



Bird Community Monitoring for Mesa Verde National Park

2015 Summary Report

Natural Resource Report NPS/SCPN/NRDS—2016/1065



ON THE COVER

Gray flycatcher (*Empidonax wrightii*)

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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 Mesa Verde National Park (MEVE), Southern Colorado Plateau Network (SCPN) and park staff selected the Loamy Mesa Top Pinyon-Juniper ecological site as an important ecosystem for vegetation and bird community monitoring. The Mesa Top Pinyon-Juniper woodland is a unique ecosystem containing old-growth pinyon-juniper woodland. It faces several threats, including changing fire regimes, climate change, and the invasion of nonnative species.

In 2015, through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN, we continued monitoring the upland bird community of the target pinyon-juniper habitat in MEVE, which had been initiated in 2007, and continued in 2009 and 2012. In this report, we document monitoring activities in 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 MEVE from the map of the Loamy Mesa Top Pinyon-Juniper ecological site, 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). The sampling frame for bird community monitoring at MEVE is henceforth referred to as pinyon-juniper habitat (Figure 1).

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 and mechanically treated areas 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
- areas containing arthropod monitoring sites

We created a set of spatially distributed sampling plots arranged in a simple grid sampling design. MEVE staff first 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 plots that were inaccessible. Sites were rejected as inaccessible if they required greater than 2 hours of traveling time (by car and foot) from Morefield campground. The crew then assessed each sampling plot 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. We selected 86 sampling plots within the target pinyon-juniper habitat and rejected 82.

