32
violet-green swallow	<i>Tachycineta thalassina</i>	25	1.27
evening grosbeak	<i>Coccothraustes vespertinus</i>	24	1.22
red-breasted nuthatch	<i>Sitta canadensis</i>	23	1.17
black-headed grosbeak	<i>Pheucticus melanocephalus</i>	14	0.71
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	14	0.71
Clark's nutcracker	<i>Nucifraga columbiana</i>	14	0.71

Table 5. (continued) Bird species and number detected during VCP counts in post-Las Conchas Fire (2011) mixed conifer habitat at Bandelier NM in 2015. Species are listed in descending order of the total number of individuals detected.

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
wild turkey	<i>Meleagris gallopavo</i>	13	0.66
western bluebird	<i>Sialia mexicana</i>	12	0.61
plumbeous vireo	<i>Vireo plumbeus</i>	8	0.41
mourning dove	<i>Zenaida macroura</i>	6	0.31
green-tailed towhee	<i>Pipilo chlorurus</i>	5	0.25
American three-toed woodpecker	<i>Picoides dorsalis</i>	4	0.20
black-chinned hummingbird	<i>Archilochus alexandri</i>	3	0.15
downy woodpecker	<i>Picoides pubescens</i>	3	0.15
orange-crowned warbler	<i>Vermivora celata</i>	3	0.15
Townsend's solitaire	<i>Myadestes townsendi</i>	3	0.15
band-tailed pigeon	<i>Columba fasciata</i>	2	0.10
Grace's warbler	<i>Dendroica graciae</i>	2	0.10
northern goshawk	<i>Accipiter gentilis</i>	1	0.05
sharp-shinned hawk	<i>Accipiter striatus</i>	1	0.05

Table 6. Mean number of individuals detected per VCP count, standard deviation (SD), and the proportion of plots in which each species was detected (plot frequency) in post-Las Conchas Fire (2011) mixed conifer habitat at Bandelier NM, 2015.

Species	Number of individuals		Plot frequency (%)
	Mean	SD	
yellow-rumped warbler	1.77	1.02	100.00
dark-eyed junco	1.30	1.12	93.75
warbling vireo	1.03	0.95	89.58
house wren	0.90	0.99	77.08
western tanager	0.86	0.96	87.50
hermit thrush	0.63	0.70	81.25
Hammond's flycatcher	0.58	0.71	77.08
ruby-crowned kinglet	0.56	0.73	72.92
mountain chickadee	0.53	0.68	70.83
northern flicker	0.52	0.74	68.75
chipping sparrow	0.51	0.70	83.33
hairy woodpecker	0.44	0.64	75.00
brown creeper	0.36	0.50	68.75
white-breasted nuthatch	0.35	0.60	60.42
Cordilleran flycatcher	0.34	0.57	58.33
pine siskin	0.33	0.69	47.92
Williamson's sapsucker	0.31	0.57	58.33
American robin	0.24	0.52	45.83
western wood-pewee	0.24	0.55	29.17
common raven	0.20	0.48	41.67
pygmy nuthatch	0.19	0.51	33.33
Steller's jay	0.18	0.45	35.42

Table 6. (*continued*) Mean number of individuals detected per VCP count, standard deviation (SD), and the proportion of plots in which each species was detected (plot frequency) in post-Las Conchas Fire (2011) mixed conifer habitat at Bandelier NM, 2015.

Species	Number of individuals		Plot frequency (%)
	Mean	SD	
violet-green swallow	0.17	0.79	22.92
evening grosbeak	0.17	0.63	29.17
red-breasted nuthatch	0.16	0.39	37.50
black-headed grosbeak	0.10	0.32	27.08
broad-tailed hummingbird	0.10	0.30	25.00
Clark's nutcracker	0.10	0.43	18.75
wild turkey	0.09	0.41	18.75
western bluebird	0.08	0.36	14.58
plumbeous vireo	0.06	0.23	16.67
mourning dove	0.04	0.23	10.42
green-tailed towhee	0.03	0.22	6.25
American three-toed woodpecker	0.03	0.16	8.33
black-chinned hummingbird	0.02	0.14	6.25
downy woodpecker	0.02	0.14	6.25
orange-crowned warbler	0.02	0.19	4.17
Townsend's solitaire	0.02	0.14	6.25
band-tailed pigeon	0.01	0.12	4.17
Grace's warbler	0.01	0.12	4.17
northern goshawk	0.01	0.08	2.08
sharp-shinned hawk	0.01	0.08	2.08

3.2 Summary of bird habitat data

3.2.1 Burn severity and heterogeneity

The 2011 Las Conchas Fire created a landscape mosaic of patches of varying burn severity (see Figure 1). We conducted sampling only in plots still containing mixed conifer habitat (i.e., plots with little to no change in vegetation structure due to fire). Within these plots, we found that canopy burn severity varied considerably. On average, the macroplots contained 9.81% low canopy burn severity (zero to less than 25% scorched canopy), 49.41% low-medium canopy burn severity (25–75% scorched canopy and needle consumption), and 33.94% medium-high or high canopy burn severity (Table 7). Understory burn severity also varied considerably. Low and low-medium understory burn severity comprised the majority (31.07% and 10.45%, respectively), on average, of the macroplot understory cover (Table 8). The four understory burn severity types were equally distributed- each were recorded on 52.08% of the macroplots. The majority (68.75%) were uniformly affected by burn, with low burn heterogeneity (Table 9).

