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Bird Community Monitoring for Petrified Forest National Park

2007 Summary Report

Natural Resource Data Series NPS/SCPN/NRDS—2010/101

ON THE COVER
Brewer's sparrow *(Spizella breweri)*
Photo courtesy of U.S. Fish and Wildlife Service

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November 2010

U.S. Department of the Interior
National Park Service
Natural Resource Program Center
Fort Collins, Colorado

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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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Please cite this publication as:

Holmes, J. A., and M. J. Johnson. 2010. Bird community monitoring for Petrified Forest National Park: 2007 summary report. Natural Resource Data Series NPS/SCPN/NRDS—2010/101. National Park Service, Fort Collins, Colorado.

NPS 110/105974, November 2010

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 Petrified Forest National Park (PEFO), Southern Colorado Plateau Network (SCPN) and park staff selected grassland as an important ecosystem for vegetation and bird community monitoring. This habitat is largely composed of perennial grasses and shrubs, and comprises a large area of the park. The grassland habitat of PEFO's upland bird community faces several threats. Exotic plant species pose a major threat. Climate change has the potential to alter the composition and structure of the grasslands and affect the distribution and abundance of grassland bird species.

In 2007, through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN, we began monitoring the upland bird community of the target grassland habitat in PEFO. 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 PEFO were derived from the maps of two ecological sites developed by the US Natural Resources Conservation Service (NRCS): Clayey Fan, and Sandy Loam ecological sites (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).

We merged the Clayey Fan and Sandy Loam ecological sites into one, henceforth referred to as grassland habitat. To complete the bird community monitoring sampling frame, we modified the map of the sampling frame using Geographical Information System (GIS) technology to eliminate

- areas that were not within the target habitat (roads, buildings, and infrastructure)
- areas near paved roads and the park boundary
- areas with slopes ≥20% to prevent erosion from occurring as a result of the field work (fig. 1)

When monitoring large target habitats, such as PEFO grassland, we employ a cluster sampling method in which bird sample points are clustered around a primary sampling unit so that a cluster of points can be sampled in a single morning. Primary sampling units are selected in a probabilistic manner from a grid of regularly-spaced points using the General-

ized Random-Tessellation Stratified (GRTS) design (Stevens and Olsen 2004). Each of the primary sampling units is associated with a cluster of 10 sampling points. Because of the irregularly shaped ecosites, the clusters were determined by identifying the 9 grid points closest to the initial target point identified by the GRTS design. In cases where 2 points were equally distant, the tie was broken using a random number identifier. For PEFO, park staff first reviewed all of 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 cluster, and rejected clusters that were inaccessible. Inaccessible sites included sites that were over 30-45 minutes walking distance from the nearest accessible road. The bird monitoring crew then assessed each sampling point within the selected clusters to ensure that (1) it fell within the target habitat, (2) had a slope of less than 20%, and (3) did not contain a major disturbance. Any points that did not meet these criteria were rejected. Ten clusters were selected for monitoring and 20 clusters were rejected (fig. 1).

2.2 Field Methods

Bird sampling occurred at permanent sampling points, or Variable Circular Plot (VCP) point count stations within clusters in grassland habitat at PEFO (fig. 1). A total of ten clusters, each containing 10 sampling points, were sampled. Habitat sampling was conducted at these same points. 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 Petrified Forest National Park (PEFO). Dates for VCP point counts conducted at PEFO in 2007, and the number of points sampled.

Survey period	Dates (2007)	Number of clusters	Number VCP point counts
1	5/14 - 5/17	10	100
2	6/3 - 6/6	10	100
3	6/21 - 6/29	10	100

At each sampling point, we conducted a VCP point count, noting all birds seen or heard during during an eight-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 clusters of sampling points.

Habitat sampling was conducted on a 50-m-radius macroplot centered on a sampling point within a cluster, 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) for the four subplots. 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 habitat (grassland) at PEFO. The sample unit for bird data is the cluster (which contains 10 VCP sampling points).

