



# Bird Community Monitoring for Petrified Forest National Park

## *2012 Summary Report*

Natural Resource Data Series NPS/SCPN/NRDS—2014/624



**ON THE COVER**

Horned lark (*Eremophila alpestris*)

Photograph courtesy of Kenneth Cole Schneider

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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 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, including climate change and the invasion of nonnative species. These threats can potentially alter the composition and structure of the grasslands and affect the distribution and abundance of grassland bird species.

In 2012, through a Colorado Plateau Cooperative Ecosystems Study Unit agreement with SCPN, we continued monitoring the upland bird community of the target grassland habitat in PEFO, which had been monitored in 2007 and 2009. In this report, we document monitoring activities in the 2012 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 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 grassland were derived from the maps of the Clayey Fan and Sandy Loam ecological sites (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). We merged the 2 ecological sites into one, henceforth referred to as grassland habitat (Figure 1).

To complete the grassland bird community monitoring sampling frame in the initial year of monitoring (2007), 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  $\geq 20\%$  to prevent erosion from occurring as a result of the field work

When monitoring in large target habitats, such as PEFO grassland, we employ a cluster sampling method in which bird sample plots are clustered around a primary sampling unit, so that a cluster of plots can be sampled in a single morning. Primary sampling units are selected in a probabilistic manner from a grid of uniformly-spaced points using a Generalized Random-Tessellation Stratified (GRTS) design (Stevens and Olsen 2004).

PEFO 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 cluster in the field and rejected clusters that were inaccessible. For PEFO grassland, sites were deemed inaccessible if they required greater than 2 hours traveling time (by car and foot) from park headquarters.

The bird monitoring crew then visited and assessed each sampling plot 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 plots that did not meet these criteria were rejected. Ten clusters were selected for monitoring and 20 clusters were rejected.