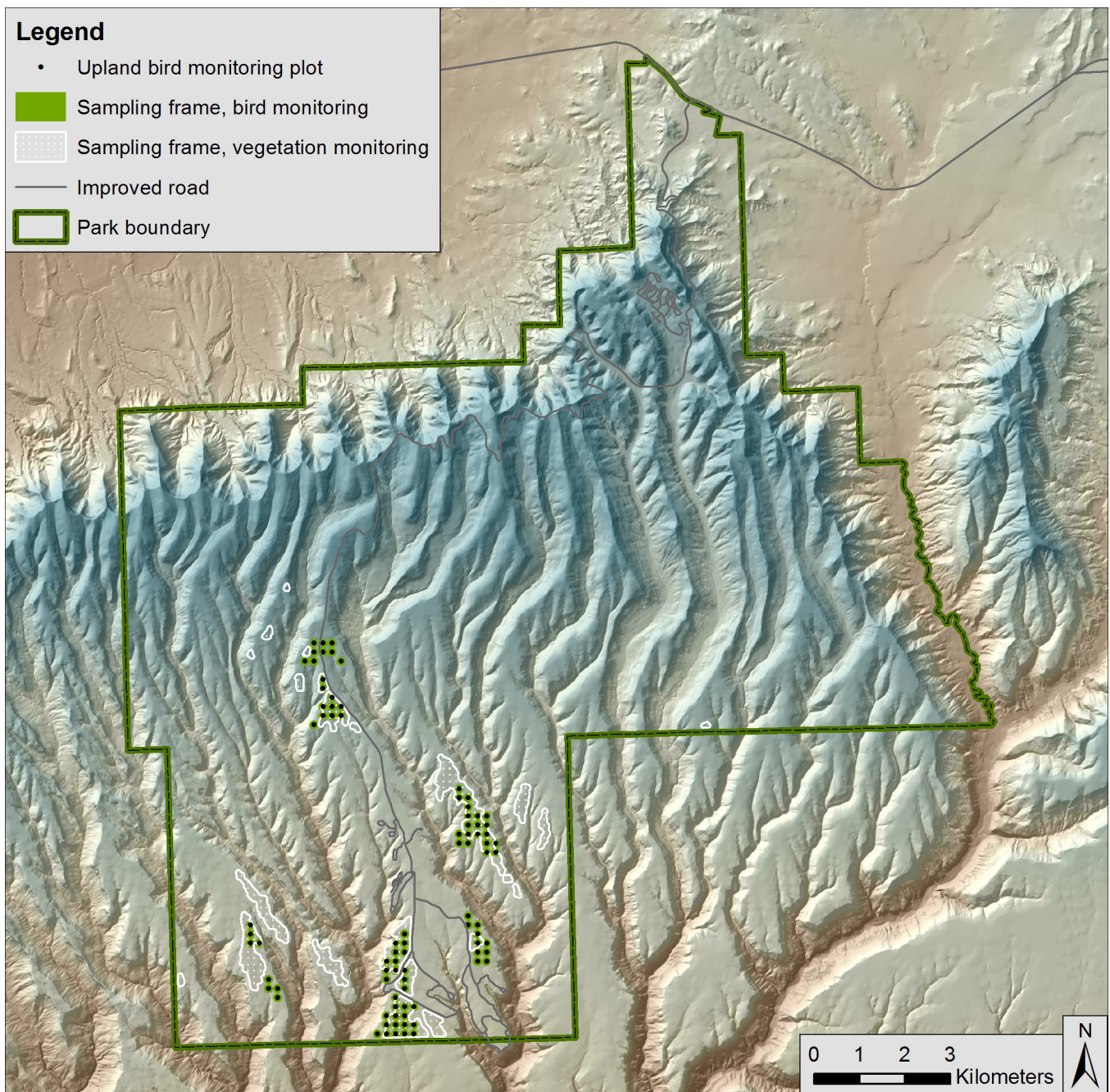


Figure 1. Bird monitoring plots in bird monitoring sampling frame in pinyon-juniper habitat; and upland vegetation monitoring sampling frame in Mesa Verde NP.

2.2 Field methods

We conducted bird sampling at 86 permanent sampling plots, or Variable Circular Plots (VCP), in pinyon-juniper habitat at MEVE (Figure 1) over the course of two survey periods 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 measured to the nearest meter using a laser range finder. During a single morning, each technician conducted approximately 10 VCP counts.

Table 1. Survey periods and sampling effort for bird community monitoring at Mesa Verde NP 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	20 May –25 May	86
2	17 June –21 June	86
Total		172

Habitat sampling was conducted in a 50 m radius macroplot centered on a VCP sampling plot, and in four subplots within the macroplot. First, for the macroplot, we estimated and recorded the area occupied by vegetation types and other land cover types. Then, in the four subplots, we recorded tree and snag basal area, tree density, canopy closure, and foliar vegetation cover by functional group (e.g., forbs, shrubs). 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 pinyon-juniper habitat at MEVE. 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 pinyon-juniper habitat using a simple grid sampling design, the data for all plots were averaged across the two survey periods, and a mean number of individuals detected and standard deviation were 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 bird species was detected in 30 of the 86 plots in the target habitat during one or both of the two visits to that plot, the proportion of plots occupied in the target habitat would be 0.35 (35%).

2.3.2 Habitat data

We use habitat data and bird sampling data to examine bird-habitat relationships. For MEVE, habitat data were collected within a circular 0.8 ha macroplot that 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 MEVE, we classified vegetation into four cover types, and identified five additional non-vegetation land cover types, as shown in Table 2. For each cover type, we calculated

- mean percent cover 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 the mean and standard deviation for the target habitat.

Table 2. Vegetation cover types and other landcover types in pinyon-juniper habitat at Mesa Verde NP. Cover types were updated to correspond with the park's vegetation mp.

Cover type	Description
Pinyon-Juniper Woodland	Pinyon pine (<i>Pinus edulis</i>) and juniper (<i>Juniperus</i> spp.) dominate the overstory (15-65% cover). The shrub layer can be well developed with antelope bitterbrush (<i>Purshia tridentata</i>) and Utah serviceberry (<i>Amelanchier utahensis</i>). Mountain mahogany (<i>Cercocarpus montanus</i>), big sagebrush (<i>Artemisia tridentata</i>), fenderbush (<i>Fendlera rupicola</i>), and Gambel oak (<i>Quercus gambelii</i>) are also present, but less common components. The herbaceous layer is commonly sparse, most frequently characterized by muttongrass (<i>Poa fendleriana</i>), and toadflax penstemon (<i>Penstemon linarioides</i>). Opuntia (<i>Opuntia</i> spp.) and Datil yucca (<i>Yucca baccata</i>) are also frequent.
Gambel Oak-Mixed Montane Shrubland	Areas where Utah serviceberry, fenderbush, and Gambel oak shrub cover exceeds 40%. Little to no overstory pinyon or juniper. Generally found in more northern portions of the park.
Big Sagebrush Shrubland	Areas with little to no overstory (<15% cover) and high shrub cover, including big sagebrush. May also have relatively high forb cover. Shrub cover of Utah serviceberry, fenderbush, and Gambel oak is <40%.
Sparse Vegetation – Pinyon-Juniper Barrens	Total vegetation cover is sparse, generally less than 10%. Pinyon-juniper may be present as overstory, but does not exceed 10% cover. Exposed sandstone bedrock is present at high cover values and is the dominant feature.
Semi-Desert Grassland	Areas that have been cleared of pinyon-juniper woodland. Understory is dominated by grasses, with little to no tree or shrub cover (<10%).
Historic structures / Ruins	Standing or partially standing historic buildings or ruins, without vegetation.
Dry arroyo	A dry deep gully or dry gulch cut by an intermittent stream. Generally devoid of vegetation.
Barren/Rock	Areas of rock formation above the surface of the surrounding land.
Road	Distinct roadway with little to no vegetation growing.

