



# Bird Community Monitoring for Wupatki National Monument

## *2008 Summary Report*

Natural Resource Data Series NPS/SCPN/NRDS—2012/330



**ON THE COVER**  
Loggerhead shrike  
Photo courtesy of U.S. Fish and Wildlife Service

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June 2012

U.S. Department of the Interior

National Park Service

Natural Resource Stewardship and Science

Fort Collins, Colorado

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

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

Please cite this publication as:

Holmes, J. A., and M. J. Johnson. 2012. Bird community monitoring for Wupatki National Monument: 2008 summary report. Natural Resource Data Series NPS/SCPN/NRDS—2012/330. National Park Service, Fort Collins, Colorado.

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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 Wupatki National Monument (WUPA), 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 monument. The grassland habitat of WUPA's upland bird community faces several threats, including climate change and the invasion of nonnative species. These threats have the potential to alter the composition and structure of the grasslands and affect the distribution and abundance of grassland bird species.

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

## 2 Methods

### 2.1 Sampling frame

A sampling frame is the area within which we 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 WUPA were derived from the maps of two ecological sites, Limy Upland and Sandstone Upland, developed by the US Natural Resources Conservation Service (NRCS; 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 two 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

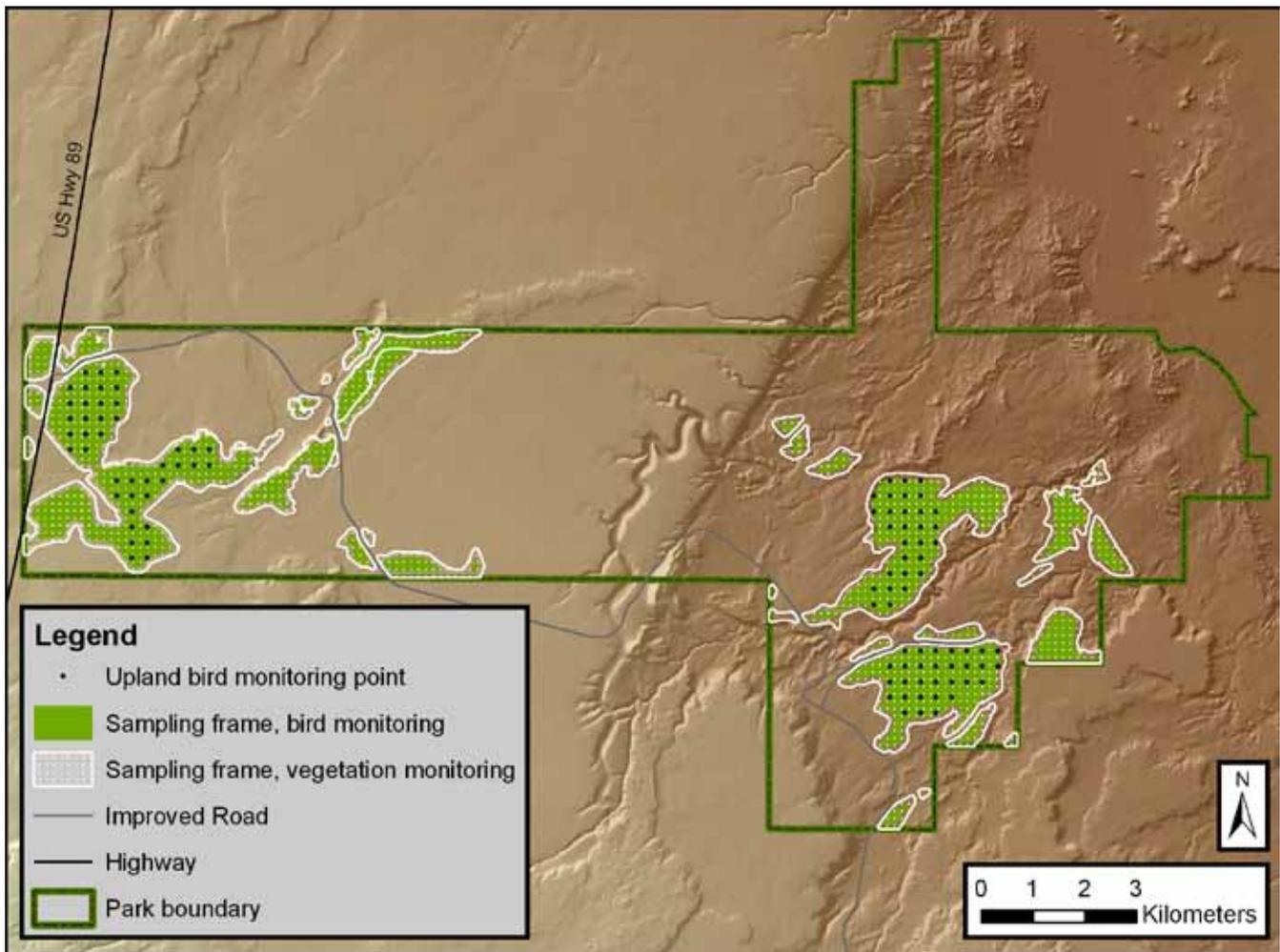
- areas that were not within the target habitat (roads, buildings, and infrastructure)
- areas near paved roads and the monument boundary
- areas with slopes  $\geq 20\%$  to prevent erosion from occurring as a result of the field work

