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Natural Resource Stewardship and Science

Bird Community Monitoring for Mesa Verde National Park

2007 Summary Report, revised

Natural Resource Data Series NPS/SCPN/NRDS—2010/201

ON THE COVER
Pinyon-juniper habitat at Mesa Verde National Park
Photo courtesy of Southern Colorado Plateau Network

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

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This project was conducted under a Colorado Plateau Cooperative Ecosystems Study Unit agreement with the Southern Colorado Plateau Network (SCPN). 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 2007 field crew consisted of Kylan Frye and Sarah Brown.

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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 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 numerous threats, including changing fire regimes, climate change, and invasion by non-native species.

In 2007, through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN, we began monitoring the upland bird community of the target pinyon-juniper habitat in MEVE. In this report, we document monitoring activities in the 2007 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. The sampling frames for vegetation and bird community monitoring at MEVE were derived from the map of the Loamy Mesa Top Pinyon-Juniper ecological site developed by the US Natural Resources Conservation Service (See Appendix A of DeCoster et al., in review). 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 Loamy Mesa Top Pinyon-Juniper ecological site is henceforth referred to as pinyon-juniper habitat (fig. 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 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 and mechanically treated areas, because these areas would have increased ecological variation, making it more difficult to detect trends
- areas with slopes ≥30% to prevent erosion from occurring as a result of the field work
- areas containing arthropod monitoring sites

A set of spatially distributed sampling points, in a simple grid sampling design, was created. MEVE park staff first reviewed the sampling points and rejected those points that

landed in the proximity of archeological sites. Next, the bird monitoring crew evaluated the accessibility of each point and rejected points that were inaccessible. Sites were deemed inaccessible if they were greater than two hours of traveling time (by car and foot) from the Morefield campground. The bird crew then assessed each sampling point within the accessible points 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 points that did not meet these criteria were rejected. We selected eighty-six sampling points and rejected 82.

2.2 Field methods

Bird sampling occurred at permanent sampling points, or Variable Circular Plot (VCP) point count stations within pinyon-juniper habitat at MEVE (fig. 1). A total of 86 sampling points were sampled. 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. (2009).

Table 1. Survey periods and sampling effort for bird community monitoring at Mesa Verde National Park (MEVE). Dates for VCP point counts conducted at MEVE in 2007, and the number of points sampled.

Survey period	Dates (2007)	Number VCP point counts
1	5/19 – 5/23	65
2	6/11 – 6/15	63
3	6/30 – 7/4	86

At each sampling point, we conducted a VCP point 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 point to the individual bird. Distances were measured to the nearest meter using a laser range finder. During a single morning, approximately ten VCP point counts each were conducted by two technicians surveying separate groups of sampling points.

Habitat sampling was conducted on a 50-m-radius macroplot centered on a sampling point, 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 foliar vegetation cover by functional group (e.g. forbs, shrubs), canopy closure, and tree and snag density and basal area for the four subplots. Basal area was measured using a DBH tape, and canopy closure was measured 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 point count data

The following data were summarized for the target (pinyon-juniper) habitat at MEVE. The sample unit for bird data is the VCP point count station (plot).

- *Observed species richness* (i.e., 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 indi-

