



# Bird Community Monitoring for Bandelier National Monument

## *2009 Summary Report*

Natural Resource Data Series NPS/SCPN/NRDS—2012/413



**ON THE COVER**  
**Western tanager**  
**Photography by: U.S. Fish and Wildlife Service**

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Natural Resource Data Series NPS/SCPN/NRDS—2012/413

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# 1 Introduction and background

The National Park Service 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 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 park staff selected the Mixed Conifer ecological site as an important ecosystem for vegetation and bird community monitoring. This ecological site represents large areas of the monument, but climate change, altered fire regimes, soil erosion, and invasion by non-native species threaten its integrity.

In 2008, we began a pilot year of monitoring the upland bird community of the target mixed conifer habitat and pinyon-juniper habitat in BAND. Subsequently, the BAND pinyon-juniper bird community was removed from the protocol. In 2009, we continued monitoring the mixed conifer bird community through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN. In this report, we document monitoring activities of the 2009 field season and summarize the data that were collected.

## 2 Methods

### 2.1 Sampling frame

A sampling frame is the area within which we locate our monitoring sites, and hence, the area to which statistical inferences can be made, based on monitoring data. SCPN generally uses ecological sites developed by the U.S. Natural Resources Conservation Service to create their sampling frames. 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). Although a soil survey update was recently completed for the monument (Hibner 2000), ecological site data were not updated. Instead, for vegetation and bird community monitoring, SCPN created soil-based sampling frames that consisted of those soil units most strongly correlated with the occurrence of mixed conifer vegetation. The overall mixed conifer sampling frame was created in 2007 as the integrated upland protocol was being developed (DeCoster et al. 2012). A draft vegetation map was available for BAND (published as Muldavin et al. 2011), and we used it to identify soils that were well correlated with mixed conifer vegetation. The Mixed Conifer ecological site is henceforth referred to as mixed conifer habitat (fig. 1).

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

- areas that were not within the target ecological site (roads, buildings, and infrastructure)
- areas that were expected to differ substantially from the norm for the target habitat, such as those 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

A simple grid of plots was created for the mixed conifer habitat type. BAND park staff first reviewed the sampling plots and rejected those plots that were in the proximity of archeological sites. Next, the bird monitoring crew evaluated the accessibility of each plot and rejected those that were inaccessible. Sites were deemed inaccessible if (1) they were greater than two 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. Because GIS data are not always accurate, the bird monitoring crew then visited and assessed each sampling plot within the accessible plots to ensure that (1) it 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 not meet these criteria were rejected. Because of these limitations, only a relatively small area was available for sampling at BAND, and all logistically feasible plots were sampled (i.e., a “census approach” was taken; see Appendix A of Holmes et al., in preparation). We selected 100 sampling plots in the mixed conifer habitat and rejected 145.