A set of spatially distributed sampling plots, in a simple grid sampling design, was created. WUPA 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 and none were deemed inaccessible. The bird monitoring crew then 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. Three plots on the western edge of the monument were rejected because they were too close to Highway 89, and traffic noise would have interfered with bird sampling. One plot was rejected because it fell close to an inhabited dwelling. One hundred plots were selected for monitoring (fig. 1).

### 2.2 Field methods

Bird sampling was conducted at permanent sampling plots, or Variable Circular Plot (VCP) count stations, in grassland habitat at WUPA (fig. 1). A total of 100 sampling plots 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. (in review).

At each sampling plot, we conducted a VCP count, noting all birds seen or heard during an eight-minute



**Figure 1.** Bird monitoring sampling frame of grassland habitat and upland vegetation monitoring sampling frame in Wupatki N.M.

**Table 1.** Survey periods and sampling effort for bird community monitoring at Wupatki N.M. (WUPA). Dates are for VCP counts conducted at WUPA in 2008, and the number of plots sampled.

Survey period	Dates (2008)	Number VCP counts
1	4/21–5/7	100
2	5/19–5/31	100
3	6/16–6/25	100

sampling period, regardless of the distance from the observer. We recorded the species, method of detection, gender (if known), and distance from the sampling plot center to the individual bird. Distances were measured to the nearest meter using a laser range finder. During a single morning, approximately ten VCP counts each were conducted by one technician.

Habitat sampling was conducted on a 50 m radius macroplot centered on a VCP sampling plot, and in four subplots within the macroplot. First we estimated and recorded the area occupied by vegetation types and other land-use types in the macroplot. Then, we recorded foliar vegetation cover by functional group (e.g. forbs, shrubs), canopy closure, and tree and snag density and basal area for the four subplots. We measured basal area using an angle gauge, and canopy 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

The following data were summarized for the target habitat (grassland) at WUPA. The sample unit for bird data is the VCP count station (plot).

- *Observed species richness* (unadjusted for detectability) is the number of species detected within a given area and specified time.
- *Mean number of individuals detected* for each species is reported as the average number of individuals detected per 8-minute VCP count. To calculate mean number of individuals detected for each species in grassland habitat using a simple grid sampling design, the data for all plots are averaged across the three survey periods, and a mean number of individuals detected and standard deviation are calculated for the target habitat. Detectability-based density estimates are not reported here, but they will be derived for multi-year trend reports.
- *Frequency* is the proportion of plots “occupied” by each species. To calculate species frequency, we calculated the proportion of plots in the target habitat in which the species was detected. For example, if black-throated sparrows were detected on 60 of the 100 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 0.60 (60%).