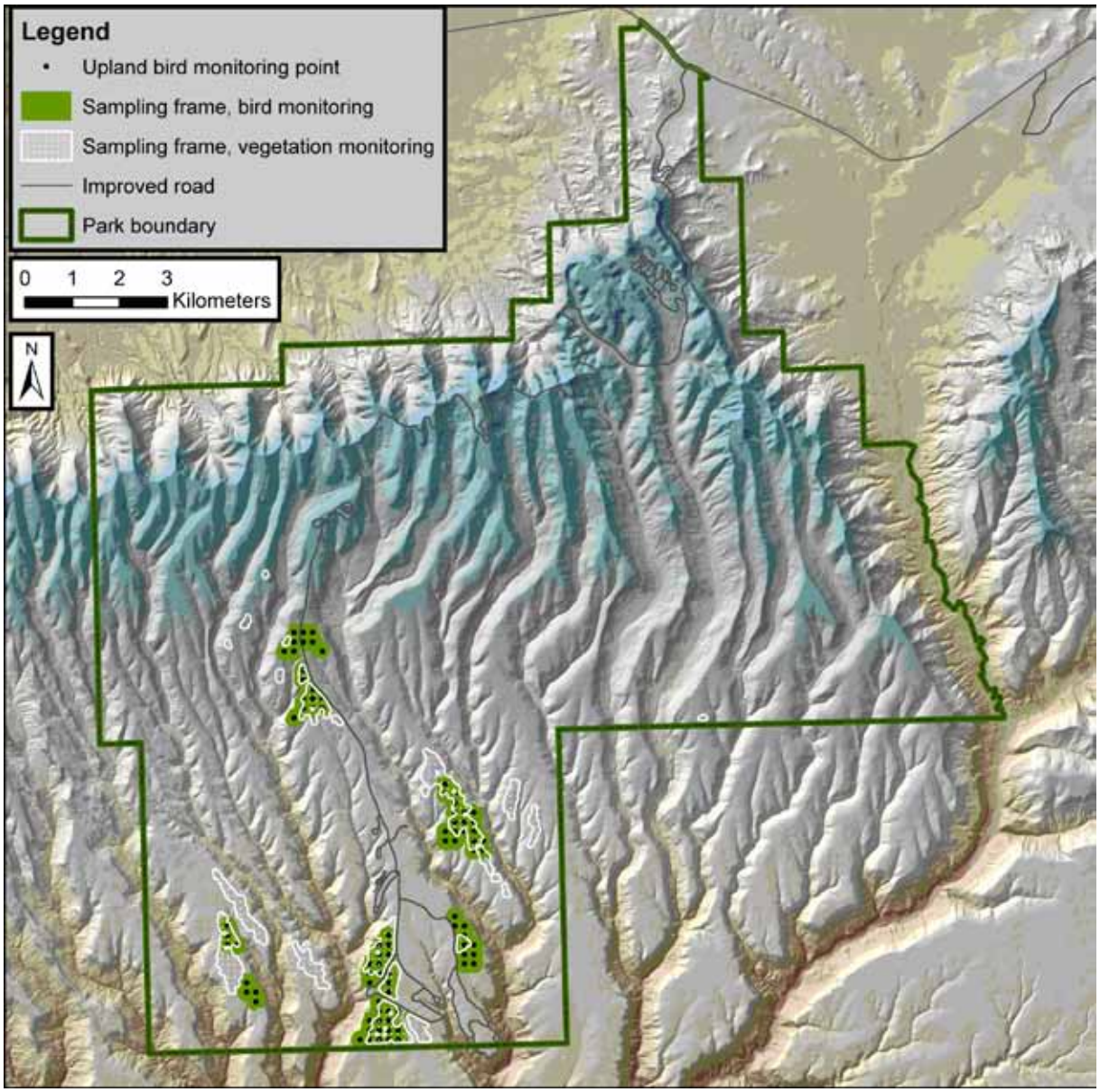

Figure 1. Bird monitoring sampling frame of pinyon-juniper habitat and upland vegetation monitoring sampling frame in Mesa Verde National Park

viduals detected per 8-minute VCP point count. To calculate mean number of individuals detected for each species in pinyon-juniper habitat 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.

- *Mean 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 gray flycatcher was detected on 30 of the 86 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 0.35 (35%).

2.3.2 Habitat data

Habitat data will be used with bird sampling data to examine bird habitat relationships. For MEVE, habitat data were collected within a circular 0.8 ha macroplot which contained four subplots and was centered on each bird sampling point. 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 three 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 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
- *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.
- *Tree and snag density*. Density was calculated as 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.
- *Tree and snag basal area*. Basal area was calculated as m^2/ha for each species and size class using the midpoints of the size class as the diameter at breast height (dbh). Mean basal area was calculated for the macroplot, and then mean basal area and standard deviation were calculated for the target habitat.

