



# Bird Community Monitoring for Bandelier National Monument

## *2008 Summary Report*

Natural Resource Data Series NPS/SCPN/NRDS—2012/329



**ON THE COVER**

Williamson's sapsuckers: male on the left; female on the right  
Photos by Sally King

---

# Bird Community Monitoring for Bandelier National Monument

## *2008 Summary Report*

Natural Resource Data Series NPS/SCPN/NRDS—2012/329

Jennifer A. Holmes and Matthew J. Johnson

Northern Arizona University

P.O. Box 5614

Flagstaff, AZ 86011-5614

June 2012

U.S. Department of the Interior

National Park Service

Natural Resource Stewardship and Science

Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

Funding for this project was provided by the National Park Service to Northern Arizona University under Colorado Plateau Cooperative Ecosystems Study Unit agreement H1200040002 (Task NAU-254).

The corresponding author and project manager for this project is Jennifer Holmes (Jennifer.Holmes@nau.edu). Other contributions were made by the SCPN staff. The 2008 field crew consisted of Gina Tarbill and Jason St. Pierre.

This report is available from SCPN (<http://science.nature.nps.gov/im/units/scpn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>) on the Internet.

Please cite this publication as:

Holmes, J. A., and M. J. Johnson. 2012. Bird community monitoring for Bandelier National Monument: 2008 summary report. Natural Resource Data Series NPS/SCPN/NRDS—2012/329. National Park Service, Fort Collins, Colorado.

# Contents

- List of Figures ..... vi
- List of Tables..... vi
- 1 Introduction and background..... 1**
- 2 Methods ..... 1**
  - 2.1 Sampling frame ..... 1
  - 2.2 Field methods ..... 3
  - 2.3 Data summary ..... 3
    - 2.3.1 Variable Circular Plot count data..... 3
    - 2.3.2 Habitat data ..... 4
- 3 Results ..... 5**
  - 3.1 Mixed conifer habitat..... 5
    - 3.1.1 Summary of bird community data..... 5
    - 3.1.2 Summary of bird habitat data ..... 6
  - 3.2 Pinyon-juniper habitat..... 10
    - 3.2.1 Summary of bird community data..... 10
    - 3.2.2 Summary of bird habitat data ..... 14
- 4 Literature cited..... 17**

## List of Figures

<b>Figure 1.</b> Bird monitoring sampling frame of A) mixed conifer habitat and B) pinyon-juniper habitat and upland vegetation monitoring sampling frame in Bandelier N.M. ....	2
<b>Figure 2.</b> Size structure of sapling and overstory trees in mixed conifer habitat in Bandelier N.M. (BAND), 2008. Mean density (number of stems/ha) of trees in BAND mixed conifer habitat, by species and size class, including saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and ≥38 cm dbh. Error bars represent one standard deviation. ....	9
<b>Figure 3.</b> Basal area of trees by species in mixed conifer habitat in Bandelier N.M., 2008. Error bars represent one standard deviation. ....	9
<b>Figure 4.</b> Density of overstory trees and snags by species in mixed conifer habitat in Bandelier N.M., 2008. Overstory trees and snags are >15 cm dbh. Error bars represent one standard deviation. ....	10
<b>Figure 5.</b> Size structure of sapling and overstory trees in pinyon-juniper habitat in Bandelier N.M. (BAND), 2008. Mean density (number of stems/ha) of trees in BAND pinyon-juniper habitat, by species and size class, including saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and ≥38 cm dbh. Error bars represent one standard deviation. ....	15
<b>Figure 6.</b> Density of overstory trees and snags by species in pinyon-juniper habitat in Bandelier N.M., 2008. Overstory trees and snags are >15 cm dbh. Error bars represent one standard deviation. ....	15

## List of Tables

<b>Table 1.</b> Survey periods and sampling effort for pinyon-juniper and mixed conifer bird community monitoring at Bandelier N.M. (BAND).....	3
<b>Table 2.</b> Vegetation cover types in mixed conifer and pinyon-juniper habitats at Bandelier N.M. ....	4
<b>Table 3.</b> Bird species and number detected during VCP counts in mixed conifer habitat at Bandelier N.M., 2008. ....	5
<b>Table 4.</b> Mean number of individuals detected per VCP count, and frequency of occupied plots in mixed conifer habitat at Bandelier N.M., 2008. ....	7
<b>Table 5.</b> Mean cover of vegetation types, standard deviation (SD), and range; and frequency (%) in target mixed conifer habitat in Bandelier N.M., 2008. ....	8
<b>Table 6.</b> Density and basal area of trees by species and size class in mixed conifer habitat in Bandelier N.M., 2008. ....	8
<b>Table 7.</b> Density of snags by species, and total basal area of snags in mixed conifer habitat in Bandelier N.M., 2008. ....	9
<b>Table 8.</b> Foliar cover of functional groups in target mixed conifer habitat in Bandelier N.M. in 2008. ....	10
<b>Table 9.</b> Bird species and number detected during VCP counts in pinyon-juniper habitat at Bandelier N.M., 2008. ....	11
<b>Table 10.</b> Mean number of individuals, per species, detected per VCP count; and frequency of occupied plots (plots in which the species was detected) in pinyon-juniper habitat at Bandelier N.M., 2008. ....	12
<b>Table 11.</b> Mean cover of vegetation and other cover types, standard deviation (SD), and range; and frequency (%) in target pinyon-juniper habitat in Bandelier N.M., 2008. ....	14
<b>Table 12.</b> Density and basal area of trees by species and size class in pinyon-juniper habitat in Bandelier N.M., 2008. ..	14
<b>Table 13.</b> Density of snags by species, and total basal area of snags in pinyon-juniper habitat in Bandelier N.M., 2008. ....	15
<b>Table 14.</b> Foliar cover of functional groups in target pinyon-juniper habitat in Bandelier N.M. in 2008.....	16

# 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 and Mesa Top Pinyon-Juniper ecological sites as important ecosystems for vegetation and bird community monitoring. These ecological sites both represent large areas of the monument, but climate change, altered fire regimes, soil erosion, and invasion by non-native species threaten their integrity.

The pinyon-juniper woodlands at BAND have been undergoing extensive restoration through the selective thinning of mature junipers. The objectives for this restoration are 1) to reduce the density of junipers to reflect historical conditions, 2) to increase the herbaceous/shrub cover to reduce soil erosion so as to protect archeological sites and ecosystem functions, and 3) to restore historical fire regimes. Restoration thinning was initiated in the area occupied by the Mesa Top Pinyon-Juniper ecological site in 2007.