3 Results

3.1 Summary of bird community data

In 2015, we conducted a total of 172 VCP counts in pinyon-juniper habitat at MEVE. During these surveys, we detected 2,536 individuals of 51 species (Table 3). The most commonly detected species was the black-throated gray warbler, which comprised 13.29% of the total number of individuals detected.

Table 3. Bird species and number detected during VCP counts in pinyon-juniper habitat at Mesa Verde NP 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 (%)
black-throated gray warbler	<i>Dendroica nigrescens</i>	337	13.29
chipping sparrow	<i>Spizella passerina</i>	215	8.48
gray flycatcher	<i>Empidonax wrightii</i>	211	8.32
common raven	<i>Corvus corax</i>	204	8.04
Bewick's wren	<i>Thyromanes bewickii</i>	181	7.14
mourning dove	<i>Zenaida macroura</i>	157	6.19
spotted towhee	<i>Pipilo maculatus</i>	144	5.68
juniper titmouse	<i>Baeolophus ridgwayi</i>	137	5.40
ash-throated flycatcher	<i>Myiarchus cinerascens</i>	131	5.17
plumbeous vireo	<i>Vireo plumbeus</i>	122	4.81
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	78	3.08
blue-gray gnatcatcher	<i>Poliophtila caerulea</i>	71	2.80
violet-green swallow	<i>Tachycineta thalassina</i>	56	2.21
lesser goldfinch	<i>Carduelis psaltria</i>	47	1.85
western tanager	<i>Piranga ludoviciana</i>	38	1.50
white-breasted nuthatch	<i>Sitta carolinensis</i>	36	1.42
gray vireo	<i>Vireo vicinior</i>	29	1.14
white-throated swift	<i>Aeronautes saxatalis</i>	27	1.06
western bluebird	<i>Sialia mexicana</i>	26	1.03
wild turkey	<i>Meleagris gallopavo</i>	24	0.95
western meadowlark	<i>Sturnella neglecta</i>	23	0.91
hairy woodpecker	<i>Picoides villosus</i>	22	0.87
western scrub-jay	<i>Aphelocoma californica</i>	20	0.79
black-chinned hummingbird	<i>Archilochus alexandri</i>	18	0.71
Bushtit	<i>Psaltiriparus minimus</i>	18	0.71
black-headed grosbeak	<i>Pheuticus melanocephalus</i>	15	0.59
mountain chickadee	<i>Poecile gambeli</i>	15	0.59
Cassin's finch	<i>Haemorhous cassinii</i>	14	0.55
Virginia's warbler	<i>Vermivora virginiae</i>	14	0.55
American robin	<i>Turdus migratorius</i>	13	0.51
brown-headed cowbird	<i>Molothrus ater</i>	11	0.43
mountain bluebird	<i>Sialia currucoides</i>	11	0.43
western wood-pewee	<i>Contopus sordidulus</i>	9	0.35
Cassin's kingbird	<i>Tyrannus vociferans</i>	8	0.32
house finch	<i>Carpodacus mexicanus</i>	8	0.32
pine siskin	<i>Carduelis pinus</i>	7	0.28