### 2.3.2 Habitat data

Habitat data will be used with bird sampling data to examine bird habitat relationships. For WUPA, habitat data were collected within a circular 0.8 ha macroplot which contained four subplots and was centered on each bird sampling plot. Data were summarized at two levels: the macroplot and the target habitat. The means and standard deviations for the target habitat were calculated from the macroplot data.

- *Vegetation cover types.* For WUPA, we classified three vegetation cover 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
- *Tree and snag density.* For trees, density was calculated as stems/ha for each species and size class, and for all species within a size class. For snags, density was calculated as stems/ha of snags equal to or greater than 15 cm diameter at breast height (dbh). Mean density was calculated for the macroplot, and then a mean species density and standard deviation were calculated for the target habitat.
- *Basal area.* Tree basal area was calculated as m<sup>2</sup>/ha for each species, and snag basal area was calculated for all snags. Mean basal area was calculated for the macroplot, and then mean basal area and standard deviation were calculated for the target habitat.
- *Foliar cover of functional groups.* The mean foliar cover for each functional group was calculated for the macroplot, using the cover class midpoints. Then the mean and standard deviation were calculated for the target habitat.

**Table 2. Vegetation cover types in grassland habitat at Wupatki N.M.**

Vegetation/cover type	Description
Grassland: Limy Upland	Mix of grass and shrubs. Common shrubs include fourwing saltbush ( <i>Atriplex canescens</i> ), rubber rabbitbrush ( <i>Ericameria nauseosa</i> ), and snakeweed ( <i>Gutierrezia sarothrae</i> ). Dominant grasses are blue grama ( <i>Bouteloua gracilis</i> ) and James' galleta ( <i>Pleuraphis jamesii</i> ).
Sandstone Upland	Variable mix of grass and shrubs. Some sites are dominated by fourwing saltbush, sand sagebrush ( <i>Artemisia filifolia</i> ) and Apache plume ( <i>Fallugia paradoxa</i> ) with bush muhly ( <i>Muhlenbergia porteri</i> ) and James' galleta. Other sites are mainly bare ground (platy red sandstone) with low shrubs usually shadscale saltbush ( <i>Atriplex confertifolia</i> ) and mound saltbush ( <i>Atriplex obovata</i> ).
Rock Outcrop	Steep slopes with exposed sandstone bedrock and minimal vegetation.

## 3 Results

### 3.1 Summary of bird community data

In 2007, we conducted a total of 300 VCP counts in grassland habitat at WUPA (table 1). During the 2008 surveys, we detected 2,368 individuals of 48 species (table 3). The most commonly detected species was the black-throated sparrow, which comprised 20.78% of the total number of individuals detected.

**Table 3.** Bird species and number detected during VCP counts in grassland habitat at Wupatki N.M. (WUPA). Data are from VCP counts conducted at WUPA in 2008. Species are listed in descending order of the total number of individuals detected.