3.2.2 Vegetation cover types

We found four vegetation cover types (Mixed Conifer Forest (dry), Mixed Conifer Forest (wet), Ponderosa Pine Woodland/Savanna, and Aspen Forest) in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the BAND sampling area (Table 10). Mixed Conifer Forest dry and wet cover types were recorded on 85.42% of the macroplots. When we calculated the mean percent cover for each vegetation type, the two mixed conifer forest vegetation types were the most common cover type, accounting for, on average, 51.41% and 21.88% (73.29% total) of the overall vegetative cover of the macroplots (Table 10).

Table 7. Mean proportion of macroplot cover within each canopy burn severity class, standard deviation (SD), and range; and plot frequency of each canopy burn severity class within macroplots in post-Las Conchas Fire (2011) plots in mixed conifer habitat at Bandelier NM, 2015.

Canopy burn severity class	Cover (%)			
	Mean	SD	Range	Frequency (%)
Low	9.81	26.79	0.05–87.50	100.00
Low-medium	49.41	42.77	0.05–87.50	100.00
Medium-high	28.21	38.71	0.05–87.50	100.00
High	5.73	15.33	0.05–87.50	100.00

Table 8. Mean proportion of macroplot cover within each understory burn severity class, standard deviation (SD), and range; and plot frequency of each understory burn severity class within macroplots in post-Las Conchas Fire (2011) plots in mixed conifer habitat at Bandelier NM, 2015.

Understory burn severity class	Cover (%)			
	Mean	SD	Range	Frequency (%)
Low	31.07	42.23	0.00–87.50	52.08
Low-medium	10.45	26.70	0.00–87.50	52.08
Medium-high	5.43	18.86	0.00–87.50	52.08
High	0.26	0.25	0.00–0.50	52.08

Table 9. Frequency (%) of macroplots containing each burn heterogeneity type in post-Las Conchas Fire (2011) plots in mixed conifer habitat in Bandelier NM, 2015.

Burn heterogeneity type	Description	Frequency (%)
Low	Uniformly affected by burn	68.75
Medium	2 or 3 discrete areas of differing severities	29.17
High	Patchy distribution of differing severities	2.08

Table 10. Mean cover of vegetation types, standard deviation (SD), range, and frequency of these types in post-Las Conchas Fire (2011) macroplots in target mixed conifer habitat in Bandelier NM, 2015

Vegetation cover type	Cover (%)			
	Mean	SD	Range	Frequency (%)
Mixed Conifer Forest (dry)	51.41	43.23	0.00–87.50	60.42
Mixed Conifer Forest (wet)	21.88	38.29	0.00–87.50	25.00
Ponderosa Pine Woodland/Savanna	14.58	32.95	0.00–87.50	16.67
Aspen Forest	0.38	1.56	0.00–7.50	6.25

3.2.3 Tree species composition and structure

In Table 11, the abundance of trees within each species is expressed in terms of basal area of overstory trees and sapling density, by species. The abundance of snags is expressed in terms of basal area, recorded for all species combined. Table 11 and Figure 2 illustrate basal area of trees by species and snags. Seven tree species were recorded on the sampling plots, with ponderosa pine having the highest postfire basal area (see Table 11 for scien

Table 11. Basal area of overstory trees (DBH > 10 cm), by species, and snags; and mean density (number of stems/ha) of saplings (DBH < 10 cm), by species, in post-Las Conchas Fire (2011) plots in mixed conifer habitat in Bandelier NM, 2015. Scientific and common names are provided for each tree species

Species	Common name	Basal area (m ² /ha)	Sapling density by size class	
			2.5 to <5.0 cm DBH	5.0 to <10.0 cm DBH
<i>Pinus ponderosa</i>	Ponderosa pine	11.51	0.00	0.00
<i>Pseudotsuga menziesii</i>	Douglas fir	6.66	3.98	5.97
<i>Populus tremuloides</i>	Aspen	2.24	7.96	0.00
<i>Abies concolor</i>	White fir	2.03	3.32	2.65
<i>Pinus flexilis</i>	Limber pine	0.49	0.00	1.33
<i>Picea engelmannii</i>	Engelmann spruce	0.17	0.00	0.66
<i>Abies lasiocarpa</i>	Subalpine fir	0.05	0.00	1.33
All tree species		23.15	15.25	11.94
Snags		10.82		