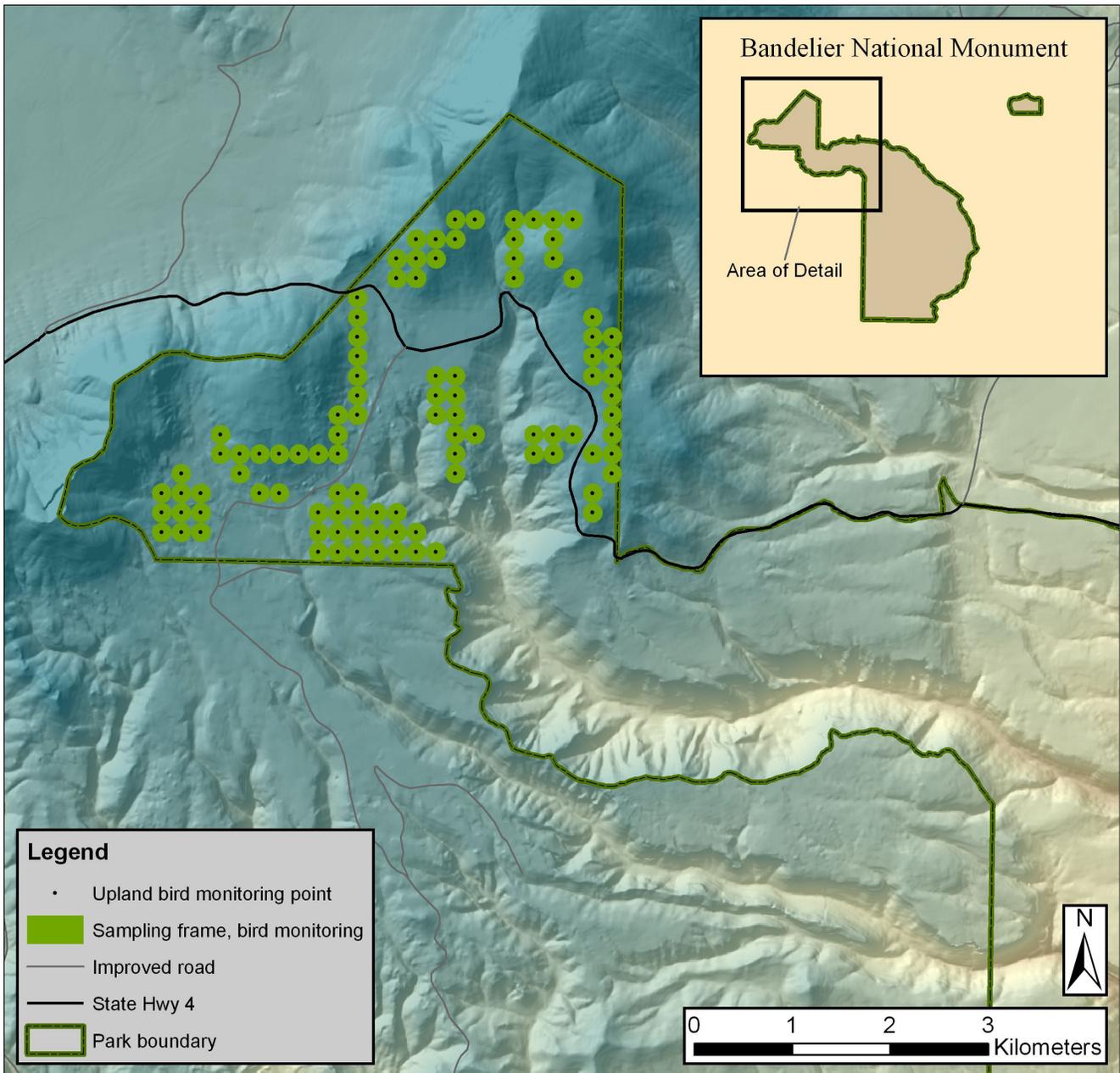


Figure 1. Bird monitoring sampling frame of mixed conifer habitat in Bandelier National Monument

## 2.2 Field methods

We conducted bird sampling at 100 permanent sampling plots, or Variable Circular Plot (VCP) count stations, within mixed conifer habitat at BAND (fig. 1) over two survey periods (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. (in preparation).

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 the species, method of detection, gender (if known), and distance from the sampling plot center to the individual bird. Distances were measured to the nearest meter using a laser range finder. During a single morning, approximately ten VCP counts

**Table 1. Survey periods and sampling effort for mixed conifer bird community monitoring at Bandelier National Monument (BAND), dates when VCP counts were conducted in BAND mixed conifer in 2009, and the number of plots sampled**

Habitat	Survey period	Survey dates (2009)	Number of VCP counts
Mixed conifer	1	5/18–5/26	100
	2	6/16–6/29	100

each were conducted by two technicians surveying separate groups of sampling plots.

Habitat sampling was conducted on a 50 m radius macroplot centered on a sampling plot, and in four subplots within the macroplot. First we estimated and recorded the area occupied by vegetation types and other land-use types in the macroplot. Then we recorded tree and snag density and basal area, canopy closure, and foliar vegetation cover by functional group (e.g. forbs, shrubs), for the four subplots. We measured basal area using an 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

The following data were summarized for the mixed conifer target habitat at BAND. The sample unit for bird data is the VCP count station (plot).

- *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 two 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 “occupied” by each species. To calculate species frequency, we calculated the proportion of plots in the target habitat in which the species was detected. For example, if a western tanager was detected on 94 of the 100 plots in the target habitat, during one or both visits to that plot, the proportion of plots occupied in the target habitat is 0.94 (94%).

### 2.3.2 Habitat data

Habitat data will be used with 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.