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

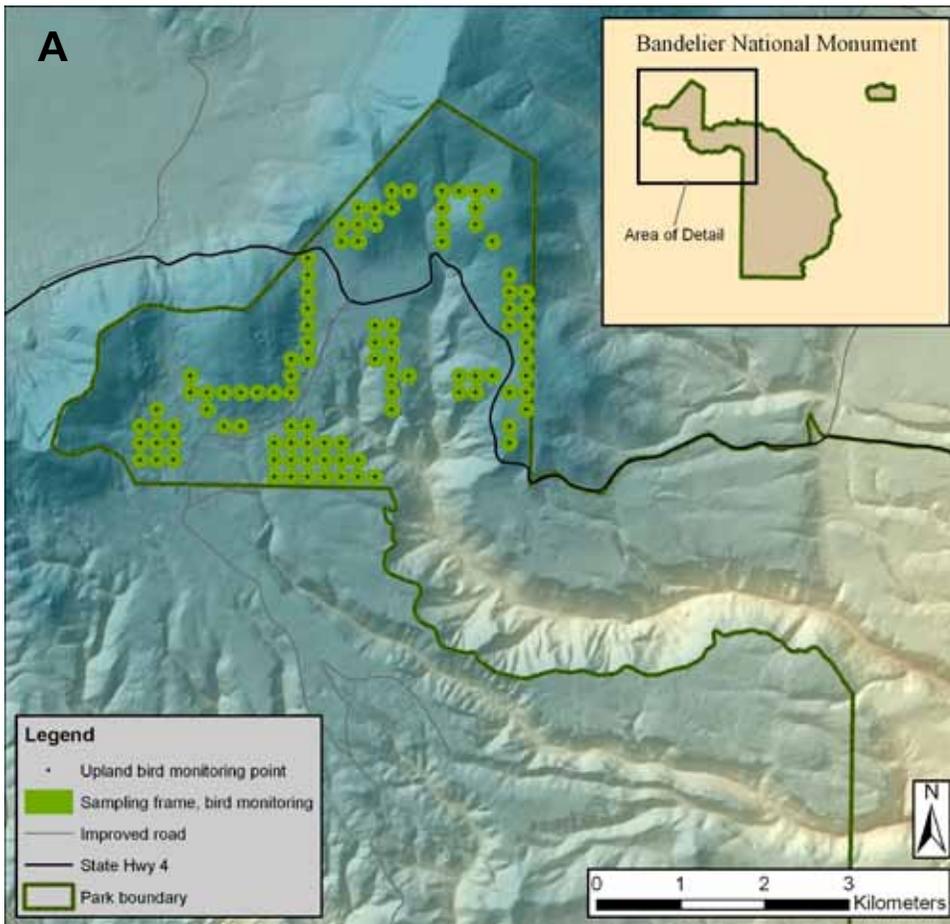
## 2 Methods

### 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 and pinyon juniper woodlands. The overall pinyon-juniper sampling frame was created in 2007, in preparation for upland vegetation monitoring. For the pinyon-juniper vegetation type, we relied on vegetation descriptions associated with the soil types. For the mixed conifer vegetation type, a draft vegetation map was available (published as Muldavin et al. 2010) and we used it to identify soils that were well-correlated with mixed conifer vegetation. The sampling frame for upland vegetation monitoring is not yet initiated. The Mixed Conifer ecological site is henceforth referred to as mixed conifer habitat and the Mesa Top Pinyon-Juniper ecological site is referred to as pinyon-juniper habitat (fig. 1).

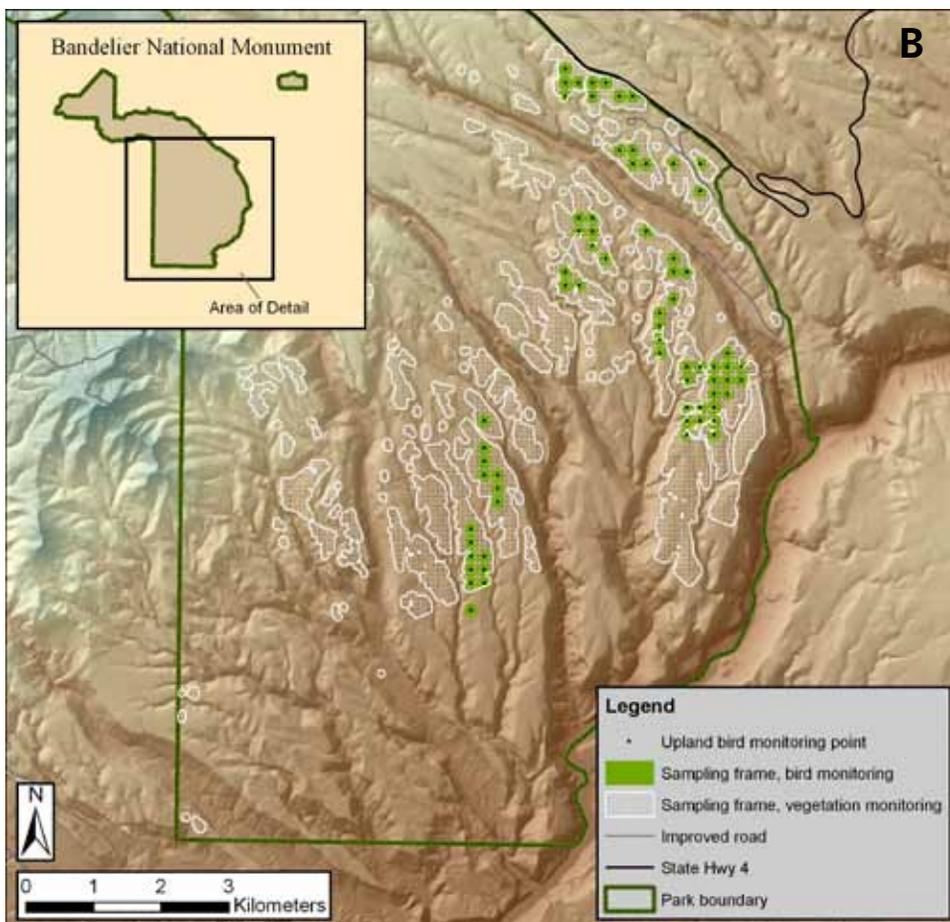
To complete the pinyon-juniper and the mixed conifer bird community monitoring sampling frames, we modified the maps of the sampling frames using Geographical Information System (GIS) technology to eliminate

- 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 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



A simple grid of plots was created for each 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 plots 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 or the back-country cabin near Capulin Creek, 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 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 of Holmes et al., in review). In the mixed conifer habitat, we selected 100 sampling plots and rejected 145. In the pinyon-juniper habitat, we selected seventy sampling plots and rejected fifty-nine.



**Figure 1.** Bird monitoring sampling frame of A) mixed conifer habitat and B) pinyon-juniper habitat and upland vegetation monitoring sampling frame in Bandelier N.M.

## 2.2 Field methods

Bird sampling was conducted at permanent sampling plots, or Variable Circular Plot (VCP) count stations, within mixed conifer and pinyon-juniper habitats at BAND (fig. 1). A total of 100 sampling plots were sampled in mixed conifer and 70 were sampled in pinyon-juniper. We conducted bird sampling during three 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 review).

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 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.

**Table 1.** Survey periods and sampling effort for pinyon-juniper and mixed conifer bird community monitoring at Bandelier N.M. (BAND). Dates VCP counts were conducted in BAND mixed conifer and pinyon-juniper habitat in 2008, and the number of plots sampled.