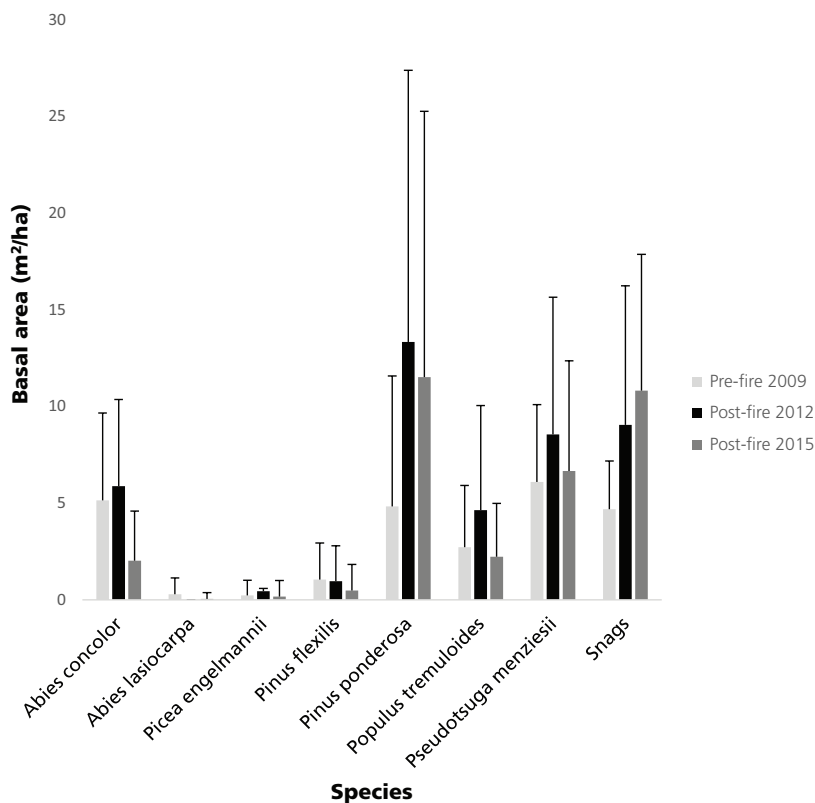


Figure 2. Basal area of trees, by species, and of snags in pre- (2009) and post- (2012 and 2015) Las Conchas Fire plots (48 plots) in mixed conifer habitat in Bandelier NM, 2015. Prefire data were collected from the original 100 plots in the pre-Las Conchas Fire mixed conifer sampling frame in 2009. Error bars represent one standard deviation.

tific and common names of tree species). Figure 3 illustrates the density of sapling trees (less than 10 cm DBH) by species and size class. Aspen was the most commonly recorded sapling in the smallest size class (2.5 to <5 cm DBH) and Douglas fir was the most common in the larger sapling size class (5 to <10 cm DBH). The average canopy closure in the mixed conifer habitat was 57.97% (SD = 14.82).

3.2.4 Understory cover by functional group

Within the mixed conifer understory, the functional group with the highest foliar cover was perennial grasses, graminoids, and there was considerable variation in the amount of cover—mean foliar cover for this functional

group ranged from 2.75% to 40.00% (Table 12). There was also considerable variation in the amount of total shrub and herbaceous cover cover—mean foliar cover for this functional group ranged from 3.50% to 56.25%.