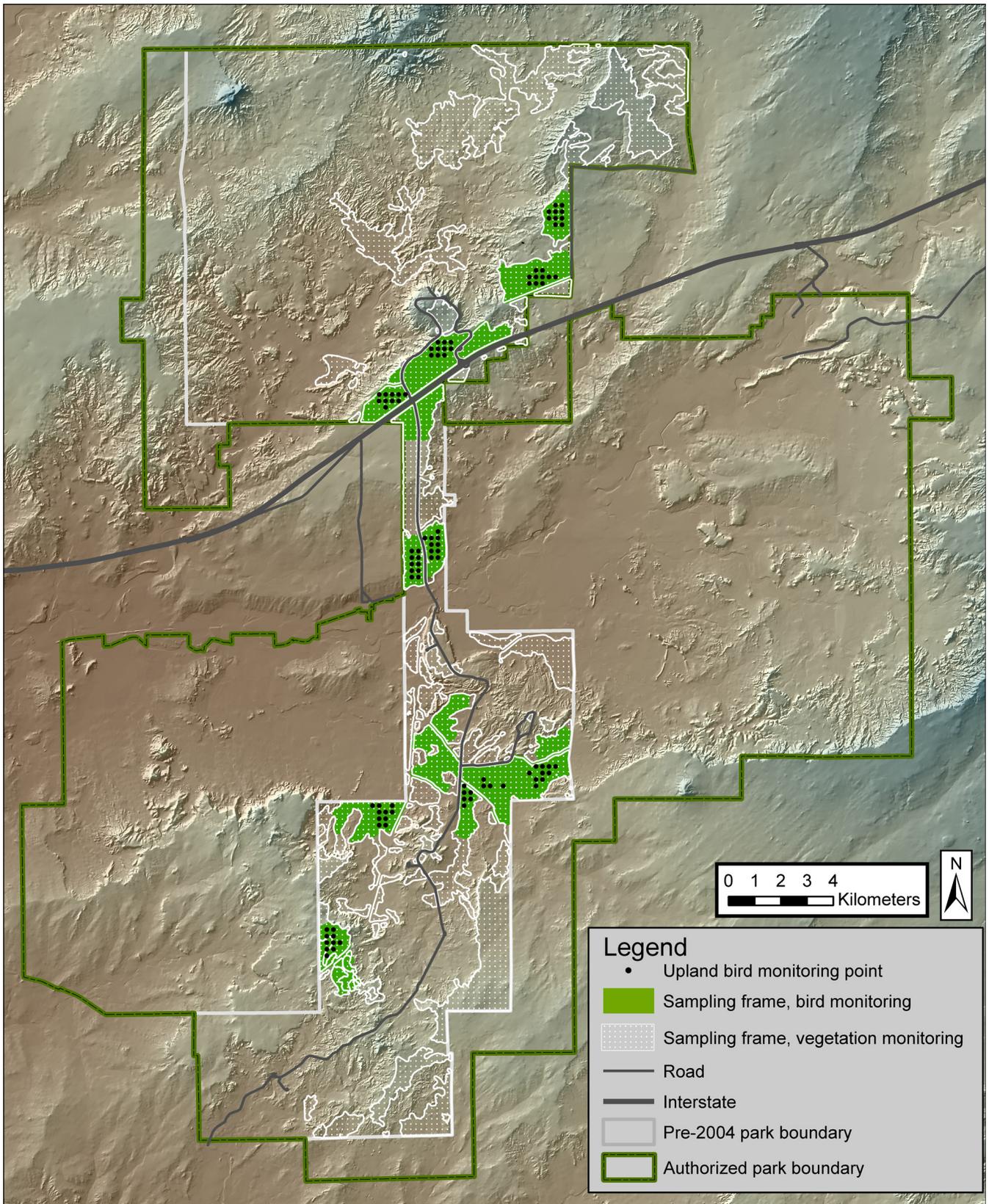


Figure 1. Bird monitoring sampling frame for grassland habitat, and upland vegetation monitoring sampling frame in Petrified Forest NP.

## 2.2 Field methods

We conducted bird sampling at permanent sampling plots, or Variable Circular Plots (VCP), within grassland habitat at PEFO over 2 survey periods. We sampled a total of 10 clusters, each containing 10 sampling plots (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).

**Table 1. Survey periods, dates, and sampling effort (number of clusters and plots) for grassland bird community monitoring at Petrified Forest NP in 2012.**

Survey period	Dates (2012)	Number of clusters	Number of VCP counts
1	8 May–15 May	10	100
2	5 June–9 June	10	100

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, 2 technicians surveying separate groups of sampling plots conducted approximately 10 VCP counts each.

Habitat sampling was conducted on a 50 m radius macroplot centered on a sampling plot, and in 4 subplots within the macroplot. First, for the macroplot, we estimated and recorded the area occupied by vegetation types and other land-use types. Then, in the 4 subplots, we recorded foliar vegetation cover by functional group (e.g., forbs, shrubs). 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 all sample units in the target habitat (grassland) at PEFO. The sample unit for bird data is the cluster (which contains 10 VCPs).

- 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, the data for a given cluster are averaged across the 2 survey periods, and a mean number of individuals detected per VCP count and standard deviation are calculated. Then the cluster means are used to calculate the mean number of individuals detected and standard deviation 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 or clusters in which each species was detected. To calculate species frequency, we first calculated the proportion of plots in each cluster in which the species was detected. For example, if black-throated sparrows were detected on 2 of the 10 plots in a cluster, (during one or both visits to that plot), the plot frequency for that cluster would be 0.20 (20%). We then calculate the mean proportion of plots occupied across the 10 clusters for the target habitat. Cluster frequency is calculated as the proportion of clusters in which the species was detected in at least one plot.

### 2.3.2 Habitat data

For PEFO, habitat data were collected within a circular 0.8 ha macroplot which contained 4 subplots and was centered on each bird sampling plot. Data were summarized at 3 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.

- *Vegetation cover types.* We classified vegetation into 4 cover types for PEFO grassland habitat, and 1 other non-vegetation landcover type, 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 landcover 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 calculating the number of macroplots within a cluster where a specific cover type had been recorded (as a proportion of the 10 macroplots per cluster), then calculating the mean and standard deviation of the proportion of macroplots per cluster for the target habitat
- *Foliar cover of functional groups.* We calculated the mean foliar cover of each functional group for the macroplot (using the cover class midpoints), and for the cluster. The mean and standard deviation were then calculated for the target habitat.