Table 2. Vegetation cover types in pinyon-juniper habitat at Mesa Verde National Park

Vegetation type	Description
Pinyon-Juniper, Loamy Mesa Top (target habitat)	Open pinyon-juniper canopy (~30% cover) with an understory of antelope bitterbrush (*Purshia tridentata)*, Datil yucca (*Yucca baccata*), muttongrass (*Poa fendleriana*), and opuntia. Mountain mahogany (*Cercocarpus montanus*) and big sagebrush (*Artemisia tridentata*) are less common components.
Gambel Oak / Fendlerbush patch*	Areas with fendlerbush (*Fendlera rupicola*) and gambel oak (*Quercus gambellii*) present, with little to no trees. Found in more northern portions of the sampling frame.
Shrub dominated	Areas with few or no trees, and high shrub cover, including big sagebrush and fendlerbush, and relatively high forb cover.

* Although areas of gambel oak and fendlerbush are considered to be part of the pinyon- juniper vegetation type, we estimated the percent cover of gambel oak / fendlerbush vegetation type separately from pinyon-juniper.

3 Results

3.1 Summary of bird community data

In 2007, we conducted a total of 214 VCP point counts in pinyon-juniper habitat at MEVE (table 1). Because the sampling schedule did not allow for rescheduling surveys due to inclement weather, and because weather conditions were a factor, we were unable to conduct VCP point counts at all sampling points during survey 1 and survey 2. During the 2007 surveys, we detected 2,466 individuals of 53 species (table 3). The most commonly detected species was the black-throated gray warbler.

Table 3. Bird species and number detected during VCP point counts at Mesa Verde National Park (MEVE). Data are from VCP point counts conducted at MEVE in 2007. Species are listed in descending order of the total number of individuals detected.

Common name	Scientific name	Total # of detections	Proportion of all detections (%)
Black-throated gray warbler	*Dendroica nigrescens*	404	16.38
Spotted towhee	*Pipilo maculatus*	246	9.98
Juniper titmouse	*Baeolophus ridgwayi*	233	9.45
Common raven	*Corvus corax*	188	7.62
Gray flycatcher	*Empidonax wrightii*	163	6.61
Bewick's wren	*Thyromanes bewickii*	146	5.92
Chipping sparrow	*Spizella passerina*	139	5.64
White-throated swift	*Aeronautes saxatalis*	112	4.54
Mourning dove	*Zenaida macroura*	96	3.89
Ash-throated flycatcher	*Myiarchus cinerascens*	91	3.69
White-breasted nuthatch	*Sitta carolinensis*	64	2.60
Lesser goldfinch	*Carduelis psaltria*	61	2.47
Mountain chickadee	*Poecile gambeli*	51	2.07
Bushtit	*Psaltriparus minimus*	44	1.78
Plumbeous vireo	*Vireo plumbeus*	37	1.50
Hairy woodpecker	*Picioides villosus*	35	1.42
American robin	*Turdus migratorius*	31	1.26
Black-chinned hummingbird	*Archilochus alexandri*	31	1.26
Western scrub-jay	*Aphelocoma californica*	29	1.18
Black-headed grosbeak	*Pheuticus melanocephalus*	21	0.85
Blue-gray gnatcatcher	*Polioptila caerulea*	20	0.81
Brown-headed cowbird	*Molothrus ater*	20	0.81
Pinyon jay	*Gymnorhinus cyanocephalus*	20	0.81
Dark-eyed junco	*Junco hyemalis*	19	0.77
Hermit thrush	*Catharus guttatus*	19	0.77
House finch	*Carpodacus mexicanus*	17	0.69
Mountain bluebird	*Sialia currocoides*	15	0.61
Steller's jay	*Cyanocitta stelleri*	15	0.61
Dusky flycatcher	*Empidonax oberholseri*	13	0.53
Violet-green swallow	*Tachycineta thalassina*	11	0.45
Northern flicker	*Colaptes auratus*	9	0.36
Gray vireo	*Vireo vicinior*	8	0.32
Red-breasted nuthatch	*Sitta canadensis*	8	0.32
Western tanager	*Piranga ludoviciana*	7	0.28
Wild turkey	*Meleagris gallopavo*	5	0.20
Lazuli bunting	*Passerina amoena*	4	0.16
Western bluebird	*Sialia mexicana*	4	0.16
Canada goose	*Branta canadensis*	3	0.12
Cliff swallow	*Petrochelidon pyrrhonota*	3	0.12