**Table 2. Vegetation cover types in mixed conifer habitat at Bandelier National Monument, 2009**

Habitat	Vegetation cover type	Description
Mixed conifer	Mixed conifer forest (target habitat)	Dominated by various combinations of ponderosa pine ( <i>Pinus ponderosa</i> ), 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> ), and sometimes other species. Typically consists of a topographically determined heterogeneous mosaic of patches, some of which are dominated by quaking aspen <sup>a</sup> ( <i>Populus tremuloides</i> ).
	Aspen grove <sup>a</sup>	Dominated by aspen. Typically, aspen groves occur in areas that have been impacted relatively recently by disturbance that removed the tree canopy.
	Ponderosa pine forest	Dominated by ponderosa pine, occupies the lowest elevation of the montane zone; often contains elements of the pinyon-juniper woodland type.
	Gambel oak shrubland	Dominated by gambel oak ( <i>Quercus gambelii</i> ) and other species, such as mountain mahogany ( <i>Cercocarpus montanus</i> , <i>C. ledifolius</i> ) or serviceberry ( <i>Amelanchier utahensis</i> ); occasionally occurs between the pinyon-juniper woodland and ponderosa pine forest types.
	Montane grassland	Consists of meadows; scattered in valley bottoms and on dry, steep, south-facing slopes in the montane zone.
	Spruce-fir forest	Characterized by Engelmann spruce ( <i>Picea engelmannii</i> ) and subalpine fir ( <i>Abies lasiocarpa</i> ).

<sup>a</sup>Although stands of quaking aspen are considered to be part of the mixed conifer vegetation type, we estimated the percent cover of aspen grove separate from mixed conifer.

*Vegetation cover types.* For BAND mixed conifer habitat, we classified six vegetation types, as shown in Table 2. We calculated the following for each vegetation type:

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

*Tree sapling density.* For sapling trees (<10 cm DBH), we calculated density (stems/ha) for each species and size class, and for all species within a size class. Mean density was calculated for the macroplot, and then a mean species density and standard deviation were calculated for the target habitat.

*Basal area.* Basal area (m<sup>2</sup>/ha ) was calculated for each tree species, and for all snags. Mean basal area was calculated for the macroplot, and then mean basal area and standard deviation were calculated for the target habitat.

*Foliar cover of functional groups.* The mean foliar cover for each functional group was calculated for the macroplot, using the cover class midpoints. Then the mean and standard deviation were calculated for the target habitat.

## 3 Results

### 3.1 Mixed conifer habitat

#### 3.1.1 Summary of bird community data

In 2009, we conducted a total of 200 VCP counts in mixed conifer habitat at BAND (table 1) and detected 3,333 individuals of 46 species (table 3). The most commonly detected species was the yellow-rumped warbler. This species comprised 13.80% of the total number of individuals detected.

**Table 3. Bird species and number detected during VCP counts in mixed conifer habitat at Bandelier National Monument, 2009. 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>Dendroica coronada</i>	460	13.80
warbling vireo	<i>Vireo gilvus</i>	294	8.82
ruby-crowned kinglet	<i>Regulus calendula</i>	243	7.29
hermit thrush	<i>Catharus guttatus</i>	210	6.30
western tanager	<i>Piranga ludoviciana</i>	200	6.00
dark-eyed junco	<i>Junco hyemalis</i>	190	5.70
mountain chickadee	<i>Poecile gambeli</i>	189	5.67
violet-green swallow	<i>Tachycineta thalassina</i>	187	5.61
Cordilleran flycatcher	<i>Empidonax occidentalis</i>	171	5.13
house wren	<i>Troglodytes aedon</i>	141	4.23
Hammond's flycatcher	<i>Empidonax hammondi</i>	105	3.15
pine siskin	<i>Carduelis pinus</i>	101	3.03
brown creeper	<i>Certhia americana</i>	82	2.46
red-breasted nuthatch	<i>Sitta canadensis</i>	81	2.43
northern flicker	<i>Colaptes auratus</i>	75	2.25
American robin	<i>Turdus migratorius</i>	63	1.89
orange-crowned warbler	<i>Vermivora celata</i>	57	1.71
red crossbill	<i>Loxia curvirostra</i>	56	1.68
chipping sparrow	<i>Spizella passerina</i>	47	1.41
Williamson's sapsucker	<i>Sphyrapicus thyroideus</i>	46	1.38
common raven	<i>Corvus corax</i>	38	1.14
evening grosbeak	<i>Coccothraustes vespertinus</i>	37	1.11
western wood-pewee	<i>Contopus sordidulus</i>	31	0.93
hairy woodpecker	<i>Picoides villosus</i>	29	0.87
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	25	0.75
Steller's jay	<i>Cyanocitta stelleri</i>	25	0.75
black-headed grosbeak	<i>Pheucticus melanocephalus</i>	19	0.57
red-naped sapsucker	<i>Sphyrapicus nuchalis</i>	17	0.51
Townsend's solitaire	<i>Myadestes townsendi</i>	17	0.51
plumbeous vireo	<i>Vireo plumbeus</i>	14	0.42
white-breasted nuthatch	<i>Sitta carolinensis</i>	14	0.42
pygmy nuthatch	<i>Sitta pygmaea</i>	13	0.39
western bluebird	<i>Sialia mexicana</i>	12	0.36
Clark's nutcracker	<i>Nucifraga columbiana</i>	9	0.27
band-tailed pigeon	<i>Columba fasciata</i>	7	0.21
downy woodpecker	<i>Picoides pubescens</i>	6	0.18