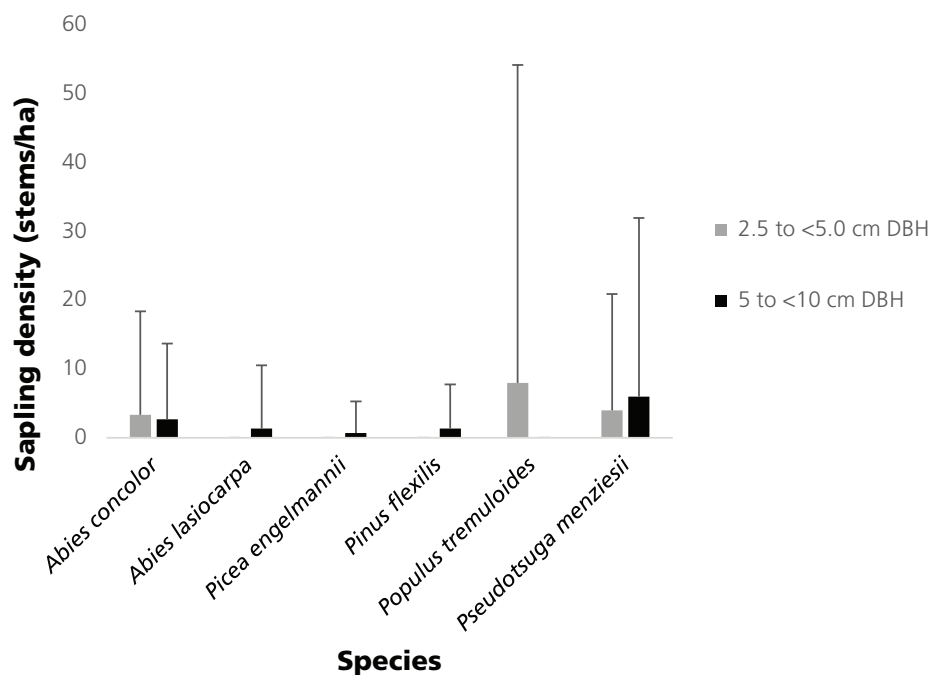


Figure 3. Size structure of sapling trees. Mean density (number of stems/ha) of sapling trees in 2 size classes (2.5 to <5, and 5 to <10 cm DBH) in post-Las Conchas Fire (2011) plots in mixed conifer habitat in Bandelier NM, 2015. Error bars represent one standard deviation.

Table 12. Mean foliar cover, standard deviation (SD), and range of functional groups in post-Las Conchas fire (2011) plots in target mixed conifer habitat in Bandelier NM, 2015

Functional groups	Foliar cover (%)		
	Mean	SD	Range
Tree seedlings	4.08	5.49	0.00–26.88
Total shrub and herbaceous cover (no trees)	30.35	13.25	3.50–56.25
Perennial grasses, graminoids	21.30	10.96	2.75–40.00
Annual grasses	0.63	2.06	0.00–11.38
Forbs	10.05	8.71	1.13–43.75
Shrubs, dwarf shrubs and woody vines	1.04	2.94	0.00–15.63
Cacti, succulents	0.02	0.11	0.00–0.75
Standing dead herbaceous	4.34	1.98	0.25–8.88
Woody standing dead	0.41	0.95	0.00–4.38

4 Discussion

These data represent the fourth year of sampling the mixed conifer bird community at BAND, and the second year of sampling after the Las Conchas Fire in June 2011. SCPN monitors bird communities within network parks as a core vital sign representing the overall health and condition of park natural resources. Similarly, the North American Bird Conservation Initiative (NABCI), U.S. Committee (2014) uses birds as indicators of ecosystem health by examining population trends of obligate species for a single habitat, using data from continental-scale monitoring programs for their *State of the Birds 2014* report. Ten species detected in BAND mixed conifer are included in the list of 39 obligate breeding birds that make up the report's western forests indicator. According to the report, the western forests indicator declined by nearly 20%, and has continued to decline since 2009. Four of the 10 BAND species (western wood-pewee, western flycatcher (Cordilleran flycatcher), plumbeous vireo, and Grace's warbler) are listed as significantly declining. The State of the Birds 2014 Report also identifies 33 common birds in steep decline—having lost more than half of their global population over the past four decades. Our BAND mixed conifer 2015 data includes 47 detections for the pine siskin, a common species in steep decline (North American Bird Conservation Initiative, U.S. Committee 2014).

The 2011 Las Conchas Fire impacted much of the monument's mixed conifer habitat and created a landscape mosaic of patches of varying burn severity, from unburned to severely burned areas. The sampling frame for the SCPN bird monitoring program consists of post-Las Conchas Fire plots still containing mixed conifer habitat (i.e., plots with low to moderate changes in vegetation structure), and precludes sampling across the full range of burn severities that would have been represented had we retained our original sampling frame. As a result, in 2012, the number of sampling plots was reduced by approximately half, but these plots were widely distributed across the park's mixed conifer zone and we adjusted our sampling effort to acquire a sample size of VCP counts comparable to those of previous years. The monitoring data will allow us to examine the effects of the fire on the bird community within still-forested plots in mixed conifer habitat, but do not allow us to compare pre- and post-fire forest areas to heavily burned postfire areas.

Bird species responses and the effects of the fire on the mixed conifer bird community will likely change with time after the fire. Several factors, including time since fire, likely affect bird responses to fire. There can be immediate effects on bird survival when fire burns occupied habitat. Short-term responses (generally less than 5 years) and longer-term responses are likely affected by several factors, including burn severity and tree mortality, burn extent, and the landscape context of burn severity and size—including the availability of unburned or low burn severity forest habitat in the landscape. Longer-term responses of the bird community are also likely affected by management actions, fire frequency, postfire successional processes, and ungulate herbivory. Our long-range plan for mixed conifer bird community monitoring in BAND is to conduct VCP counts every three years to continue collecting data on bird species abundance, distribution, and habitat metrics. When sufficient data have been collected, we will analyze changes in these data over time.

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