Table 3. Bird species and number detected during VCP point counts at Mesa Verde National Park, *continued.*

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
Turkey vulture	*Cathartes aura*	3	0.12
Western wood-pewee	*Contopus sordidulus*	3	0.12
Black-billed magpie	*Pica hudsonia*	2	0.08
Broad-tailed hummingbird	*Selasphorus platycercus*	2	0.08
Common nighthawk	*Chordeiles minor*	2	0.08
Green-tailed towhee	*Pipilo chlorurus*	2	0.08
Ruby-crowned kinglet	*Regulus calendula*	2	0.08
Scaled quail	*Callipepla squamata*	2	0.08
American kestrel	*Falco sparverius*	1	0.04
Canyon wren	*Catherpes mexicanus*	1	0.04
Cooper's hawk	*Accipiter cooperii*	1	0.04
Northern pygmy-owl	*Glaucidium gnoma*	1	0.04
Virginia's warbler	*Vermivora virginiae*	1	0.04
Western meadowlark	*Sturnella neglecta*	1	0.04

This species comprised 16.38% of the total number of individuals detected. The mean observed (i.e., unadjusted for detectability) bird species richness, per VCP point count, was 7.40 (n=214, SD=2.53).

The mean number of individuals detected per species during a VCP point count, and the frequency of plots with 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 0.87 individuals detected during an eight-minute point count. Black-throated gray warblers were also widespread in the target habitat—detected in 95.35% of plots. The brown-headed cowbird had a relatively low abundance (0.09 individuals/point count), but was fairly widely distributed—detected on 18.60% of the plots (table 4).

3.2 Summary of bird habitat data

We found five vegetation or other cover types in the macroplots (0.8 ha circular plots centered on each bird sampling point) in the MEVE sample area: Pinyon-Juniper, Gambel Oak/Fendlerbush, Shrub Dominated, Historic Structures/Ruins, and Trails (table 5). When we calculated the mean percent cover for each vegetation type, Pinyon-Juniper, the target habitat for this study, was the most common cover type (table 5), accounting for, on average, 85.88% of the overall vegetative cover of the macroplots. The average canopy closure was 14.36% (SD=8.48, range 3.78-33.60).

The understory of the pinyon-juniper habitat at MEVE is mainly comprised of shrubs, small trees, and perennial grasses (table 6). There is considerable variation in the amount of total foliar cover, and the amount of foliar cover each functional group contributes to a particular plot (as reflected in the standard deviations; SD). For example, the amount of total foliar cover ranges from 6.38% to 68.75%, and perennial grass and graminoids cover ranges from zero to 38.75%.

The abundance of trees is expressed in terms of density—the number of stems per hectare—and basal area, by species and size class. Table 7 and Figure 2 illustrate density of trees by species and size class. Only two tree species—Utah juniper and two-needle pinyon (see table 7 for scientific names of tree species)—were recorded on the sampling plots.

Table 4. Mean number of individuals detected per VCP point count, and frequency of occupied plots in pinyon-juniper habitat at Mesa Verde National Park (MEVE), 2007. Mean number of individuals detected per VCP point count, and frequency (%) of occupied plots (plots in which the species was detected).