Table 3. (continued) Bird species and number detected during VCP counts in pinyon-juniper habitat at Mesa Verde NP 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 (%)
evening grosbeak	<i>Coccothraustes vespertinus</i>	6	0.24
hermit thrush	<i>Catharus guttatus</i>	5	0.20
pinyon jay	<i>Gymnorhinus cyanocephalus</i>	5	0.20
warbling vireo	<i>Vireo gilvus</i>	5	0.20
Cooper's hawk	<i>Accipiter cooperii</i>	3	0.12
canyon wren	<i>Catherpes mexicanus</i>	2	0.08
dusky flycatcher	<i>Empidonax oberholseri</i>	2	0.08
northern flicker	<i>Colaptes auratus</i>	2	0.08
Say's phoebe	<i>Sayornis saya</i>	2	0.08
great horned owl	<i>Bubo virginianus</i>	1	0.04
greater roadrunner	<i>Geococcyx californianus</i>	1	0.04
green-tailed towhee	<i>Pipilo chlorurus</i>	1	0.04
rock wren	<i>Salpinctes obsoletus</i>	1	0.04
western screech-owl	<i>Megascops kennicottii</i>	1	0.04

The mean number of individuals detected per species during a VCP count, and the frequency of detections for each species detected in MEVE pinyon-juniper habitat are presented in Table 4. The black-throated gray warbler had the highest mean number of individuals, with an average of 1.96 individuals detected during an 8-minute count. They were also widespread in the target habitat—detected in 97.67% of the plots (Table 4). The spotted towhee was also abundant (average of 0.84 individuals detected during an 8-minute count) but was only detected in 62% of the plots.

Table 4. 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 pinyon-juniper habitat at Mesa Verde NP, 2015.

Species	Number of individuals		Plot frequency (%)
	Mean	SD	
black-throated gray warbler	1.96	1.21	97.67
chipping sparrow	1.25	0.99	94.19
gray flycatcher	1.23	0.93	94.19
common raven	1.19	1.03	86.05
Bewick's wren	1.05	0.93	87.21
mourning dove	0.91	0.88	84.88
spotted towhee	0.84	1.07	61.63
juniper titmouse	0.80	0.78	81.40
ash-throated flycatcher	0.76	0.70	86.05
plumbeous vireo	0.71	0.72	75.58
broad-tailed hummingbird	0.45	0.54	81.40
blue-gray gnatcatcher	0.41	0.75	45.35
violet-green swallow	0.33	1.67	22.09
lesser goldfinch	0.27	0.63	36.05
western tanager	0.22	0.44	38.37
white-breasted nuthatch	0.21	0.44	31.40
gray vireo	0.17	0.42	30.23

Table 4. (*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 pinyon-juniper habitat at Mesa Verde NP, 2015.

Species	Number of individuals		Plot frequency (%)
	Mean	SD	
white-throated swift	0.16	0.49	20.93
western bluebird	0.15	0.39	26.74
wild turkey	0.14	0.36	26.74
western meadowlark	0.13	0.34	22.09
hairy woodpecker	0.13	0.43	22.09
western scrub-jay	0.12	0.37	17.44
black-chinned hummingbird	0.10	0.31	19.77
bushtit	0.10	0.39	13.95
black-headed grosbeak	0.09	0.28	17.44
mountain chickadee	0.09	0.36	12.79
Cassin's finch	0.08	0.37	11.63
Virginia's warbler	0.08	0.33	9.30
American robin	0.08	0.29	11.63
brown-headed cowbird	0.06	0.27	11.63
mountain bluebird	0.06	0.29	10.47
western wood-pewee	0.05	0.22	9.30
Cassin's kingbird	0.05	0.21	9.30
house finch	0.05	0.24	8.14
pine siskin	0.04	0.33	4.65
evening grosbeak	0.03	0.26	3.49
hermit thrush	0.03	0.17	5.81
pinyon jay	0.03	0.23	3.49
warbling vireo	0.03	0.17	5.81
Cooper's hawk	0.02	0.13	3.49
American kestrel	0.01	0.11	2.33
canyon wren	0.01	0.11	2.33
dusky flycatcher	0.01	0.11	2.33
northern flicker	0.01	0.11	2.33
Say's phoebe	0.01	0.11	2.33
great horned owl	0.01	0.08	1.16
greater roadrunner	0.01	0.08	1.16
green-tailed towhee	0.01	0.08	1.16
rock wren	0.01	0.08	1.16
western screech-owl	0.01	0.08	1.16

3.2 Summary of bird habitat data

We found 5 vegetation cover types and 4 other cover types in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the MEVE sampling area (Table 5). Pinyon-Juniper Woodland was recorded on 100% of the macroplots. When we calculated the mean percent cover for each cover type, Pinyon-Juniper Woodland was the most common vegetation cover type, accounting for, on average, 85.76% of the overall vegetative cover of the macroplots.