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
black-throated sparrow	<i>Amphispiza bilineata</i>	492	20.78
horned lark	<i>Eremophila alpestris</i>	378	15.96
northern mockingbird	<i>Mimus polyglottos</i>	313	13.22
Brewer's sparrow	<i>Spizella breweri</i>	259	10.94
eastern meadowlark	<i>Sturnella magna</i>	158	6.67
common raven	<i>Corvus corax</i>	95	4.01
pinyon jay	<i>Gymnorhinus cyanocephalus</i>	87	3.67
mourning dove	<i>Zenaida macroura</i>	73	3.08
vesper sparrow	<i>Pooecetes gramineus</i>	66	2.79
chipping sparrow	<i>Spizella passerina</i>	63	2.66
lark sparrow	<i>Chondestes grammacus</i>	58	2.45
loggerhead shrike	<i>Lanius ludovicianus</i>	56	2.36
Say's phoebe	<i>Sayornis saya</i>	27	1.14
house finch	<i>Carpodacus mexicanus</i>	19	0.80
ash-throated flycatcher	<i>Myiarchus tuberculifer</i>	17	0.72
Scott's oriole	<i>Icterus parisorum</i>	17	0.72
violet-green swallow	<i>Tachycineta thalassina</i>	17	0.72
rock wren	<i>Salpinctes obsoletus</i>	15	0.63
yellow-rumped warbler	<i>Dendroica coronada</i>	15	0.63
broad-tailed hummingbird	<i>Selasphorus platycercus</i>	13	0.55
gray flycatcher	<i>Empidonax wrightii</i>	13	0.55
brown-headed cowbird	<i>Molothrus ater</i>	12	0.51
lesser goldfinch	<i>Carduelis psaltria</i>	12	0.51
white-crowned sparrow	<i>Zonotrichia leucophrys</i>	12	0.51
blue-gray gnatcatcher	<i>Polioptila caerulea</i>	11	0.46
Bullock's oriole	<i>Icterus bullockii</i>	8	0.34
crissal thrasher	<i>Toxostoma crissale</i>	8	0.34
western kingbird	<i>Tyrannus verticalis</i>	8	0.34
common nighthawk	<i>Chordeiles minor</i>	6	0.25
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	4	0.17
American kestrel	<i>Falco sparverius</i>	3	0.13
bush tit	<i>Psaltriparus minimus</i>	3	0.13
Cassin's sparrow	<i>Aimophila cassinii</i>	3	0.13
greater roadrunner	<i>Geococcyx californianus</i>	3	0.13
spotted towhee	<i>Pipilo maculatus</i>	3	0.13
western wood-pewee	<i>Contopus sordidulus</i>	3	0.13

**Table 3** *continued*

Common name	Scientific name	Total number of detections	Proportion of all detections (%)
Bendire's thrasher	<i>Toxostoma bendirei</i>	2	0.08
northern harrier	<i>Circus cyaneus</i>	2	0.08
prairie falcon	<i>Falco mexicanus</i>	2	0.08
rufous-crowned sparrow	<i>Aimophila ruficeps</i>	2	0.08
red-tailed hawk	<i>Buteo jamaicensis</i>	2	0.08
western tanager	<i>Piranga ludoviciana</i>	2	0.08
barn swallow	<i>Hirundo rustica</i>	1	0.04
golden eagle	<i>Aquila chrysaetos</i>	1	0.04
house sparrow	<i>Passer domesticus</i>	1	0.04
northern pygmy-owl	<i>Glaucidium gnoma</i>	1	0.04
sharp-shinned hawk	<i>Accipiter striatus</i>	1	0.04
Townsend's solitaire	<i>Myadestes townsendi</i>	1	0.04

The mean number of individuals detected per species during a VCP count, and the frequency of plots with detections for each species detected in WUPA grassland habitat are presented in Table 4. The black-throated sparrow had the highest mean number of individuals, with an average of 1.66 individuals detected during an eight-minute count. They were also widespread in the target habitat—detected in 60.0% of plots. The pinyon jay had a fairly high abundance (0.29 individuals/count), but had a limited distribution—detected on 14.0% of the plots (table 4).

**Table 4.** Mean number of individuals detected per VCP count, standard deviation (SD), and frequency of occupied plots (in which the species was detected) in grassland habitat at Wupatki N.M., 2008.

Species	Mean number of individuals	SD	Frequency of occupied plots (%)
black-throated sparrow	1.66	1.84	60.00
horned lark	1.27	2.27	60.00
northern mockingbird	1.05	1.45	93.00
Brewer's sparrow	0.87	1.99	59.00
eastern meadowlark	0.53	0.97	45.00
common raven	0.32	0.74	48.00
pinyon jay	0.29	2.19	14.00
mourning dove	0.25	0.64	45.00
vesper sparrow	0.22	1.05	17.00
chipping sparrow	0.21	0.60	33.00
lark sparrow	0.20	0.59	26.00
loggerhead shrike	0.19	0.62	32.00
Say's phoebe	0.09	0.31	22.00
house finch	0.06	0.38	9.00
ash-throated flycatcher	0.06	0.28	14.00
Scott's oriole	0.06	0.25	13.00
violet-green swallow	0.06	0.39	10.00
rock wren	0.06	0.39	10.00
yellow-rumped warbler	0.05	0.31	11.00
broad-tailed hummingbird	0.04	0.22	12.00