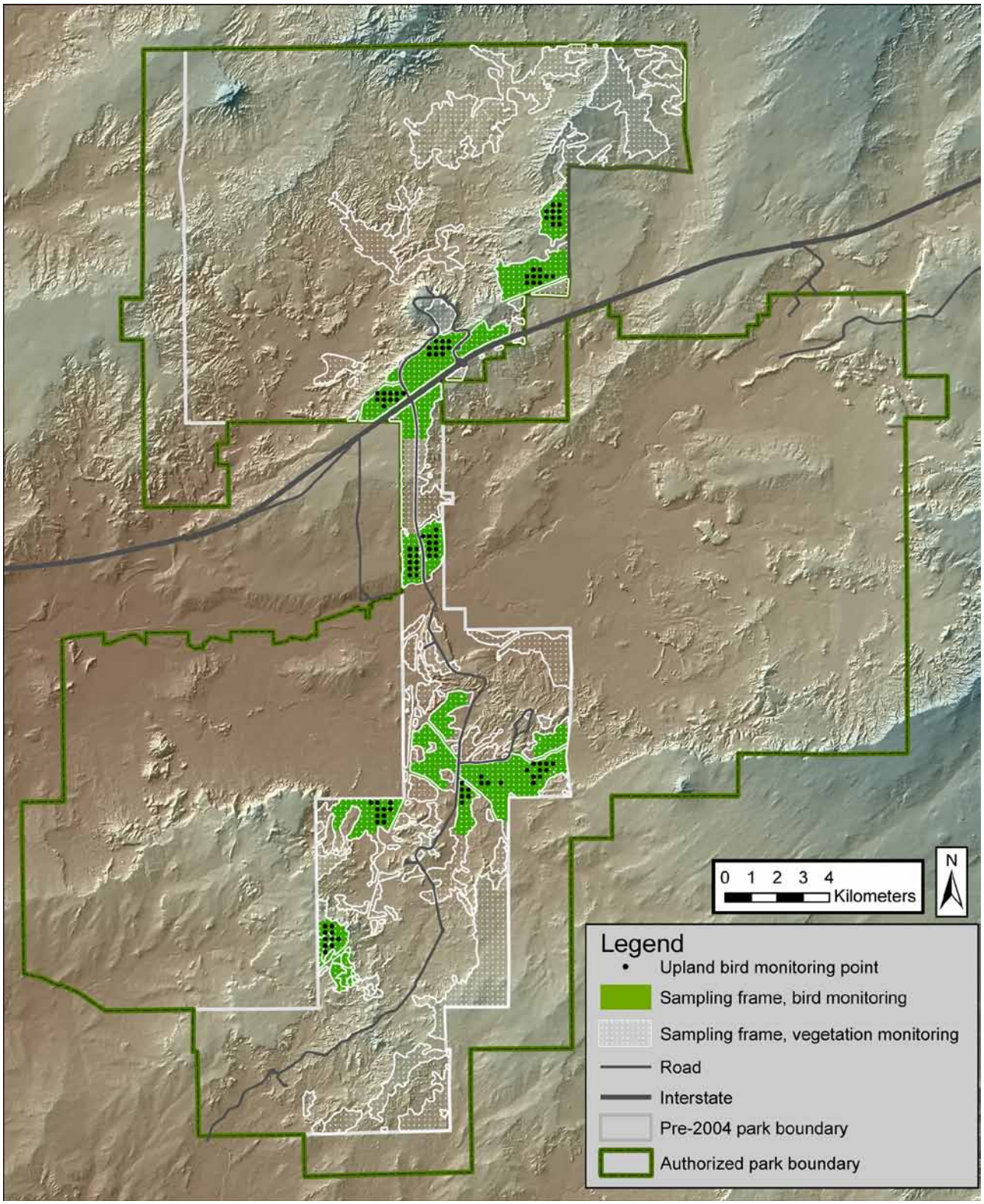

Figure 1. Bird monitoring sampling frame of grassland habitat at Petrified Forest National Park with the 10 clusters of 10 bird and habitat sampling plots and upland vegetation monitoring sampling frame.