Species	Mean number of individuals	SD	Frequency of occupied plots (%)
Black-throated gray warbler	0.87	0.33	95.35
Spotted towhee	0.76	0.43	84.88
Juniper titmouse	0.73	0.44	83.72
Common raven	0.72	1.04	81.40
Gray flycatcher	0.67	0.48	90.70
Bewick's wren	0.57	0.50	75.58
Chipping sparrow	0.55	0.50	73.26
White-throated swift	0.46	1.01	46.51
Mourning dove	0.40	0.49	52.33
Ash-throated flycatcher	0.39	0.50	62.79
White-breasted nuthatch	0.29	0.45	52.33
Lesser goldfinch	0.26	0.51	40.70
Mountain chickadee	0.22	0.42	34.88
Bushtit	0.19	0.52	22.09
Plumbeous vireo	0.17	0.37	24.42
Hairy woodpecker	0.16	0.37	34.88
American robin	0.14	0.35	19.77
Black-chinned hummingbird	0.14	0.35	30.23
Western scrub-jay	0.13	0.34	23.26
Black-headed grosbeak	0.10	0.30	20.93
Blue-gray gnatcatcher	0.09	0.29	16.28
Brown-headed cowbird	0.09	0.29	18.60
Dark-eyed junco	0.09	0.28	20.93
Hermit thrush	0.09	0.28	18.60
Pinyon jay	0.09	0.29	12.79
House finch	0.08	0.54	8.14
Mountain bluebird	0.07	0.25	13.95
Steller's jay	0.07	0.25	12.79
Dusky flycatcher	0.06	0.24	10.47
Violet-green swallow	0.05	0.22	8.14
Gray vireo	0.04	0.19	9.30
Northern flicker	0.04	0.20	10.47
Red-breasted nuthatch	0.04	0.19	6.98
Western tanager	0.03	0.18	6.98
Lazuli bunting	0.02	0.14	4.65
Western bluebird	0.02	0.14	2.33
Wild turkey	0.02	0.15	5.81
Black-billed magpie	0.01	0.10	2.33

Table 4. Mean number of individuals detected per VCP point count, and frequency of occupied plots in pinyon-juniper habitat at Mesa Verde National Park, *continued*

Species	Mean number of individuals	SD	Frequency of occupied plots (%)
Broad-tailed hummingbird	0.01	0.10	2.33
Canada goose	0.01	0.12	2.33
Cliff swallow	0.01	0.21	1.16
Common nighthawk	0.01	0.10	2.33
Green-tailed towhee	0.01	0.10	2.33
Ruby-crowned kinglet	0.01	0.10	2.33
Scaled quail	0.01	0.10	2.33
Turkey vulture	0.01	0.15	2.33
Western wood-pewee	0.01	0.12	3.49
American kestrel	0.00	0.07	1.16
Canyon wren	0.00	0.07	1.16
Cooper's hawk	0.00	0.07	1.16
Northern pygmy-owl	0.00	0.07	1.16
Virginia's warbler	0.00	0.07	1.16
Western meadowlark	0.00	0.07	1.16

Table 5. Mean cover of vegetation and other cover types, standard deviation (SD), and range; and frequency (%) in target pinyon-juniper habitat in Mesa Verde National Park, 2007

Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Pinyon-Juniper	84.88	9.42	37.50-87.50	100.00
Gambel Oak / Fendlerbush	2.45	9.72	0.00-62.50	10.47
Shrub Dominated	1.35	7.85	0.00-62.50	6.98
Historic Structures / Ruins	0.20	1.89	0.00-17.50	1.16
Trails	0.07	0.45	0.00-3.00	2.33

Table 6. Foliar cover of functional groups in target pinyon-juniper habitat in Mesa Verde National Park, 2007

Functional groups	Mean foliar cover (%)	SD	Range
Total foliar cover	24.69	14.07	6.38-68.75
Perennial grass & graminoids	8.55	8.96	0.00-38.75
Annual grasses	0.04	0.14	0.00-0.75
Forbs	1.55	1.54	0.00-5.25
Shrubs*	7.08	5.27	0.25-18.88
Understory trees (< 1.4 m height)	2.71	1.93	0.00-7.00
Standing dead herbaceous	0.08	0.34	0.00-1.88
Standing dead woody	1.40	2.43	0.00-11.25

*Note: In 2007, this only included shrubs < 0.5 m tall.