**Table 4** *continued*

Species	Mean number of individuals	SD	Frequency of occupied plots (%)
gray flycatcher	0.04	0.22	12.00
brown-headed cowbird	0.04	0.32	5.00
lesser goldfinch	0.04	0.33	6.00
white-crowned sparrow	0.04	0.36	5.00
blue-gray gnatcatcher	0.04	0.22	9.00
Bullock's oriole	0.03	0.20	6.00
crissal thrasher	0.03	0.27	4.00
western kingbird	0.03	0.18	7.00
common nighthawk	0.02	0.14	6.00
Brewer's blackbird	0.01	0.18	2.00
American kestrel	0.01	0.10	3.00
bush-tit	0.01	0.17	1.00
Cassin's sparrow	0.01	0.17	1.00
greater roadrunner	0.01	0.10	3.00
spotted towhee	0.01	0.10	3.00
western wood-pewee	0.01	0.13	2.00
Bendire's thrasher	0.01	0.12	1.00
northern harrier	0.01	0.08	2.00
prairie falcon	0.01	0.08	2.00
rufous-crowned sparrow	0.01	0.12	1.00
red-tailed hawk	0.01	0.08	2.00
western tanager	0.01	0.08	2.00
barn swallow	0.00	0.06	1.00
golden eagle	0.00	0.06	1.00
house sparrow	0.00	0.06	1.00
northern pygmy-owl	0.00	0.06	1.00
sharp-shinned hawk	0.00	0.06	1.00
Townsend's solitaire	0.00	0.06	1.00

### 3.2 Summary of bird habitat data

We found three vegetation cover types (sandstone upland, grassland: limy upland, and rock outcrop) and three other cover types (dry arroyo, old road, and historic structures/ruins) in the macroplots (0.8 ha circular plots centered on each bird sampling plot) in the WUPA sampling area (table 5). When we calculated the mean percent cover for each vegetation type, Sandstone Upland was the most common cover type (table 5), accounting for, on average, 50.38% of the overall vegetative cover of the macroplots.

There were few trees in the WUPA grassland—on average, 4.49 oneseed junipers/ha (table 6). The density of snags was 0.06 stems/ha (SD=0.62), and snag basal area was 3.26 m<sup>2</sup>/ha (SD=15.4). The grassland habitat at WUPA had, on average, total foliar cover of 21.05%. There was considerable variability in the amount of shrub cover—it ranged from zero to 31.25%, and perennial grass cover—it ranged from zero to 43.75% (table 7).

## 5 Discussion

These data represent the first year baseline sampling for the grassland bird community at WUPA. The grassland habitat at WUPA had a variable density of shrubs, and the bird community was primarily comprised of species typically found in the region's grasslands and shrublands. The black-throated sparrow, which

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

Vegetation or other cover type	Cover (%)	SD	Range	Frequency (%)
Sandstone upland	50.38	42.84	0.00–87.50	59.00
Grassland: Limy Upland	34.14	42.89	0.00–87.50	39.00
Rock outcrop	1.18	4.54	0.00–37.50	15.00
Dry arroyo	1.01	6.69	0.00–62.50	4.00
Old road	0.35	2.46	0.00–17.50	2.00
Historic structures / ruins	0.18	0.60	0.00–3.00	4.00

**Table 6.** *Juniperus monosperma* density (by size class) and basal area in grassland habitat in Wupatki N.M., 2008. Mean density (number of stems/ha) of *Juniperus monosperma* is provided for saplings (<15 cm drc), and overstory trees 15 to <23 cm drc, 23 to <38 cm drc, and ≥38 cm drc. The basal area (m<sup>2</sup>/ha) estimate includes all size classes.