- *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 individuals detected per eight-minute VCP point count. To calculate mean number of individuals detected for each species, the data for a given cluster are averaged across the three survey periods, and a mean number of individuals detected and standard deviation are calculated. Then the cluster means are used to calculate the mean number of individuals detected and associated standard deviation 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 first calculated the proportion of plots occupied in each cluster. For example, if an eastern meadowlark was detected on two of the ten plots in a cluster, during any or all of the three visits to that plot, the proportion of plots occupied in that cluster is 0.20 (20%). We then calculate the mean proportion of plots occupied across the ten clusters for the target habitat.

2.3.2 Habitat Data

Habitat data will be used with bird sampling data to examine bird habitat relationships. For PEFO, 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 three levels: the macroplot, the cluster, and the target habitat. The means and standard deviations for the cluster were calculated from the macroplot data. The means and standard deviations for the target habitat were calculated from the cluster data.

Table 2. Cover types in grassland habitat at Petrified Forest National Park.

Vegetation or other cover type	Description
Grassland: Clayey Fan	Vegetation includes mix of low shrubs and grass. Typically mound saltbush (*Atriplex obvata*) and alkali sacaton (*Sporobolus airodies)* dominate, with blue grama (*Bouteluoa gracilis*), galleta grass (*Pleuraphis jamesii*), four-wing saltbush (*Atriplex canescens*), and shadcale (*Atriplex confertifolia*) also present.
Grassland: Sandy Loam Upland	Complex of ecosites which occurs over gently rolling topology in the park. Sandier areas occur on slight hills or ridges, and contain a mix of shrubs and grasses. Four-wing saltbush, sandsage (*Artemisia filifolia*), blue grama, galleta grass, muhly (*Muhlenbergia* spp), and various *Sporobolus* spp are typically present. In the low areas, soils have more clay (often showing typical 'shrink-swell' crack lines), and there is more variation in plant species. Sometimes expressed as a wide, shallow valley consisting of a virtual monoculture of alkalai sacaton, with little to no shrubs. Can also be a mix of grass and shrubs, with galleta grass and four-wing saltbush as the dominants.
Barren: Claysprings Soils	These areas have highly cracked soil surfaces and are barren of vegetation, or contain only small annual species. They are highly clayey, so may have standing pools of water or show evidence of flooding.
Grassland: Sheppard Soils	These areas look like dunes or small hillocks. The soils are deep and very sandy. Shrubs are noticeably taller and more diverse, generally some sandsage and four-wing salt-bush and/or shadscale, with little to no mound saltbush. Grasses on these sites are usually more diverse than on the Clayey Fan ecosites, and often include spike dropseed (*Sporobolus contractus*).
Roads	Paved or unpaved roads.
Dry Arroyo	Dry wash with little or no grass or shrubs.

- *Vegetation cover types*. For PEFO, we classified six vegetation cover and other land-use cover types as shown in Table 2. For each cover type, we calculated
  - mean percent cover by calculating the mean cover per cluster for each vegetation or other cover type (using the cover class midpoints), and then calculating the mean of the cluster means to determine the mean 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 for the cluster. The mean and standard deviation were then calculated for the target habitat.

3 Results

3.1 Summary of Bird Community Data

In 2007, we conducted a total of 300 VCP point counts in grassland habitat at PEFO (table 1). During the 2007 surveys, we detected 3,025 individuals of 23 species (table 3). The most commonly detected species was the horned lark, which comprised 52.96% of the total number of individuals detected.

The number of species detected at each cluster, during each of three survey periods, and the total number of species detected at each cluster in 2007 are shown in Figure 2. No clear pattern emerged for the number of species detected per survey period. Four clusters had the highest number of species detected during the first survey period; two clusters during the second survey period; and four clusters had the highest number during the third survey. The total number of species detected at a cluster was always higher than the number of species in any given survey period, indicating that some unique species were detected during specific survey periods. The mean observed (i.e., unadjusted for detectability) bird species richness per cluster, across all three surveys, was 13.20 (n=10, SE=0.68).