**Table 2. Vegetation cover types and other landcover types in grassland habitat at Petrified Forest NP.**

Cover type	Description
Clayey fan	Vegetation includes mix of low shrubs and grass. Typically mound saltbush ( <i>Atriplex obvata</i> ) and alkali sacaton ( <i>Sporobolus airoides</i> ) dominate, with blue grama ( <i>Bouteloua gracilis</i> ), galleta grass ( <i>Pleuraphis jamesii</i> ), four-wing saltbush ( <i>Atriplex canescens</i> ), and shadscale ( <i>Atriplex confertifolia</i> ) also present.
Sandy loam upland	This complex of ecosites occurs over gently rolling topography in the park. Sandier areas occur on slight hills or ridges, and contain a mix of shrubs and grasses. Four-wing saltbush, sandsage ( <i>Artemisia filifolia</i> ), blue grama, galleta grass, muhly ( <i>Muhlenbergia</i> spp.), and various <i>Sporobolus</i> 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. This type is sometimes expressed as a wide, shallow valley consisting of a virtual monoculture of alkali sacaton, with little to no shrubs. It can also be a mix of grass and shrubs, with galleta grass and four-wing saltbush as the dominants.
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 saltbush and/or shadscale, with little to no mound saltbush. Grasses on these sites are usually more diverse than on the Clayey Fan ecosite, and often include spike dropseed ( <i>Sporobolus contractus</i> ).
Claysprings soils	These areas have highly cracked soil surfaces and are barren of vegetation, or contain only small annual species. They are highly clayey and may have standing pools of water or show evidence of flooding.
Dry arroyo	Dry wash with little or no grass or shrubs.

## 3 Results

### 3.1 Summary of bird community data

In 2012, we conducted a total of 300 VCP counts in grassland habitat at PEFO and detected 1,322 individuals of 27 species (Table 3). The most commonly detected species were the horned lark and the black-throated sparrow, which together comprised 76.18% of the total number of individuals detected.

**Table 3. Bird species and number detected during VCP counts in grassland habitat at Petrified Forest NP, 2012. 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	<i>Eremophila alpestris</i>	731	55.30
black-throated sparrow	<i>Amphispiza bilineata</i>	276	20.88
eastern meadowlark	<i>Sturnella magna</i>	49	3.71
common raven	<i>Corvus corax</i>	44	3.33
mourning dove	<i>Zenaida macroura</i>	42	3.18
western meadowlark	<i>Sturnella neglecta</i>	41	3.10
Brewer's sparrow	<i>Spizella breweri</i>	37	2.80
loggerhead shrike	<i>Lanius ludovicianus</i>	24	1.82
northern mockingbird	<i>Mimus polyglottos</i>	13	0.98
violet-green swallow	<i>Tachycineta thalassina</i>	12	0.91
black-chinned hummingbird	<i>Archilochus alexandri</i>	8	0.61
Cassin's sparrow	<i>Aimophila cassinii</i>	8	0.61
Say's phoebe	<i>Sayornis saya</i>	6	0.45
white-throated swift	<i>Aeronautes saxatalis</i>	4	0.30
cliff swallow	<i>Petrochelidon pyrrhonota</i>	3	0.23
lark sparrow	<i>Chondestes grammacus</i>	3	0.23
rock wren	<i>Salpinctes obsoletus</i>	3	0.23
turkey vulture	<i>Cathartes aura</i>	3	0.23
vesper sparrow	<i>Pooecetes gramineus</i>	3	0.23
American kestrel	<i>Falco sparverius</i>	2	0.15
ash-throated flycatcher	<i>Myiarchus cinerascens</i>	2	0.15
common nighthawk	<i>Chordeiles minor</i>	2	0.15
scaled quail	<i>Callipepla squamata</i>	2	0.15
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	1	0.08
prairie falcon	<i>Falco mexicanus</i>	1	0.08
western kingbird	<i>Tyrannus verticalis</i>	1	0.08
yellow-headed blackbird	<i>Xanthocephalus xanthocephalus</i>	1	0.08

The mean number of individuals detected per species during a VCP count, the frequency of detections, and the percent of clusters with detections for each species detected in PEFO grassland habitat are presented in Table 4. The horned lark and black-throated sparrow have the highest mean number of individuals, with an average of 3.66 and 1.38 individuals detected, respectively, during an 8-minute count. Both species were also widespread in the target habitat—detected on 100% of the plots. Other species that were relatively common in the target habitat include eastern meadowlark, common raven, mourning dove, western meadowlark, and Brewer's sparrow.