Habitat	Survey period	Dates (2008)	Number VCP counts
Mixed conifer	1	5/19–5/25	100
	2	6/6–6/10	100
	3	6/30–7/4	100
Pinyon-juniper	1	5/5–5/12	70
	2	5/26–6/3	70
	3	6/16–6/22	70

## 2.3 Data summary

### 2.3.1 Variable Circular Plot count data

The following data were summarized for each of the target habitats (mixed conifer and pinyon-juniper) 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 the two target habitats with a simple grid sampling design, the data for all plots are averaged across the three 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 Bewick’s wren was detected on 65 of the 70 plots in the target habitat, during any or all of the three visits to that plot, the proportion of plots occupied in the target habitat is 0.93 (93%).

### 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.

- *Vegetation cover types.* For BAND mixed conifer habitat, we classified six vegetation types, and for pinyon-juniper habitat, we classified five vegetation types as shown in Table 2. For each vegetation type we calculated
  - mean percent cover by calculating the mean cover for each vegetation type (using the cover class mid-points) 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 and snag density.* For trees, density was calculated as stems/ha for each species and size class, and

**Table 2.** Vegetation cover types in mixed conifer and pinyon-juniper habitats at Bandelier N.M.

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 stands occur in areas relatively recently impacted 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> ).
Pinyon-juniper	Pinyon-juniper mesa top (target habitat)	Typically open pinyon-juniper canopy. High levels of pinyon mortality, some regeneration in small size classes. Shrub component is gambel oak, Apache plume ( <i>Fallugia paradoxa</i> ), big sagebrush ( <i>Artemisia tridentata</i> ), broom snakeweed ( <i>Gutierrezia sarothrae</i> ), Opuntia, and Yucca ( <i>Yucca</i> spp.). Grasses are dominated by blue grama ( <i>Bouteloua gracilis</i> ), with needle and thread grass ( <i>Hesperostipa comata</i> ), squirreltail ( <i>Elymus elymoides</i> ) and James' galleta ( <i>Pleuraphis jamesii</i> ).
	Pinyon-juniper treatment	Areas of Mesa Top Pinyon-Juniper that have been treated. Areas variable, with low, moderate, and high level of cutting that has taken place and other results of treatment (e.g., thick layer of cut pinyon and juniper branches on ground throughout site).
	Mesa top grassland	Open areas with little or no pinyon-juniper cover. Dominated by blue grama with some forbs and low shrubs.
	Mesa top scrubland	Shrub dominated areas. Likely to be dominated by gambel oak.
	Ponderosa pine forest	Dominated by ponderosa pine. Often contains elements of pinyon-juniper woodland type.

<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.

for all species within a size class. For snags, density was calculated as stems/ha of snags equal to or greater than 15 cm diameter at breast height (dbh). Mean density was calculated for the macroplot, and then a mean species density and standard deviation were calculated for the target habitat.

- *Basal area.* Tree basal area was calculated as m<sup>2</sup>/ha for each species, and snag basal area was calculated 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 2008, we conducted a total of 300 VCP counts in mixed conifer habitat at BAND (table 1). During the 2008 surveys, we detected 3,538 individuals of 55 species (table 3). The most commonly detected species was the yellow-rumped warbler—this species comprised 15.49% of the total number of individuals detected.

**Table 3.** Bird species and number detected during VCP counts in mixed conifer habitat at Bandelier N.M., 2008. 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>	548	15.49
warbling vireo	<i>Vireo gilvus</i>	356	10.06
hermit thrush	<i>Catharus guttatus</i>	240	6.78
dark-eyed junco	<i>Junco hyemalis</i>	200	5.65
mountain chickadee	<i>Poecile gambeli</i>	194	5.48
ruby-crowned kinglet	<i>Regulus calendula</i>	168	4.75
western tanager	<i>Piranga ludoviciana</i>	161	4.55
pine siskin	<i>Carduelis pinus</i>	147	4.15
Hammond's flycatcher	<i>Empidonax hammondi</i>	145	4.10
violet-green swallow	<i>Tachycineta thalassina</i>	142	4.01
American robin	<i>Turdus migratorius</i>	114	3.22
northern flicker	<i>Colaptes auratus</i>	107	3.02
Williamson's sapsucker	<i>Sphyrapicus thyroideus</i>	88	2.49
house wren	<i>Troglodytes aedon</i>	77	2.18
evening grosbeak	<i>Coccothraustes vespertinus</i>	75	2.12
common raven	<i>Corvus corax</i>	74	2.09
chipping sparrow	<i>Spizella passerina</i>	73	2.06
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	72	2.03
Cordilleran flycatcher	<i>Empidonax occidentalis</i>	68	1.92
orange-crowned warbler	<i>Vermivora celata</i>	67	1.89
Steller's jay	<i>Cyanocitta stelleri</i>	58	1.64
brown creeper	<i>Certhia americana</i>	48	1.36
red-breasted nuthatch	<i>Sitta canadensis</i>	35	0.99
black-headed grosbeak	<i>Pheucticus melanocephalus</i>	33	0.93
pygmy nuthatch	<i>Sitta pygmaea</i>	32	0.90

Table 3 continued

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
white-breasted nuthatch	<i>Sitta carolinensis</i>	30	0.85
western wood-pewee	<i>Contopus sordidulus</i>	30	0.85
downy woodpecker	<i>Picoides pubescens</i>	27	0.76
hairy woodpecker	<i>Picoides villosus</i>	21	0.59
Townsend's solitaire	<i>Myadestes townsendi</i>	21	0.59
band-tailed pigeon	<i>Columba fasciata</i>	17	0.48
red crossbill	<i>Loxia curvirostra</i>	10	0.28
Clark's nutcracker	<i>Nucifraga columbiana</i>	8	0.23
red-naped sapsucker	<i>Sphyrapicus nuchalis</i>	7	0.20
plumbeous vireo	<i>Vireo plumbeus</i>	6	0.17
Cassin's finch	<i>Carpodacus cassinii</i>	5	0.14
mourning dove	<i>Zenaida macroura</i>	4	0.11
Virginia's warbler	<i>Vermivora virginiae</i>	4	0.11
western bluebird	<i>Sialia mexicana</i>	3	0.09
wild turkey	<i>Meleagris gallopavo</i>	3	0.09
brown-headed cowbird	<i>Molothrus ater</i>	2	0.06
dusky flycatcher	<i>Empidonax oberholseri</i>	2	0.06
Grace's warbler	<i>Dendroica graciae</i>	2	0.06
MacGillivray's warbler	<i>Oporornis tolmiei</i>	2	0.06
Say's phoebe	<i>Sayornis saya</i>	2	0.06
American crow	<i>Corvus brachyrhynchos</i>	1	0.03
Cooper's hawk	<i>Accipiter cooperii</i>	1	0.03
common poorwill	<i>Phalaenoptilus nuttallii</i>	1	0.03
golden-crowned kinglet	<i>Regulus satrapa</i>	1	0.03
green-tailed towhee	<i>Pipilo chlorurus</i>	1	0.03
hepatic tanager	<i>Piranga flava</i>	1	0.03
house finch	<i>Carpodacus mexicanus</i>	1	0.03
olive-sided flycatcher	<i>Contopus cooperi</i>	1	0.03
turkey vulture	<i>Cathartes aura</i>	1	0.03
Wilson's warbler	<i>Wilsonia pusilla</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 1.83 individuals detected during an eight-minute count. Yellow-rumped warblers were also widespread in the target habitat—detected in 99% of plots. The pygmy nuthatch had a relatively low abundance (0.11 individuals/count), but was fairly widely distributed—detected on 27% of the plots (table 4).