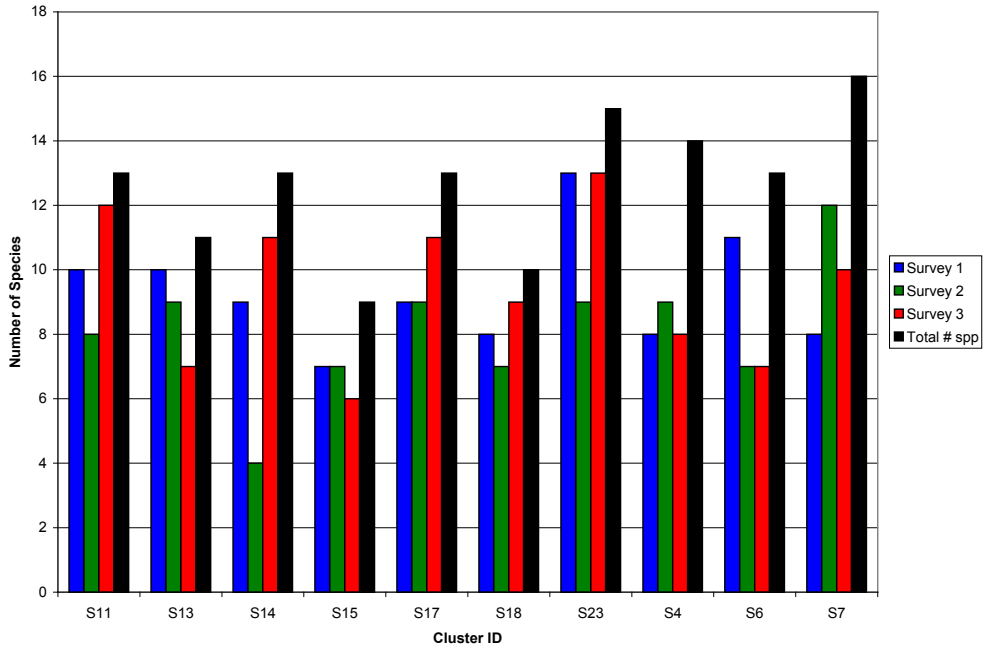

Figure 2. Number of bird species detected in grassland habitat at Petrified Forest National Park (PEFO). The number of species detected at each cluster, during each of three survey periods, and the total number of species detected at each cluster in PEFO grassland habitat in 2007.

Table 3. Bird species and number detected during VCP point counts in grassland habitat at Petrified Forest National Park (PEFO). Data are from VCP point counts conducted at PEFO in 2007. 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 (%)
Horned lark	*Eremophila alpestris*	1602	52.96
Black-throated sparrow	*Amphispiza bilineata*	367	12.13
Brewer's sparrow	*Spizella breweri*	230	7.60
Scaled quail	*Callipepla squamata*	156	5.16
Eastern meadowlark	*Sturnella magna*	119	3.93
Common raven	*Corvus corax*	116	3.83
Mourning dove	*Zenaida macroura*	105	3.47
Western meadowlark	*Sturnella neglecta*	97	3.21
Cassin's sparrow	*Aimophila cassinii*	70	2.31
Northern mockingbird	*Mimus polyglottos*	60	1.98
Brown-headed cowbird	*Molothrus ater*	32	1.06
Say's phoebe	*Sayornis saya*	23	0.76
Rock wren	*Salpinctes obsoletus*	10	0.33
Black-chinned hummingbird	*Archilochus alexandri*	9	0.30
Lark sparrow	*Chondestes grammacus*	6	0.20
Violet-green swallow	*Tachycineta thalassina*	5	0.17
Loggerhead shrike	*Lanius ludovicianus*	5	0.17
Western kingbird	*Tyrannus verticalis*	4	0.13
American kestrel	*Falco sparverius*	3	0.10
Cassin's kingbird	*Tyrannus vociferans*	2	0.07
Bendire's thrasher	*Toxostoma bendirei*	2	0.07
Turkey vulture	*Cathartes aura*	1	0.03
Northern harrier	*Circus cyaneus*	1	0.03