**Table 3 continued**

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
Grace's warbler	<i>Dendroica graciae</i>	6	0.18
white-throated swift	<i>Aeronautes saxatalis</i>	5	0.15
hepatic tanager	<i>Piranga flava</i>	3	0.09
green-tailed towhee	<i>Pipilo chlorurus</i>	2	0.06
flammulated owl	<i>Otus flammeolus</i>	1	0.03
golden-crowned kinglet	<i>Regulus satrapa</i>	1	0.03
great horned owl	<i>Bubo virginianus</i>	1	0.03
olive-sided flycatcher	<i>Contopus cooperi</i>	1	0.03
turkey vulture	<i>Cathartes aura</i>	1	0.03
wild turkey	<i>Meleagris gallopavo</i>	1	0.03

The mean number of individuals detected per species during a VCP count, and the frequency of plots with detections for each species detected in BAND mixed conifer habitat are presented in Table 4. The yellow-rumped warbler had the highest mean number of individuals, with an average of 2.30 individuals detected during an eight-minute count. Yellow-rumped warblers were also widespread in the target habitat—detected in 99% of plots. The Williamson's sapsucker had a relatively low abundance (0.23 individuals/count), but was fairly widely distributed—detected on 59% of the plots (table 4).

**Table 4. Mean number of individuals detected per VCP count, and frequency of occupied plots (plots in which the species was detected) in mixed conifer habitat at Bandelier National Monument, 2009**

Species	Mean # of individuals	Standard deviation	Frequency of occupied plots (%)
yellow-rumped warbler	2.30	1.17	99.00
warbling vireo	1.47	1.12	90.00
ruby-crowned kinglet	1.22	1.24	80.00
hermit thrush	1.05	0.99	89.00
western tanager	1.00	0.84	94.00
dark-eyed junco	0.95	1.02	86.00
mountain chickadee	0.95	0.96	82.00
violet-green swallow	0.94	1.63	57.00
Cordilleran flycatcher	0.86	0.87	79.00
house wren	0.71	0.95	62.00
Hammond's flycatcher	0.53	0.72	63.00
pine siskin	0.51	0.97	52.00
brown creeper	0.41	0.72	43.00
red-breasted nuthatch	0.41	0.60	55.00
northern flicker	0.38	0.58	59.00
American robin	0.32	0.55	46.00
orange-crowned warbler	0.29	0.55	40.00
red crossbill	0.28	1.01	19.00
chipping sparrow	0.24	0.58	34.00
Williamson's sapsucker	0.23	0.47	39.00
common raven	0.19	0.43	30.00
evening grosbeak	0.19	0.54	22.00
western wood-pewee	0.16	0.43	23.00
hairy woodpecker	0.15	0.39	23.00

**Table 4 continued**

Species	Mean # of individuals	Standard deviation	Frequency of occupied plots (%)
broad-tailed hummingbird	0.13	0.35	21.00
Steller's jay	0.13	0.37	21.00
black-headed grosbeak	0.10	0.29	19.00
red-naped sapsucker	0.09	0.30	14.00
Townsend's solitaire	0.09	0.30	16.00
plumbeous vireo	0.07	0.27	13.00
pygmy nuthatch	0.07	0.30	10.00
white-breasted nuthatch	0.07	0.27	13.00
western bluebird	0.06	0.31	7.00
Clark's nutcracker	0.05	0.39	4.00
band-tailed pigeon	0.04	0.21	6.00
downy woodpecker	0.03	0.17	5.00
Grace's warbler	0.03	0.20	5.00
white-throated swift	0.03	0.21	3.00
hepatic tanager	0.02	0.16	2.00
flammulated owl	0.01	0.07	1.00
golden-crowned kinglet	0.01	0.07	1.00
great horned owl	0.01	0.07	1.00
green-tailed towhee	0.01	0.10	2.00
olive-sided flycatcher	0.01	0.07	1.00
turkey vulture	0.01	0.07	1.00
wild turkey	0.01	0.07	1.00