In Table 6, the abundance of trees within each species is expressed in terms of basal area of overstory trees and

Table 5. Mean cover of vegetation and other land cover types, standard deviation (SD), range, and frequency of these types in macroplots in target pinyon-juniper habitat in Mesa Verde NP, 2015.

Vegetation or other land cover type	Cover (%)			
	Mean	SD	Range	Frequency (%)
Pinyon-Juniper Woodland	85.76	8.39	37.50–87.50	100.00
Gambel Oak–Mixed Montane Shrubland	1.66	8.22	0.00–62.50	5.81
Big Sagebrush Shrubland	1.02	7.01	0.00–62.50	3.49
Sparse Vegetation–Pinyon-Juniper Barrens	0.70	3.31	0.00–17.50	4.65
Semi-Desert Grassland	0.20	1.89	0.00–17.50	1.16
Dry arroyo	0.22	1.18	0.00–7.50	3.49
Historic Structures / Ruins	0.20	1.89	0.00–17.50	1.16
Barren / Rock	0.09	0.81	0.00–7.50	1.16
Road	0.09	0.81	0.00–7.50	1.16

Table 6. 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 pinyon-juniper habitat in Mesa Verde NP, 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>Juniperus osteosperma</i>	Utah juniper	13.70	135.10	137.32
<i>Pinus edulis</i>	Twoneedle pinyon	2.37	343.48	257.24
All species		16.07	478.58	394.56
Snags		3.18		

sapling density, 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. Two tree species—Utah juniper and twoneedle pinyon—were recorded on the sampling plots and, of them, Utah juniper had the highest basal area (see Table 6 for scientific and common names of tree species). Table 6 and Figure 3 illustrate the density of sapling trees (less than 10 cm DBH) by species and size class. Twoneedle pinyon dominated both of the sapling classes. The average canopy closure in pinyon-juniper habitat was 32.16% (SD = 11.83).

Within the pinyon-juniper understory, the functional group with the highest foliar cover was the group that included shrubs,

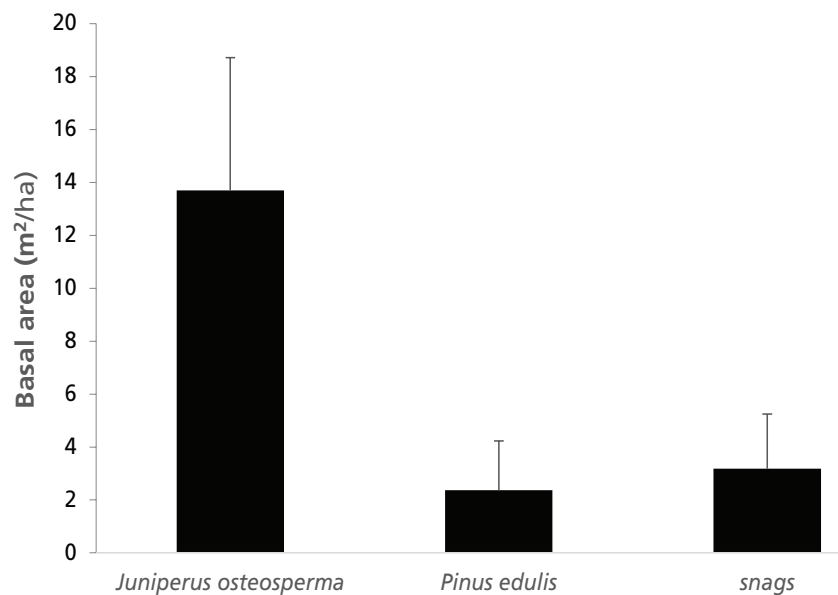


Figure 2. Basal area of tree species and snags in pinyon-juniper habitat in Mesa Verde NP, 2015. Error bars represent one standard deviation.

dwarf shrubs, and woody vines (Table 7). There was considerable variation in the amount of total shrub and herbaceous cover—mean foliar cover for this functional group ranged from 1.13% to 43.75%.