	Size class (drc)	Density (stems/ha)		Basal area (m <sup>2</sup> /ha)	
		Mean	SD	Mean	SD
<b><i>Juniperus monosperma</i></b>					
Sapling trees	<15 cm	0	-	--	
Overstory trees	15 to <23 cm	1.25	8.21	--	
	23 to <38 cm	1.74	11.35	--	
	≥38 cm	1.50	5.95	--	
All trees	Total overstory	4.49	18.54	44.58	83.52

**Table 7.** Foliar cover of functional groups in target grassland habitat in Wupatki N.M., 2008.

Functional groups	Mean foliar cover (%)	SD	Range
Total foliar cover	21.05	10.51	2.38–43.75
perennial grasses, graminoids	12.38	12.33	0.00–43.75
annual grasses	-	-	-
forbs	0.65	0.62	0.00–4.00
shrubs	7.90	7.38	0.00–31.25
understory trees (<1.4 m height)	0.32	1.87	0.00–15.63
Standing dead herbaceous	0.93	0.99	0.00–4.13
Standing dead woody	1.85	1.96	0.00–10.00

prefers semi-open habitat with evenly spaced shrubs and trees (Johnson et al. 2002), was the most commonly detected species, comprising 20% of the total detections, on 60% of the plots. WUPA grassland habitat also had a variable density of juniper trees (*Juniperus monosperma*), along with a considerable amount of pinyon-juniper woodlands in the landscape adjacent to the monument. Many of the bird species we detected, including pinyon jay, Scott’s oriole, and gray flycatcher, are typically associated with pinyon-juniper habitats. Other species, such as western tanager, western wood-pewee, and Townsend’s solitaire, were likely migrating through the monument and not breeding there.

The WUPA grasslands are home to five common bird species—the eastern meadowlark, loggerhead shrike, black-throated sparrow, lark sparrow, and horned lark—that are among the “top 20 common birds in decline” in the United States (Butcher and Niven 2007). The eastern meadowlark, which was the 5th most detected species in WUPA grasslands, has declined by an estimated 72% nationwide in the last 40 years. Five percent or less of the eastern meadowlark’s distribution is on public lands (U.S. North American Bird

Conservation Initiative Committee 2011), including NPS lands. The loggerhead shrike was estimated to have declined by 70%, the black-throated sparrow and the lark sparrow each by 63%, and the horned lark by 56% nationwide (Butcher and Niven 2007). Further monitoring at WUPA should provide data to track changes in these species abundance, occurrence, and habitat over time.

The Brewer's sparrow was also among the most common species in WUPA grasslands. Results of analysis of Breeding Bird Survey (BBS) data (Sauer et al. 2011) show negative trends, from 1968 to 2009, in the Southern Rockies/Colorado Plateau Region, as well as the Western BBS Region and the United States. This species is on the Yellow WatchList of declining species, part of the United States WatchList of Birds of Conservation Concern (Butcher et al. 2007), and is on the federal list of Birds of Conservation Concern (U.S. Fish and Wildlife Service 2002). In addition, the 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) considers it a high priority for conservation. Brewer's sparrows 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). Further monitoring should provide insight into the relationship between precipitation and Brewer's sparrow distribution and abundance.

Another species of note was the Bendire's thrasher. This species has a relatively small breeding distribution centered in Arizona, and is patchily distributed within its range. It is one of 59 species on the Red WatchList of the United States WatchList of Birds of Conservation Concern (Butcher et al. 2007) and is on the federal list of Birds of Conservation Concern (U.S. Fish and Wildlife service 2002). "Red" species are of the highest national concern for conservation. In Arizona, Bendire's thrasher is more widespread than any other thrasher and it nests in a diverse array of flat to gently rolling open habitats with scattered shrubs or trees (Corman and Wise-Gervais 2005). A pair of Bendire's thrashers was observed on June 22, 2008 in the western portion of the monument, in an area comprised of open grassland with scattered shrubs.

Our long-range plan is to conduct VCP 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) over time. More thorough trend analyses will be conducted once sufficient data have been collected.

## 6 Literature cited

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