The mean number of individuals detected per species during a VCP point count, and the mean frequency of plots with detections (averaged across the frequency for each sampling cluster), for each species detected in PEFO grassland habitat are presented in Table 4. The horned lark had the highest mean number of individuals, with an average of 5.34 individuals detected during an eight-minute point count. Horned larks were also found at every plot. The brown-headed cowbird had a relatively low abundance (0.11 individuals/point count), but was fairly widely distributed, and detected on an average of 35.7% of the plots in a cluster (table 4).

3.2 Summary of Bird Habitat Data

We found six vegetation and other cover types in the macroplots (0.8 ha circular plots centered on each bird sampling point) in the PEFO sampling area: Grassland Sandy Loam Upland, Clayey Fan, Sheppard Soils, Barren Claysprings Soils, Roads, and Dry Arroyo (table 5). Using GIS and the park's soil map layer, we compared the frequency of vegetation cover types, calculated as the proportion of the macroplots in which the vegetation occurred (as observed in the field), with the proportion of macroplots "remotely" classified as one of two ecological sites: Sandy Loam Upland or Clayey Fan. One macroplot was on the border of two ecological site types and was classified as "border of ecosites" (see table 5). The frequency of the Grassland: Clayey Fan vegetation type corresponds fairly

Table 4. Mean number of individuals detected per VCP point count, mean frequency of occupied plots, and proportions of clusters occupied in grassland habitat at Petrified Forest National Park (PEFO). Mean number of individuals detected per VCP point count (averaged across sampling clusters), mean frequency (%) of occupied plots per cluster, averaged across 10 clusters, and proportion (%) of clusters occupied in grassland habitat at PEFO in 2007.

Species	Mean # of individuals	SD	Mean frequency occupied plots (%)	% Clusters occupied
Horned lark	5.34	1.49	100.00	100.00
Black-throated sparrow	1.22	0.94	79.00	90.00
Brewer's sparrow	0.77	0.60	74.00	100.00
Scaled quail	0.52	0.40	73.00	100.00
Eastern meadowlark	0.40	0.40	57.00	80.00
Common raven	0.39	0.28	56.00	100.00
Mourning dove	0.35	0.16	60.00	100.00
Western meadowlark	0.32	0.43	53.80	80.00
Cassin's sparrow	0.23	0.54	23.00	60.00
Northern mockingbird	0.20	0.19	41.00	90.00
Brown-headed cowbird	0.11	0.13	35.70	70.00
Say's phoebe	0.08	0.12	12.00	40.00
Black-chinned hummingbird	0.03	0.04	9.00	50.00
Rock wren	0.03	0.06	25.00	40.00
Lark sparrow	0.02	0.04	5.00	30.00
Loggerhead shrike	0.02	0.02	5.00	50.00
Violet-green swallow	0.02	0.05	2.00	10.00
American kestrel	0.01	0.03	2.00	10.00
Bendire's thrasher	0.01	0.02	2.00	10.00
Cassin's kingbird	0.01	0.01	2.00	20.00
Western kingbird	0.01	0.03	3.00	20.00
Northern harrier	0.00	0.01	1.00	10.00
Turkey vulture	0.00	0.01	1.00	10.00

Table 5. Mean frequency per cluster and proportion of sites classified as each vegetation type using GIS, in target grassland habitat in Petrified Forest National Park in 2007.

Vegetation or other cover type	Frequency (%)	Proportion classified using GIS
Grassland: Sandy Loam Upland	80	68*
Grassland: Clayey Fan	29	31
Barren: Claysprings Soils	21	-
Grassland: Sheppard Soils	15	-
Roads	1	-
Dry arroyo	6	-
Border of ecosites**	-	1

*Includes one macroplot clearly within the Sandy Loam Upland ecological site type, but within 50 m of a border.