Sapling densities provide insight into the structure and dynamics of the forest. Pinyon dominated the sapling size class (trees less than 15 cm dbh), while there where more large juniper than pinyon (table 7 and fig. 2). The size structure of the two species shows a typical decline in tree density with increasing tree diameter (fig. 2).

The abundance of snags is expressed in terms of density—the number of stems per hectare—and basal area, by species and size class (table 8 and fig. 3). We were often unable to identify the species of snags and these snags had the highest density in each size class. Pinyon snags outnumbered juniper snags in both size classes (table 8).

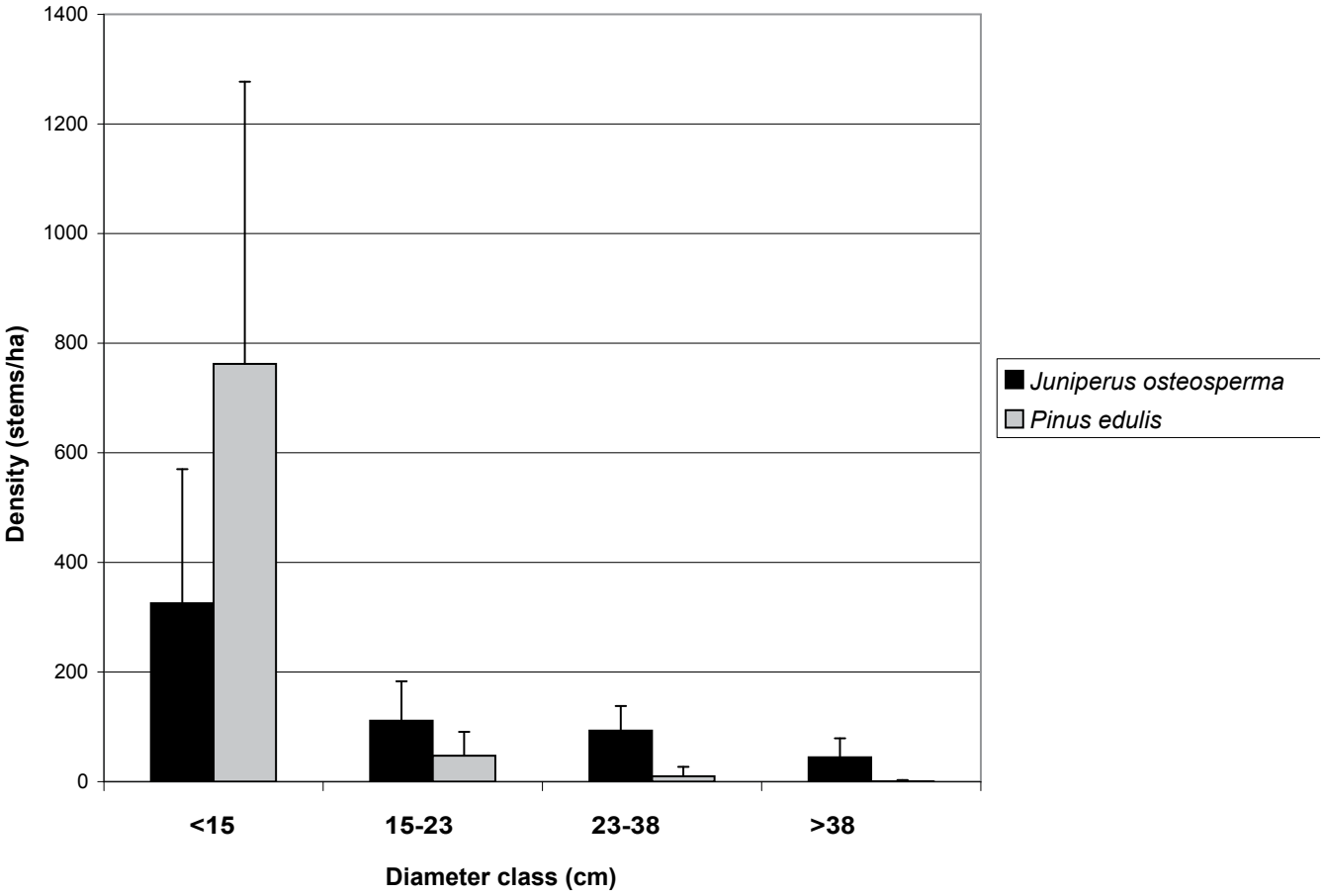

Figure 2. Size structure of sapling and overstory trees in pinyon-juniper habitat in Mesa Verde National Park (MEVE), 2007. Mean density (number of stems/ha) of trees in MEVE pinyon-juniper habitat, by species and size class, including saplings (<15 cm dbh), and overstory trees 15-23 cm dbh, 23-38 cm dbh, and ≥38 cm dbh. Error bars represent one standard deviation.