### 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) 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 94% 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, 78.31% of the overall vegetative cover of the macroplots.

**Table 4.** Mean number of individuals detected per VCP count, and frequency of occupied plots in mixed conifer habitat at Bandelier N.M., 2008. Mean number of individuals detected per VCP count, and frequency (%) of occupied plots (plots in which the species was detected).

<b>Species</b>	<b>Mean # of individuals</b>	<b>Standard deviation</b>	<b>Frequency of occupied plots (%)</b>
yellow-rumped warbler	1.83	0.92	99.00
warbling vireo	1.19	1.00	92.00
hermit thrush	0.80	0.76	89.00
dark-eyed junco	0.67	0.82	79.00
mountain chickadee	0.65	0.72	83.00
ruby-crowned kinglet	0.56	0.68	75.00
western tanager	0.54	0.70	77.00
pine siskin	0.49	0.76	68.00
Hammond's flycatcher	0.48	0.67	64.00
violet-green swallow	0.47	1.32	43.00
American robin	0.38	0.68	60.00
northern flicker	0.36	0.57	69.00
Williamson's sapsucker	0.29	0.50	58.00
house wren	0.26	0.56	39.00
evening grosbeak	0.25	0.56	48.00
common raven	0.25	0.50	52.00
chipping sparrow	0.24	0.55	45.00
broad-tailed hummingbird	0.24	0.44	52.00
Cordilleran flycatcher	0.23	0.47	51.00
orange-crowned warbler	0.22	0.50	43.00
Steller's jay	0.19	0.51	38.00
brown creeper	0.16	0.39	35.00
red-breasted nuthatch	0.12	0.34	28.00
black-headed grosbeak	0.11	0.34	28.00
pygmy nuthatch	0.11	0.37	27.00
white-breasted nuthatch	0.10	0.34	22.00
western wood-pewee	0.10	0.31	17.00
downy woodpecker	0.09	0.31	24.00
hairy woodpecker	0.07	0.28	17.00
Townsend's solitaire	0.07	0.27	17.00
band-tailed pigeon	0.06	0.30	12.00
red crossbill	0.03	0.21	8.00
Clark's nutcracker	0.03	0.20	6.00
red-naped sapsucker	0.02	0.19	5.00
plumbeous vireo	0.02	0.16	5.00
Cassin's finch	0.02	0.15	4.00
mourning dove	0.01	0.14	3.00
Virginia's warbler	0.01	0.14	3.00
western bluebird	0.01	0.10	3.00
wild turkey	0.01	0.13	2.00
brown-headed cowbird	0.01	0.08	2.00
dusky flycatcher	0.01	0.08	2.00
Grace's warbler	0.01	0.08	2.00

**Table 4** *continued*

Species	Mean # of individuals	Standard deviation	Frequency of occupied plots (%)
MacGillivray's warbler	0.01	0.08	2.00
Say's phoebe	0.01	0.08	2.00
American crow	0.00	0.06	1.00
Cooper's hawk	0.00	0.06	1.00
common poorwill	0.00	0.06	1.00
golden-crowned kinglet	0.00	0.06	1.00
green-tailed towhee	0.00	0.06	1.00
hepatic tanager	0.00	0.06	1.00
house finch	0.00	0.06	1.00
olive-sided flycatcher	0.00	0.06	1.00
turkey vulture	0.00	0.06	1.00
Wilson's warbler	0.00	0.06	1.00

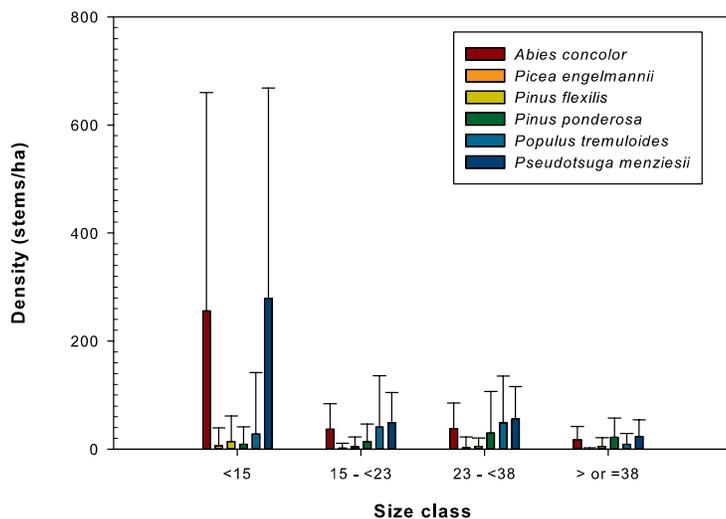
**Table 5.** Mean cover of vegetation types, standard deviation (SD), and range; and frequency (%) in target mixed conifer habitat in Bandelier N.M., 2008.

Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Mixed conifer forest	78.31	25.24	0.00–87.50	94.00
Aspen grove	1.83	9.64	0.00–62.50	5.00
Ponderosa pine forest	6.93	22.67	0.00–87.50	11.00
Montane grassland	1.30	5.16	0.00–37.50	8.00

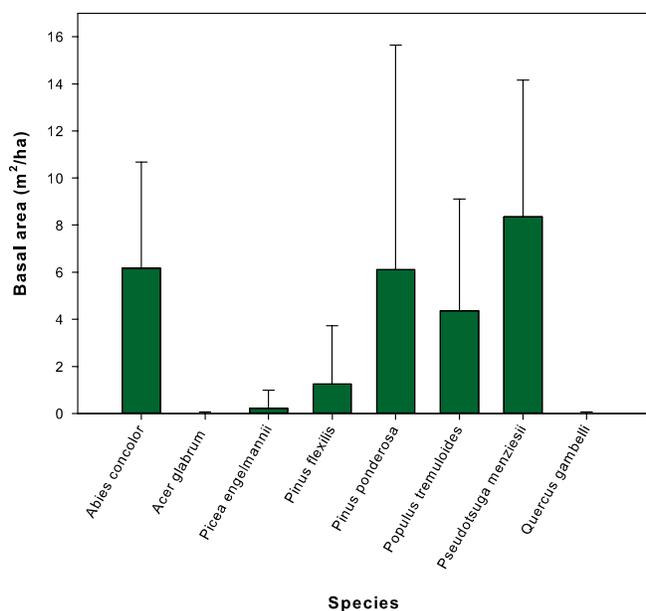
The abundance of trees is expressed in terms of density—the number of stems per hectare—and basal area. Table 6 and Figure 2 illustrate density of trees by species and size class. Figure 3 shows basal area by tree species. Eight tree species were recorded on the sampling plots and the most common tree species, in all size classes, was Douglas fir (see table 6 for scientific and common names of tree species).