**Table 4. Mean number and standard deviation (SD) of individuals detected per species per VCP count, plot frequency, and cluster frequency (% of clusters in which the species was detected) in grassland habitat at Petrified Forest NP, 2012.**

Species	Number of individuals		Plot frequency (%)	Cluster frequency (%)
	Mean	SD		
horned lark	3.66	1.41	100.00	100.00
black-throated sparrow	1.38	0.97	80.00	100.00
eastern meadowlark	0.25	0.33	36.00	90.00
common raven	0.22	0.18	31.00	100.00
mourning dove	0.21	0.32	22.00	50.00
western meadowlark	0.21	0.29	30.00	60.00
Brewer's sparrow	0.19	0.15	27.00	80.00
loggerhead shrike	0.12	0.18	13.00	70.00
northern mockingbird	0.07	0.10	12.00	40.00
violet-green swallow	0.06	0.08	8.00	50.00
black-chinned hummingbird	0.04	0.05	8.00	50.00
Cassin's sparrow	0.04	0.09	5.00	30.00
Say's phoebe	0.03	0.05	6.00	40.00
white-throated swift	0.02	0.05	3.00	20.00
cliff swallow	0.02	0.05	1.00	10.00
lark sparrow	0.02	0.03	3.00	20.00
rock wren	0.02	0.03	3.00	20.00
turkey vulture	0.02	0.03	2.00	20.00
vesper sparrow	0.02	0.03	3.00	20.00
American kestrel	0.01	0.02	2.00	20.00
ash-throated flycatcher	0.01	0.03	2.00	10.00
common nighthawk	0.01	0.03	2.00	10.00
scaled quail	0.01	0.02	2.00	20.00
broad-tailed hummingbird	0.01	0.02	1.00	10.00
prairie falcon	0.01	0.02	1.00	10.00
western kingbird	0.01	0.02	1.00	10.00
yellow-headed blackbird	0.01	0.02	1.00	10.00

### 3.2 Summary of bird habitat data

We found 4 vegetation cover types (sandy loam upland, clayey fan, Sheppard soils, and clayspring soils) and one other cover type (dry arroyo) in the PEFO sampling area (Table 5). When we calculated the mean percent cover for each vegetation type, sandy loam upland was the most common cover type, accounting for, on average, 65.80% of the overall vegetative cover of the macroplots.

Looking at functional groups, the grassland habitat at PEFO had, on average, total shrub and herbaceous cover of 8.21%. There was considerable variation in the amount of shrub cover and perennial grass cover, ranging from 1.26% to 5.49%, and from 1.68% to 7.39%, respectively (Table 6).

**Table 5. Mean cover, standard deviation (SD), and range of cover for vegetation and other landcover types, as well as mean frequency within macroplots in a cluster in target grassland habitat in Petrified Forest NP, 2012.**

Cover type	Cover (%)			Frequency (%)
	Mean	SD	Range	
Sandy loam upland	65.80	35.14	0.00–87.50	76.00
Clayey fan	18.91	31.78	0.00–82.50	24.00
Sheppard soils	2.97	5.30	0.00–15.00	12.00
Dry arroyo	0.49	1.20	0.00–3.75	4.00
Clayspring soils	0.03	0.09	0.00–0.30	1.00

**Table 6. Mean foliar cover, standard deviation (SD), and range of cover for functional groups in target grassland habitat in Petrified Forest NP, 2012.**

Functional groups	Foliar cover (%)		
	Mean	SD	Range
Total shrub and herbaceous cover (no trees)	8.21	3.07	3.43–14.41
Perennial grasses, graminoids	3.80	1.57	1.68–7.39
Annual grasses	0.02	0.03	0.00–0.08
Forbs	1.01	0.52	0.31–1.70
Shrubs, dwarf shrubs and woody vines	3.26	1.36	1.26–5.49
Cacti, succulents	0.19	0.14	0.03–0.43
Standing dead herbaceous	6.47	1.33	4.46–7.99
Woody standing dead	2.14	1.01	0.80–3.84

## 4 Discussion

These data represent the third year of sampling for the grassland bird community at PEFO. Grassland birds are among the nation's fastest declining species (North American Bird Conservation Initiative, U.S. Committee 2011). Many of PEFO's most common grassland species, including the horned lark, and 4 others, eastern meadowlark, loggerhead shrike, black-throated sparrow, and lark sparrow, are among the 20 common bird species with the greatest population declines since 1967 (Audubon.org 2007, Butcher and Niven 2007). Additional species of conservation concern are the scaled quail and Brewer's sparrow, which are included on the Yellow WatchList of declining species, part of the United States WatchList of Birds of Conservation Concern (Butcher et al. 2007).

Our long-range plan for grassland bird community monitoring in PEFO is to conduct VCP counts every 3 years 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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