### 3.1.2 Summary of bird habitat data

We found four vegetation cover types (mixed conifer forest, aspen grove, ponderosa pine forest, and montane grassland) and the rock outcrop cover type in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the BAND mixed conifer sample area (table 5). Mixed conifer forest, the target habitat, was recorded on 99% of the macroplots. When we calculated the mean percent cover for each vegetation type, mixed conifer forest was the most common cover type (table 5), accounting for, on average, 86.38% of the overall vegetative cover of the macroplots.

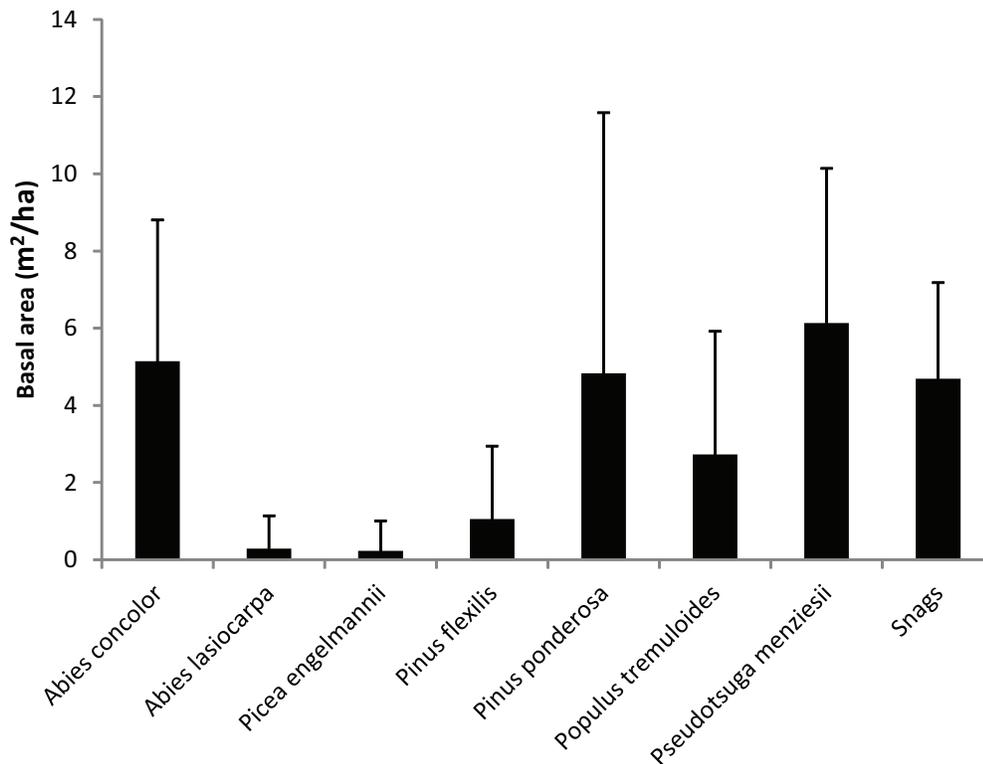
**Table 5. Mean cover of vegetation types, standard deviation (SD), and range; and frequency (%) in target mixed conifer habitat in Bandelier National Monument, 2009**

Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Mixed conifer forest	86.38	9.08	0.00–87.50	99.00
Aspen grove	2.24	5.06	0.00–17.50	21.00
Ponderosa pine forest	0.88	8.75	0.00–87.50	1.00
Montane grassland	0.60	3.08	0.00–17.50	4.00
Rock outcrop	0.93	2.81	0.00–17.50	11.00

In Table 6, the abundance of trees is expressed in terms of basal area of overstory trees and sapling densities, by species. The abundance of snags is expressed in terms of basal area, recorded for all species combined. Table 6 and Figure 2 illustrate basal area of trees by species and snags. Eight tree species were recorded on the sampling plots and Douglas fir had the highest basal area (fig. 2; see table 6 for scientific and common names of tree