**Table 6.** Density and basal area of trees by species and size class in mixed conifer habitat in Bandelier N.M., 2008. Density (number of stems/ha) and basal area (m<sup>2</sup>/ha) are provided for saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and ≥38 cm dbh. Common names are provided for each tree species.

Species	Common name	Tree basal area (m <sup>2</sup> /ha)	Tree density by size class				
			Overstory trees				Saplings
			15 to <23 cm	23 to <38 cm	≥38 cm	Total	<15 cm
<i>Abies concolor</i>	white fir	6.16	36.64	38.14	17.70	92.48	255.92
<i>Pinus ponderosa</i>	ponderosa pine	6.11	13.46	29.91	21.94	65.31	8.91
<i>Populus tremuloides</i>	aspen	4.36	41.13	48.36	8.72	98.22	28.01
<i>Pinus flexilis</i>	limber pine	1.25	4.49	5.23	5.48	15.21	14.01
<i>Picea engelmannii</i>	Engelmann spruce	0.21	1.74	2.49	0.25	4.49	6.37
<i>Acer glabrum</i>	Rocky Mountain maple	0.01	-	-	-	-	8.91
<i>Quercus gambelli</i>	Gambel oak	0.01	-	-	-	-	17.83
All species		26.47	242.32	146.83	179.48	77.28	403.59



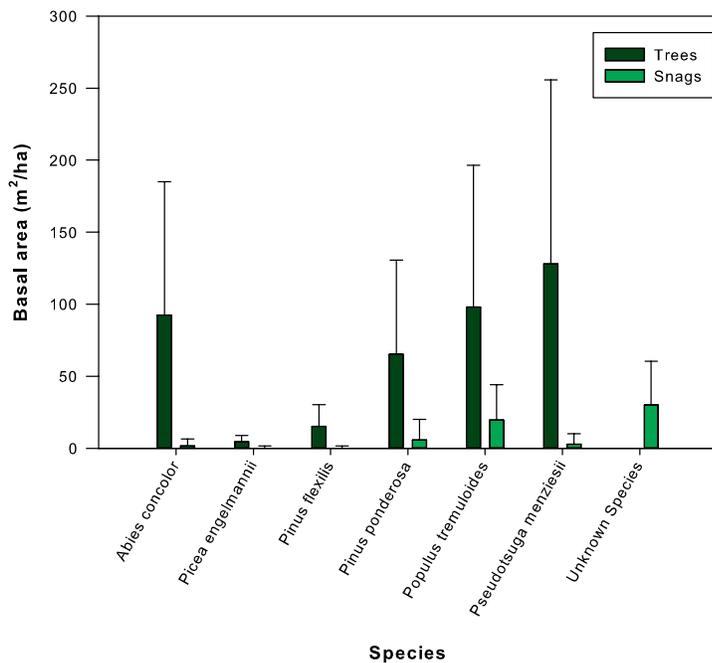
**Figure 2.** Size structure of sapling and overstory trees in mixed conifer habitat in Bandelier N.M. (BAND), 2008. Mean density (number of stems/ha) of trees in BAND mixed conifer habitat, by species and size class, including saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and  $\geq 38$  cm dbh. Error bars represent one standard deviation.



**Figure 3.** Basal area of trees by species in mixed conifer habitat in Bandelier N.M., 2008. Error bars represent one standard deviation.

**Table 7.** Density of snags by species, and total basal area of snags in mixed conifer habitat in Bandelier N.M., 2008. Density (number of stems/ha) and basal area ( $m^2/ha$ ) are provided for overstory snags (>15 cm dbh).

Species	Density (stems/ha)	Basal area ( $m^2/ha$ )
<i>Abies concolor</i>	1.56	
<i>Picea engelmannii</i>	0.19	
<i>Pinus flexilis</i>	0.19	
<i>Pinus ponderosa</i>	5.67	
<i>Populus tremuloides</i>	19.76	
<i>Pseudotsuga menziesii</i>	2.80	
Unknown species	30.04	
All snags	60.20	6.23



**Figure 4.** Density of overstory trees and snags by species in mixed conifer habitat in Bandelier N.M., 2008. Overstory trees and snags are >15 cm dbh. Error bars represent one standard deviation.

Sapling densities provide insight into the structure and dynamics of the forest. Douglas fir dominated the sapling class — trees less than 15 cm dbh. The size structure (fig. 2) indicates a typical decline in tree density with increasing tree diameter.

The abundance of snags is expressed in terms of density and basal area. Density—the number of stems per hectare—was recorded by species and size class. Basal area was recorded for all species combined. We were often unable to identify the species of snag and these snags had the highest density, followed by snags of aspen (table 7 and fig. 4).

The understory of the mixed conifer habitat at BAND is mainly comprised of perennial grasses, forbs, and shrubs, with few small trees (table 8). Of these, the amount of shrub cover is likely to have the most influence on bird community composition. There is considerable variation in the amount of cover of shrubs—mean foliar cover for this functional group ranged from 0.50% to 35.75%.

**Table 8.** Foliar cover of functional groups in target mixed conifer habitat in Bandelier N.M. in 2008.

Functional groups	Mean foliar cover (%)	Standard Deviation	Range
Total foliar cover	49.69	22.22	2.25–87.50
perennial grasses, graminoids	31.75	21.05	0.50–87.50
annual grasses	0.50	0.01	0.38–0.50
forbs	15.11	11.20	0.50–56.25
shrubs	6.42	8.07	0.50–35.75
understory trees (< 1.4 m height)	3.29	3.84	0.50–20.75
Standing dead herbaceous	0.71	1.60	0.50–16.00
Standing dead woody	0.74	1.14	0.38–9.75

### 3.2 Pinyon-juniper habitat

#### 3.2.1 Summary of bird community data

In 2008, we conducted a total of 210 VCP counts in pinyon-juniper habitat at BAND (table 1) and detected 2,402 individuals of 56 species (table 9). The most commonly detected species was the spotted towhee, comprising 11.78% of the total number of individuals detected.

The mean number of individuals, by species, detected during a VCP count, and the frequency of plots with detections for each species detected in BAND pinyon-juniper habitat are presented in Table 10. The spotted towhee had the highest mean number of individuals, with an average of 1.35 individuals detected during an eight-minute count. Spotted towhees were also widespread in the target habitat—detected in 95.71% of plots. The brown-headed cowbird had a relatively low abundance (0.14 individuals/count), but was fairly widely distributed—detected on 28.57% of the plots (table 10).