Table 7. Density and basal area of trees by species and size class in pinyon-juniper habitat in Mesa Verde National Park, 2007. Density (number of stems/ha) and basal area (m^2/ha) are provided for saplings (<15 cm dbh), and overstory trees 15-23 cm dbh, 23-38 cm dbh, and ≥38 cm dbh.

	Juniperus osteosperma (Utah juniper)		*Pinus edulis* (Two-needle pinyon)		Both species	
Size Class (dbh)	**Density (stems/ha)**	**Basal area (m^2/ha)**	**Density (stems/ha)**	**Basal area (m^2/ha)**	**Density (stems/ha)**	**Basal area (m^2/ha)**
< 15 cm	325.59	1.44	762.12	3.37	1087.71	4.81
≥15 - ≤ 23 cm	111.29	3.16	47.36	1.34	158.65	4.50
≥23- < 38 cm	93.13	6.80	9.79	0.72	102.92	7.52
≥ 38 cm	44.51	7.24	0.53	0.09	45.05	7.32
Overstory (≥ 15 cm)	248.93	17.20	57.69	2.15	306.62	19.34

Table 8. Density and basal area of snags by species and size class in pinyon-juniper habitat in Mesa Verde National Park, 2007. Density (stems/ha) and basal area (m^2/ha) are provided for small snags (<15 cm dbh), and overstory snags (≥15 cm dbh).

	Density (stems/ha)		Basal area (m^2/ha)	
Species	**< 15 cm**	**≥15 cm**	**< 15 cm**	**≥15 cm**
Juniperus osteosperma	5.70	18.87	0.03	1.71
Pinus edulis	31.69	26.35	0.14	2.39
Unknown species	87.61	61.07	0.39	5.55
All snags	125.00	106.30	0.55	9.65