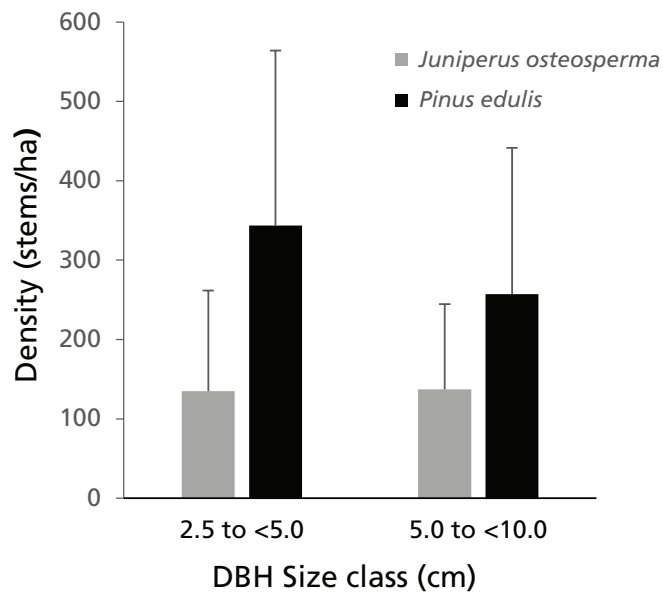


Figure 3. Size structure of sapling trees. Mean density (number of stems/ha) of sapling trees in two size classes (2.5 to <5.0, and 5.0 to <10.0 cm DBH) in pinyon-juniper habitat in Mesa Verde NP, 2015. Error bars represent one standard deviation.

Table 7. Mean foliar cover, standard deviation (SD), and range of functional groups in target pinyon-juniper habitat in Mesa Verde NP, 2015.

Functional group	Mean	Foliar cover (%)	
		SD	Range
Tree seedlings	2.41	2.29	0.00–12.00
Total shrub and herbaceous cover (no trees)	12.53	8.17	1.13–43.75
Perennial grasses, graminoids	3.52	2.71	0.25–11.63
Annual grasses	0.17	1.11	0.00–10.13
Forbs	1.59	1.44	0.25–6.50
Shrubs, dwarf shrubs and woody vines	6.77	7.25	0.00–39.00
Cacti, succulents	1.97	2.17	0.00–10.13
Standing dead herbaceous	1.01	0.81	0.00–4.13
Woody standing dead	3.29	3.67	0.00–22.00

4 Discussion

These data represent the fourth year of sampling for the pinyon-juniper bird community at MEVE. SCPN monitors bird communities within network parks as a core vital sign representing the overall health and condition of park natural resources. Similarly, for *The State of the Birds 2014*, 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. Eleven species detected in MEVE pinyon-juniper 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. Five of the 11 MEVE species are listed as significantly declining. In particular, black-throated gray warbler, the most commonly detected species in MEVE pinyon-juniper habitat, has a declining trend of -1.45 and the pinyon jay has the highest declining trend of the western forest indicator, at -4.26.

The State of the Birds 2014 report also includes a Watch List of 233 species most in need of conservation action, and identifies 33 common birds in steep decline—having lost more than half of their global population over the past four decades. Five Watch List species, gray vireo, pinyon jay, Virginia's warbler, Cassin's finch, and evening grosbeak, were detected in MEVE pinyon-juniper habitat in 2015. Our MEVE pinyon-juniper 2015 data also includes seven detections for the pine siskin, a common species in steep decline (North American Bird Conservation Initiative, U.S. Committee 2014).

The black-throated gray warbler continues to be the most common breeding bird in MEVE's pinyon-juniper habitat—in 2015 it comprised over 13% of all detections. These birds are insectivorous and forage and nest in tree foliage. They are migratory, and winter primarily in western Mexico (Guzy and Lowther 2012), and breed across much of the western United States and into British Columbia. Across their breeding range, they nest in a variety of habitats, but in Colorado they breed exclusively in mature pinyon-juniper woodlands (Versaw 1998). Much of the warbler's pinyon-juniper breeding habitat has escaped development, but climate change, changing fire regimes, and invasion by nonnative species may threaten it.

Our long-range plan for pinyon-juniper bird community monitoring in MEVE is to conduct VCP counts every three years and 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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