*continued on page 14...*

**Table 9.** Bird species and number detected during VCP counts in pinyon-juniper habitat at Bandelier N.M., 2008. 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 (%)
spotted towhee	<i>Pipilo maculatus</i>	283	11.78
Bewick's wren	<i>Thyromanes bewickii</i>	253	10.53
ash-throated flycatcher	<i>Myiarchus cinerascens</i>	231	9.62
chipping sparrow	<i>Spizella passerina</i>	207	8.62
gray flycatcher	<i>Empidonax wrightii</i>	175	7.29
house finch	<i>Carpodacus mexicanus</i>	111	4.62
juniper titmouse	<i>Baeolophus ridgwayi</i>	97	4.04
mourning dove	<i>Zenaida macroura</i>	96	4.00
western scrub-jay	<i>Aphelocoma californica</i>	91	3.79
violet-green swallow	<i>Tachycineta thalassina</i>	79	3.29
western bluebird	<i>Sialia mexicana</i>	68	2.83
northern flicker	<i>Colaptes auratus</i>	63	2.62
black-headed grosbeak	<i>Pheucticus melanocephalus</i>	58	2.42
Cassin's kingbird	<i>Tyrannus vociferans</i>	58	2.42
blue-gray gnatcatcher	<i>Polioptila caerulea</i>	54	2.25
pine siskin	<i>Carduelis pinus</i>	41	1.71
common raven	<i>Corvus corax</i>	39	1.62
brown-headed cowbird	<i>Molothrus ater</i>	29	1.21
western wood-pewee	<i>Contopus sordidulus</i>	28	1.17
white-winged dove	<i>Zenaida asiatica</i>	28	1.17
hairy woodpecker	<i>Picoides villosus</i>	27	1.12
black-throated gray warbler	<i>Dendroica nigrescens</i>	26	1.08
turkey vulture	<i>Cathartes aura</i>	26	1.08
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	21	0.87
lesser goldfinch	<i>Carduelis psaltria</i>	21	0.87
plumbeous vireo	<i>Vireo plumbeus</i>	20	0.83
evening grosbeak	<i>Coccothraustes vespertinus</i>	17	0.71
rock wren	<i>Salpinctes obsoletus</i>	15	0.62
Virginia's warbler	<i>Vermivora virginiae</i>	13	0.54
American robin	<i>Turdus migratorius</i>	12	0.50
American kestrel	<i>Falco sparverius</i>	11	0.46
western tanager	<i>Piranga ludoviciana</i>	11	0.46
white-throated swift	<i>Aeronautes saxatalis</i>	10	0.42
Say's phoebe	<i>Sayornis saya</i>	8	0.33
white-breasted nuthatch	<i>Sitta carolinensis</i>	8	0.33
canyon wren	<i>Catherpes mexicanus</i>	6	0.25
dark-eyed junco	<i>Junco hyemalis</i>	6	0.25
black-chinned hummingbird	<i>Archilochus alexandri</i>	5	0.21
common nighthawk	<i>Chordeiles minor</i>	5	0.21
Grace's warbler	<i>Dendroica graciae</i>	5	0.21
Brewer's Sparrow	<i>Spizella breweri</i>	4	0.17
canyon towhee	<i>Pipilo fuscus</i>	4	0.17
hepatic tanager	<i>Piranga flava</i>	4	0.17

**Table 9** *continued*

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
northern mockingbird	<i>Mimus polyglottos</i>	4	0.17
red crossbill	<i>Loxia curvirostra</i>	4	0.17
bush-tit	<i>Psaltriparus minimus</i>	3	0.13
MacGillivray's warbler	<i>Oporornis tolmiei</i>	3	0.13
yellow-rumped warbler	<i>Dendroica coronada</i>	3	0.13
hermit thrush	<i>Catharus guttatus</i>	2	0.08
pygmy nuthatch	<i>Sitta pygmaea</i>	2	0.08
Steller's jay	<i>Cyanocitta stelleri</i>	2	0.08
great-horned owl	<i>Bubo virginianus</i>	1	0.04
pinyon jay	<i>Gymnorhinus cyanocephalus</i>	1	0.04
red-tailed hawk	<i>Buteo jamaicensis</i>	1	0.04
spotted sandpiper	<i>Actitis macularia</i>	1	0.04
Townsend's solitaire	<i>Myadestes townsendi</i>	1	0.04

**Table 10. Mean number of individuals, per species, detected per VCP count; and frequency of occupied plots (plots in which the species was detected) in pinyon-juniper habitat at Bandelier N.M., 2008.**

Species	Mean # of individuals	Standard deviation	Frequency of occupied plots (%)
spotted towhee	1.35	0.93	95.71
Bewick's wren	1.20	1.01	92.86
ash-throated flycatcher	1.10	0.88	95.71
chipping sparrow	0.99	1.27	92.86
gray flycatcher	0.83	0.82	88.57
house finch	0.53	0.82	68.57
juniper titmouse	0.46	0.62	72.86
mourning dove	0.46	0.71	70.00
western scrub-jay	0.43	0.65	70.00
violet-green swallow	0.38	1.47	44.29
western bluebird	0.32	0.79	34.29
northern flicker	0.30	0.50	60.00
black-headed grosbeak	0.28	0.50	52.86
Cassin's kingbird	0.28	0.63	48.57
blue-gray gnatcatcher	0.26	0.51	47.14
pine siskin	0.20	0.45	45.71
common raven	0.19	0.46	44.29
brown-headed cowbird	0.14	0.48	28.57
western wood-pewee	0.13	0.38	27.14
white-winged dove	0.13	0.35	22.86

**Table 10** *continued*

<b>Species</b>	<b>Mean # of individuals</b>	<b>Standard deviation</b>	<b>Frequency of occupied plots (%)</b>
hairy woodpecker	0.13	0.34	32.86
black-throated gray warbler	0.12	0.40	18.57
turkey vulture	0.12	0.56	17.14
broad-tailed hummingbird	0.10	0.30	28.57
lesser goldfinch	0.10	0.37	22.86
plumbeous vireo	0.10	0.29	22.86
evening grosbeak	0.08	0.41	14.29
rock wren	0.07	0.26	20.00
Virginia's warbler	0.06	0.24	18.57
American robin	0.06	0.25	15.71
American kestrel	0.05	0.26	12.86
western tanager	0.05	0.22	15.71
white-throated swift	0.05	0.25	11.43
Say's phoebe	0.04	0.19	10.00
white-breasted nuthatch	0.04	0.22	7.14
canyon wren	0.03	0.17	5.71
dark-eyed junco	0.03	0.24	5.71
black-chinned hummingbird	0.02	0.18	5.71
common nighthawk	0.02	0.15	5.71
Grace's warbler	0.02	0.15	7.14
Brewer's Sparrow	0.02	0.22	2.86
canyon towhee	0.02	0.14	5.71
hepatic tanager	0.02	0.17	4.29
northern mockingbird	0.02	0.14	5.71
red crossbill	0.02	0.28	1.43
bushtit	0.01	0.21	1.43
MacGillivray's warbler	0.01	0.15	2.86
yellow-rumped warbler	0.01	0.15	2.86
hermit thrush	0.01	0.10	2.86
pygmy nuthatch	0.01	0.10	2.86
Steller's jay	0.01	0.10	2.86
great-horned owl	0.00	0.07	1.43
pinyon jay	0.00	0.07	1.43
red-tailed hawk	0.00	0.07	1.43
spotted sandpiper	0.00	0.07	1.43
Townsend's solitaire	0.00	0.07	1.43

...continued from page 10

### 3.2.2 Summary of bird habitat data

We found five vegetation cover types (pinyon-juniper mesa top, pinyon-juniper treatment, mesa top grassland, mesa top scrubland, and ponderosa pine forest) and four other cover types (dry arroyo, trails, enclosure, and road) in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the BAND pinyon-juniper sample area (table 11). When we calculated the mean percent cover for each vegetation type, pinyon-juniper mesa top was the most common cover type (table 11), accounting for, on average, 50.57% of the overall vegetative cover of the macroplots.