**Table 6. Basal area of overstory trees and snags, and density of saplings by species in mixed conifer habitat in Bandelier National Monument, 2009. Basal area (m<sup>2</sup>/ha) is provided for overstory trees (DBH greater or equal to 10 cm), and density (number of stems/ha) is provided for saplings (<10 cm DBH). Common names are provided for each tree species.**

Species	Common name	Basal area (m <sup>2</sup> /ha)	Sapling density by size class	
			2.5 to <5 cm	5 to <10 cm
<i>Pseudotsuga menziesii</i>	Douglas fir	6.10	113.32	90.40
<i>Abies concolor</i>	White fir	5.15	127.64	114.59
<i>Pinus ponderosa</i>	Ponderosa pine	4.83	3.18	2.55
<i>Populus tremuloides</i>	Aspen	2.73	13.37	0.32
<i>Pinus flexilis</i>	Limber pine	1.06	17.19	7.32
<i>Abies lasiocarpa</i>	Subalpine fir	0.29	3.82	2.55
<i>Picea engelmannii</i>	Engelmann spruce	0.23	1.91	4.14
<i>Acer glabrum</i>	Rocky mountain maple	0.03	0.32	6.05
All tree species		20.41	282.98	235.87
Snags		4.69		



**Figure 2.** Basal area of trees, by species, and snags in mixed conifer habitat in Bandelier National Park, 2009. Error bars represent one standard deviation.

species). Table 6 illustrates the density of sapling trees by species. White fir and Douglas fir dominated the sapling class—trees less than 10 cm DBH.

The understory of the mixed conifer habitat at BAND is mainly comprised of perennial grasses, forbs, and shrubs, with few small trees (table 7). Of these, the amount of shrub cover is likely to have the most influence on bird community composition. The amount of shrub cover varied considerably—mean foliar cover for this functional group ranged from 0.50% to 26.50%.

**Table 7. Foliar cover of functional groups in target mixed conifer habitat in Bandelier National Monument in 2009**

<b>Functional groups</b>	<b>Mean foliar cover (%)</b>	<b>Standard deviation</b>	<b>Range</b>
Total foliar cover	30.27	18.33	1.13–75.00
Perennial grasses, graminoids	12.26	11.63	0.50–50.00
Annual grasses	0.57	0.45	0.50–4.75
Forbs	9.43	8.45	0.50–35.13
Shrubs	4.38	6.35	0.50–26.50
Understory trees (< 1.4 m height)	1.29	1.52	0.50–10.38
Standing dead herbaceous	1.23	1.91	0.50–16.00
Standing dead woody	0.62	0.34	0.50–2.25

## 4 Discussion

These data represent the second year of sampling for the mixed conifer bird community at BAND. This bird community is primarily comprised of species closely associated with mixed conifer forests and aspen groves. The most abundant species are also widespread. The 15 most commonly detected species were also detected on over half of the plots.

Bandelier's mixed conifer forests are home to many bird species that are near the southern extent of their breeding ranges. Tracking trends in the distribution of species at the 'trailing edge' of their ranges may be particularly useful as an early indicator of climate change impacts to the persistence of bird populations. For example, the hermit thrush was the fourth most commonly detected species at BAND and is one of the most widely distributed migratory birds in North America (Jones and Donovan 1996). In New Mexico, it is most often found in mixed coniferous forests and its populations in New Mexico represent the southern part of its breeding range. If climate change affects the distribution of mixed conifer forests, it may also affect the distribution of the hermit thrush. Climate change may also affect fire risk, and the hermit thrush may be sensitive to fire-caused habitat changes. Eight years after a fire in the Sierra Nevada there were no hermit thrushes recorded breeding in the burn area (Bock and Lynch 1970).

Another species of concern in the BAND mixed conifer bird community is the Williamson's sapsucker. This species is on the Yellow WatchList of declining species, part of the United States WatchList of Birds of Conservation Concern (Butcher et al. 2007), and is on the federal list of Birds of Conservation Concern (U.S. Fish and Wildlife Service 2002). It is fairly common in the mixed conifer habitat of BAND (46 detections on 59% of the mixed conifer plots).

Our long-range plan for mixed conifer bird community monitoring is to conduct VCP counts every three years to track changes in bird species abundance, distribution, and habitat metrics over time. Following the Las Conchas Wildfire in 2011, which burned approximately half of the mixed conifer bird sampling plots at high or moderate severity, additional discussion and re-assessment of the remaining habitat will be necessary before proceeding with bird community monitoring.

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