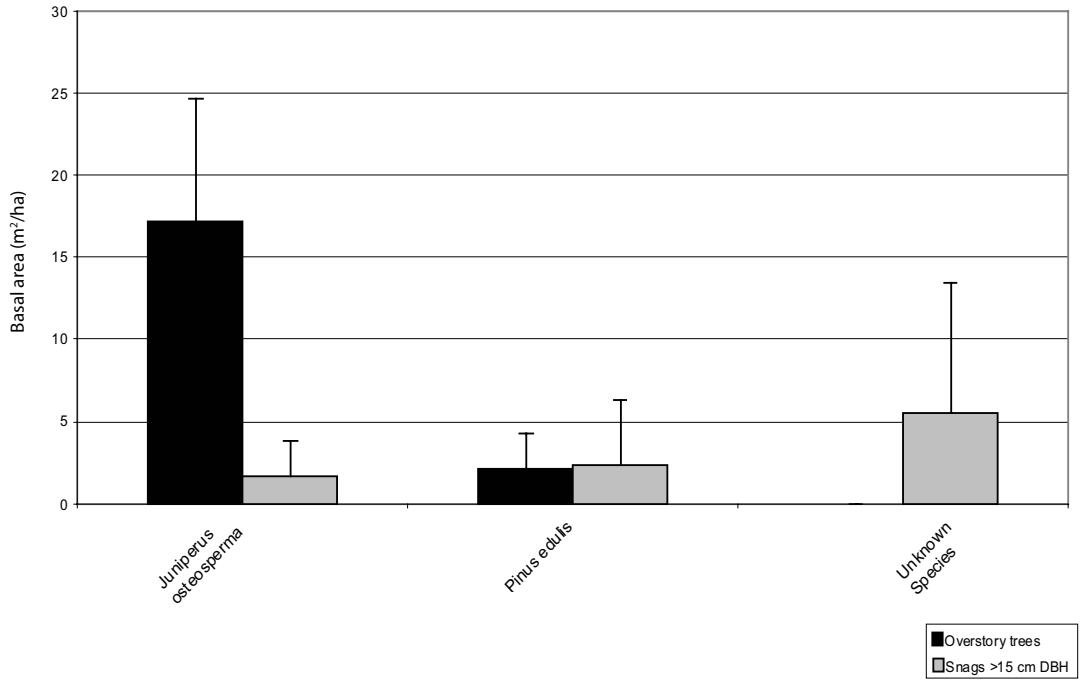

Figure 3. Basal area of overstory trees and snags by species in pinyon-juniper habitat in Mesa Verde National Park, 2007. Overstory trees and snags are ≥15 cm dbh. Error bars represent one standard deviation.

4 Discussion

These data represent the first year baseline sampling for the pinyon-juniper bird community at MEVE. The pinyon-juniper habitat at MEVE has a relatively high density of trees and snags, including older, larger pinyon and juniper trees. The bird community includes several pinyon-juniper obligate species, some of which the Partners in Flight's North American Landbird Conservation Plan (Rich et al. 2004) lists on its watchlist of species of national conservation concern. These include the gray vireo, pinyon jay, Virginia's warbler, and white-throated swift. Seven others are considered Stewardship Species that merit special attention.

We detected the gray vireo on 9.3% of the plots. In Colorado, this species inhabits lightly forested mesas, steep hillsides, canyons, and wide valleys where scattered juniper trees grow spaced apart, and avoids denser areas of pinyon-juniper (Kingery 1998). We detected this species in the more open, less dense pinyon-juniper sites. Threats to gray vireo habitat include clearing of pinyon-juniper woodlands, usually for forage production (Barlow et al. 1999). In addition, introduction of livestock into protected lands may attract cowbirds, a brood parasite known to parasitize gray vireo nests (Barlow et al. 1999). However, the incidence of brood parasitism in the park, and the extent to which it impacts the park's gray vireo population are unknown.

Another Watchlist Species and pinyon obligate, the pinyon jay, was detected at 12.79% of the plots. This species is of particular interest in MEVE because it can play a role in reforestation of burned areas by bringing in pinyon seeds from some distance and planting them (see Balda 2002).

The black-throated gray warbler, the most commonly detected species, also had the highest relative abundance. In Colorado this species almost exclusively occupies mature pinyon-juniper habitats (Kingery 1998). Detections of black-throated gray warblers comprised 16.38% of the total of detections, and they were detected on almost every plot (95.35%).

During our pilot work in pinyon-juniper habitat in MEVE, we were unable to complete sampling during the scheduled field season using the pilot habitat sampling methods. This promted us to modify our sampling techniques. We are currently developing more time-efficient methods.

Our long-range plan is to conduct VCP point counts every three years in order to track changes in bird species abundance, distribution, and habitat metrics over time. Each year's data will be compared to the previously collected data to analyze changes through time in bird species abundance, occurrence, and density (for species with adequate sample size). More thorough trend analyses will be conducted once sufficient data have been collected.

5 Literature cited

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