**Table 11.** Mean cover of vegetation and other cover types, standard deviation (SD), and range; and frequency (%) in target pinyon-juniper habitat in Bandelier N.M., 2008.

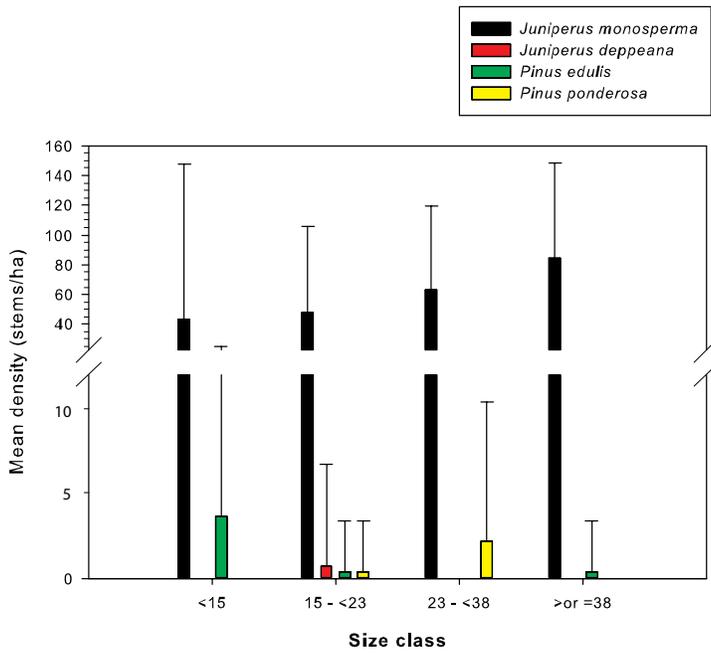
Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Pinyon-juniper mesa top	50.57	41.79	0.00–87.50	65.71
Pinyon-juniper treatment	28.04	39.96	0.00–87.50	35.71
Mesa top grassland	6.36	19.01	0.00–87.50	14.29
Mesa top scrubland	1.90	10.82	0.00–87.50	7.14
Ponderosa pine forest	2.79	13.45	0.00–87.50	5.71
Dry arroyo	3.63	9.88	0.00–62.50	21.43
Trails	1.01	3.62	0.00–17.50	12.86
Enclosure	0.25	2.09	0.00–17.50	1.43
Road	0.11	0.90	0.00–7.50	1.43

The abundance of trees is expressed in terms of density—the number of stems per hectare—and basal area. Table 12 and Figure 5 illustrate density of trees by species and size class. Four tree species were recorded on the sampling plots and the most common species, in all size classes, was oneseed juniper (see Table 12 for scientific names of tree species).

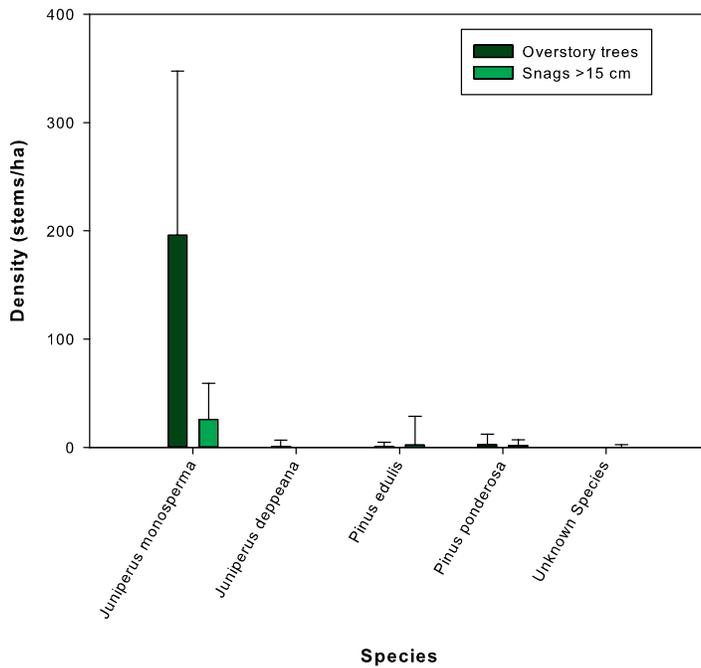
The abundance of snags is expressed in terms of density and basal area. Density—the number of stems per hectare—was recorded by species and size class. Basal area was recorded for all species combined. Snags of oneseed juniper had the greatest density, followed by two-needle pinyon (table 13 and fig. 6).

**Table 12.** Density and basal area of trees by species and size class in pinyon-juniper habitat in Bandelier N.M., 2008. Density (number of stems/ha) and basal area (m<sup>2</sup>/ha) are provided for saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and ≥38 cm dbh. Common names are provided for each tree species.

Species	Common name	Tree basal area (m <sup>2</sup> /ha)	Tree density by size class				
			Overstory trees				Saplings
			15 to <23 cm	23 to <38 cm	≥38 cm	Total	<15 cm
<i>Juniperus monosperma</i>	oneseed juniper	129.85	48.08	63.39	84.40	195.87	43.65
<i>Juniperus deppeana</i>	alligator juniper	0.10	0.71	-	-	0.71	-
<i>Pinus edulis</i>	two-needle pinyon	0.04	0.36	-	0.36	0.71	3.64
<i>Pinus ponderosa</i>	ponderosa pine	0.34	0.36	2.14	-	2.49	-
All species		130.32	49.50	65.53	84.76	199.78	47.29



**Figure 5.** Size structure of sapling and overstory trees in pinyon-juniper habitat in Bandelier N.M. (BAND), 2008. Mean density (number of stems/ha) of trees in BAND pinyon-juniper habitat, by species and size class, including saplings (<15 cm dbh), and overstory trees 15 to <23 cm dbh, 23 to <38 cm dbh, and ≥38 cm dbh. Error bars represent one standard deviation.



**Figure 6.** Density of overstory trees and snags by species in pinyon-juniper habitat in Bandelier N.M., 2008. Overstory trees and snags are >15 cm dbh. Error bars represent one standard deviation.

**Table 13.** Density of snags by species, and total basal area of snags in pinyon-juniper habitat in Bandelier N.M., 2008. Density (number of stems/ha) and basal area (m<sup>2</sup>/ha) are provided for overstory snags (>15 cm dbh).