**Not clearly within either of the two ecological site types, in the border between two clearly defined ecological sites.

Table 6. Foliar cover of functional groups in target grassland habitat in Petrified Forest National Park in 2007.

	Foliar cover (%)		
Functional groups	**Mean foliar cover**	**SD**	**Range**
Total foliar cover	39.45	13.37	21.00-62.63
Perennial grasses, graminoids	19.52	6.22	12.60-27.40
Annual grasses	0.38	0.46	0.01-1.20
Forbs	1.58	0.57	0.90-2.26
Shrubs*	11.69	5.26	4.76-20.84
Understory trees (< 1.4 m height)	-	-	-
Standing dead herbaceous	0.52	0.29	0.30-1.05
Standing dead woody	0.86	0.92	0.31-2.69

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

closely to the proportion of plots that were remotely classified as belonging to the Clayey Fan ecological site (29 plots compared to 31 plots). Grassland: Sandy Loam Upland is the most common type under both methods for classifying plots, but is more commonly recorded during field observations than indicated from the GIS-based ecological site classification.

The grassland habitat at PEFO was dominated by grasses (table 6). Perennial grasses and graminoids had an average foliar cover of 19.52%, while shrubs, on average, provided 11.69% foliar cover. The most common shrubs in the plots were *Gutierrezia sarothrae* (broom snakeweed) and *Atriplex canescens* (four-wing saltbush), each occurring on 24% of the plots, and *Artemisia filifolia* (sand sage) on 12% of the plots.

4 Discussion

These data represent the first year baseline sampling for the grassland bird community at PEFO. The grassland habitat at PEFO had a variable density of shrubs, and the bird community was comprised of species typically found in the region's grasslands and shrublands. The horned lark, a grassland associate, was the most commonly detected species, comprising more than 52% of the total detections. Horned larks generally travel in pairs or small groups that are easily detected during surveys, which, at least partially, explains the high number of detections for this species. The black-throated sparrow was the second most commonly detected species. It is widely distributed throughout Arizona in shrubland and grassland habitats, and we confirmed breeding (we found active nests) within the park.

Brewer's sparrows were also common nesters in PEFO grasslands with scattered shrubs. Partners in Flight's North American Landbird Conservation Plan (Rich et al. 2004) lists the Brewer's sparrow on its watchlist of species of national conservation concern, and the Arizona Bird Conservation Plan (Latta et al. 1999) also considers it a high priority for conservation. The Brewer's sparrow belongs to a group of species that are most typical of undisturbed shrubsteppe and appear to be especially sensitive to the negative effects of habitat fragmentation (Rotenberry 1998). The species appears to have undergone significant declines throughout its range during the 30-year period of the Breeding

Bird Survey (Rotenberry et al. 1999). They are thought to be common nesters in appropriate habitat in Arizona, during wet or normal precipitation years, but they can be nearly absent when winter and spring precipitation is low (Corman and Wise-Gervais 2005). Our nest records for PEFO represent some of the most southerly breeding records for the species to date (see Rotenberry et al. 1999, Corman and Wise-Gervais 2005). Further monitoring should provide insight into the relationship between precipitation and Brewer's sparrow distribution and abundance.

Another species of note was the Cassin's sparrow. In Arizona, most Cassin's sparrows breed in southeastern Arizona's grasslands. Atlasers for the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005) found Cassin's sparrows in only one location north of the Mogollon Rim, in grasslands east of Saint Johns, but they were a common species during our 2007 surveys at PEFO. This species is known to have strong annual fluctuations in numbers and range, although the reasons for these fluctuations are unknown (Dunning et al. 1999).

Monitoring can provide information about the abundance and distribution of the brown-headed cowbird, a brood parasite that can impact songbird breeding productivity. While this species was detected in relatively low numbers, it was fairly widely distributed in the park. Its impact may be greater than that indicated by its abundance, as one female cowbird may lay up to 40 eggs in a season (Lowther 1993).

Our long-range plan is to conduct VCP point counts every three years 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.

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