Species	Density (stems/ha)	Basal area (m <sup>2</sup> /ha)
<i>Juniperus monosperma</i>	25.82	
<i>Juniperus deppeana</i>	-	
<i>Pinus edulis</i>	19.76	
<i>Pinus ponderosa</i>	1.87	
Unknown species	0.36	
All snags	47.81	10.28

**Table 14.** Foliar cover of functional groups in target pinyon-juniper habitat in Bandelier N.M. in 2008.

Functional groups	Mean foliar cover (%)	Standard deviation	Range
Total foliar cover	21.02	12.49	2.38–57.50
perennial grasses, graminoids	9.89	9.63	0.50–51.25
annual grasses	0.95	2.05	0.38–14.00
forbs	2.68	3.25	0.50–22.50
shrubs	10.15	7.12	0.50–28.75
understory trees (<1.4 m height)	0.77	0.96	0.50–6.50
Standing dead herbaceous	0.57	0.32	0.50–2.88
Standing dead woody	0.60	0.28	0.50–2.25

The understory of the pinyon-juniper habitat at BAND is mainly comprised of shrubs and perennial grasses (table 14). There is considerable variation in the cover of perennial grasses—mean foliar cover for this functional group ranged from 0.50% to 51.25%.

## 4 Discussion

These data represent the pilot year of sampling for the mixed conifer and pinyon-juniper bird communities at BAND. The two habitats and their bird communities are quite distinct. The mixed conifer bird community is primarily comprised of species closely associated with mixed conifer forests. The pinyon-juniper habitat at BAND has a relatively low density of trees, and is strongly dominated by *Juniperus monosperma*. *Pinus edulis* density was very low (0.71 trees/ha) and a few *Pinus ponderosa* trees were also present (2.49 trees/ha). Its bird community is primarily comprised of habitat generalists, with one juniper obligate, the juniper titmouse.

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 Williamson’s sapsucker is fairly common in the mixed conifer habitat of BAND (88 detections on 58% of the mixed conifer plots). Its breeding range is confined to western forests of the U.S. and south-central British Columbia, with the exception of a disjunct population in Baja California Norte (Dobbs et al. 1997). 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). If climate change affects the distribution of mixed conifer forests, it may also affect the distribution of the Williamson’s sapsucker.

In the pinyon-juniper habitat, a ponderosa pine obligate, the Grace’s warbler, was detected on 7.15% of the plots. This species is on the Yellow WatchList of declining species (Butcher et al. 2007), and is on the Federal list of Birds of Conservation Concern (U.S. Fish and Wildlife Service 2002). The Partners in Flight’s North American Landbird Conservation Plan (Rich et al. 2004) lists the Grace’s warbler on its Watch List of species of national conservation concern, and the New Mexico Bird Conservation Plan (New Mexico Partners in Flight 2007) considers it a high priority for conservation. Breeding Bird Survey data for Grace’s warbler show significant and sharp declines in New Mexico, and elsewhere (New Mexico Partners in Flight 2007). In northern New Mexico, this species inhabits mesa tops and lower canyon bottoms with ponderosa pine. Our macroplots had a variable amount of ponderosa pine forest cover and ponderosa pine forests comprise much of the monument’s surrounding landscape.

Another United States WatchList of Birds of Conservation Concern Yellow Watchlist species, the Virginia’s warbler, was detected at 3% of the mixed conifer and 18.57% of the pinyon-juniper plots. This species has a relatively small range and population size and, during the breeding season, New Mexico holds a consider-

able percentage of the entire species population (New Mexico Partners in Flight 2007).

The goal of bird community monitoring is to provide status and trends data on bird communities in select habitats and parks. Much of the pinyon-juniper habitat at BAND is inaccessible for implementing the SCPN bird monitoring protocol (Holmes et al. 2009) and we were unable to reach our target minimum of 80 to 100 sampling plots within the target habitat. In addition, the pinyon-juniper woodlands at BAND have been undergoing extensive restoration through the selective thinning of mature junipers, initiated in the area occupied by our sampling plots in 2007. The low number of sampling plots, and the high variability among pinyon-juniper plots would likely inhibit our ability to analyze changes through time in bird species abundance, occurrence, and density, and to conduct trend analyses. Therefore, the BAND pinyon-juniper bird community was excluded from the long-range monitoring plan.

Our long-range plan for the mixed conifer bird community monitoring has been 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.

## 4 Literature cited

- Butcher, G. S., D. K. Niven, A. O. Panjabi, D. N. Pashley, and K. V. Rosenberg. 2007. The 2007 WatchList for United States Birds. *American Birds* 61:18-25.
- Butler, L. D., J. B. Cooper, R. H. Johnson, A. J. Norman, G. L. Peacock, P. L. Shaver, and K. E. Spaeth. 2003. National range and pasture handbook. US Department of Agriculture, Natural Resource Conservation Service, Grazing Lands Technology Institute, Fort Worth, Texas.
- Dobbs, R. C., T. E. Martin, and C. J. Martin. 1997. Williamson's Sapsucker (*Sphyrapicus thyroideus*), The Birds of North America Online (A. Poole, Ed). Ithaca: Cornell Lab of Ornithology; Retrieved from The Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/285>.
- Hibner, C. D. 2000. Special project soil survey of Bandelier National Monument. U.S. Department of Agriculture, Natural Resources Conservation Service, Santa Fe Soil Survey Office, Santa Fe, New Mexico. Interim report.
- Holmes, J. A., M. J. Johnson, C. Lauer, J. Norris, A. Snyder, and L. Thomas. *In review*. Habitat-based bird community monitoring protocol for the Southern Colorado Plateau Network. National Park Service, Fort Collins, Colorado.
- Muldavin, E., A. Kennedy, C. Jackson, T. Neville, P. Neville, K. Schulz, and M. Reid. 2010. A Vegetation Classification and Map Report: Bandelier National Monument. Natural Resource Technical Report NPS/SCPN/NRTR-2010/00X, National Park Service, Fort Collins, Colorado.
- New Mexico Partners in Flight. 2007. New Mexico Bird Conservation Plan Version 2.1. C. Rustay and S. Norris, compilers. Albuquerque, New Mexico. Available at <http://nmpartnersinflight.org/bcp.html>.
- Rich, T. D., C. J. Beardmore, H. Berlanga, P. J. Blancher, M. S. W. Bradstreet, G. S. Butcher, D. W. Demarest, E. H. Dunn, W. C. Hunter, E. E. Inigo-Elias, J. A. Kennedy, A. M. Martell, A. O. Panjabi, D. N. Pashley, K. V. Rosenberg, C. M. Rustay, J. S. Wendt, and T. C. Will. 2004. Partners in Flight North American landbird conservation plan. Cornell Lab of Ornithology, Ithaca, NY. Available at [http://www.partnersinflight.org/cont\\_plan](http://www.partnersinflight.org/cont_plan).
- U.S. Fish and Wildlife Service. 2002. Birds of conservation concern 2002. Division of Migratory Bird Management, Arlington, Virginia. Available at <http://www.fws.gov/migratorybirds/reports/reports.html>.