ASSESSING LAND USE PRACTICES ON THE ECOLOGICAL CHARACTERISTICS OF SAGEBRUSH ECOSYSTEMS: MULTIPLE MIGRATORY BIRD RESPONSES

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Assessing Land Use Practices on the Ecological Characteristics of Sagebrush Ecosystems: Multiple Migratory Bird Responses

2013 ANNUAL PROGRESS REPORT

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SUMMARY OF PROGRESS

This research study is designed to evaluate responses of migratory birds to rest-rotation grazing management in a sagebrush ecosystem. Rest-rotation grazing is likely to enhance important components of sagebrush, shrubland, and grassland habitat for a wide range of species; however, little work has been done to evaluate impacts of prescribed rest-rotation grazing on migratory avian species, which can serve as an indicator of sagebrush ecosystem integrity. Therefore evaluating the impacts of rest-rotation grazing designed to positively benefit sagebrush ecosystems can provide valuable insight into a potential monitoring tool. In 2012 we initiated a research project building off of the existing US Department of Agriculture - Natural Resource Conservation Service's Sage-Grouse Initiative (SGI) infrastructure in eastern Montana, which uses rest-rotation grazing, to evaluate the impact of conservation managed grazing on migratory birds.

Here we describe our preliminary findings from the 2012 pilot season and 2013 field season. Results from the 2012 pilot season were primarily used in determining sampling scheme and methods for 2013 field efforts. The 2013 field efforts expanded from the pilot year, which only included BLM land with traditional grazing systems, including private lands enrolled in SGI with rest-rotation grazing. From these two years we have identified a set of potential focal species for the region: Brewer's sparrow (*Spizella breweri*), vesper sparrow (*Pooecetes gramineus*), western meadowlark (*Sturnella neglecta*), McCown's longspur (*Rhynchophanes mccownii*), and horned lark (*Eremophila alpestris*). Preliminary results from 2013

indicate little difference in avian communities (e.g, observed abundance, mean species richness) between rest-rotation and traditional grazing regimes.

BACKGROUND

Livestock grazing is the most widespread land use practice of sagebrush ecosystems (Knick et al. 2010). Due to our ability to manipulate the process, domestic livestock grazing is a suitable land management tool that can facilitate desired habitat conditions (Fuhlendorf and Engle 2001). Additionally, using domestic livestock grazing to achieve sagebrush conservation objectives and outcomes provides land managers with opportunities to reduce conflicts between sagebrush conservation and livestock production goals. In the face of increasing global challenges, particularly increased human consumption of natural resources and the uncertainty of the impacts of climate change, it is urgent to couple modern land use practices and response of sagebrush ecosystems.

Migratory birds can serve as an initial barometer of sagebrush ecosystem integrity and the impacts of grazing management designed to positively benefit avian communities. Migratory birds are among the few groups of organisms in which community reassembly (e.g., Lemoine et al. 2007, Zuckerberg et al. 2009) and adaptation of species to climate change (Schaefer et al. 2008) and conservation actions have been documented. Additionally, sagebrush-associated migratory birds respond quickly to habitat changes by shifting their distributions and adapting their reproductive performance.

The long-term goal of our study is to determine how changes in landscape due to grazing regime alter avian communities. We aim to accomplish this using avian community composition measures and demographic parameters to compare avian communities between two grazing regimes: traditional and rest-rotation grazing. The primary community composition measures that we will use are species richness and abundance. Species richness represents the finest scale of community complexity. In general, it is thought to increase as heterogeneity in both biotic and abiotic factors increase (Chase & Myers 2011). Because grazing has a known effect on landscape heterogeneity, we have the potential to track changes that occur as a result of grazing by measuring changes in species richness. In addition, species abundance may also directly track these changes in the landscape. Because habitat quality is one of the main drivers of nest success, and grazing causes a known change in habitat quality, we are interested in tracking effects of grazing regimes with nest success. Finally, we are interested in how this potential change in nest success may affect population growth rates in a variety of birds.

PILOT STUDY

The 2012 pilot study addressed two main goals: to determine avian community composition in the study area and to evaluate the sampling methods. Due to access constraints at the time the pilot study was initiated, sampling was only conducted on BLM land (traditional grazing) and information on community composition only included species richness in traditional grazing systems. However, these results provided a baseline of avian community information for comparison of subsequent years of data.

We tested two field survey methods and conducted a power analysis to determine appropriate study design for subsequent survey years. The 2012 field effort consisted of two to four technicians working between May 23 and June 29, during which we compared two survey methods, point counts and dependent double observer transects (also referred to as walking transects). Overall, more birds were detected and the probability of detection was higher using the walking transect survey method than the point count survey method. We assume this was a result of detecting birds that flushed when we walked the transect, potentially increasing our ability to detect them in our plot. As a result, in 2013 field efforts we eliminated the use of the point count survey method. We conducted a power analysis using the program R version 2.15.1 (R Core Team 2012) to determine our statistical power to detect a range of differences in species richness given our 2012 sampling scheme of 40 plots. We simulated data based on 2012 pilot study results and a range of changes in species richness (from a 5% to a 75% change in species richness from 2012 levels). A sampling scheme of 40 plots per grazing regime provided 98% statistical power to detect any change in species richness as small as 5%. Because we anticipate that changes in species richness due to grazing may be small or happen over a short period of time, we wanted the high statistical power and kept the sampling scheme of 40 plots per grazing regime.

2013 FIELD STUDY

We conducted field surveys in 2013 to continue to address our long-term research objectives of using avian community composition and demographic parameters to evaluate the effects of traditional and rest-rotation grazing regimes on avian communities in sagebrush ecosystems. The data collection occurred in the same general area as the 2012 pilot study near Roundup, Montana. In 2013 we were granted access to private lands enrolled in the SGI, which uses rest-rotation grazing, allowing us to evaluate two grazing regimes (traditional and rest-rotation). The following sections provide an overview of the field methods, data analysis, and preliminary results.

Survey Methods

Our survey methods used in 2013 were similar to those used in the 2012 pilot study. We kept the a sample plot size of 500 x 500 m, which is based on the observed territory size of the passerine species that we believe has the largest breeding territory in the ecosystem, the loggerhead shrike (*Lanius ludovicianus*) (Brooks 1988). Sample plots were selected randomly within each of the two grazing regimes using ArcMap 10. We sampled a total of 40 sample plots per grazing regime.

We used dependent double observer transect surveys (Nichols et al. 2000) to obtain our avian community composition information. This method is grounded in mark-recapture estimation methodology. By using two observers, an encounter history can be constructed for each individual (or individual species) with which mark-recapture estimators can be used. As stated above, this method resulted in overall higher probability of detection for species than the point count survey method in the 2012 pilot study. This method required a two-person survey team, with one person designated as the 'primary' observer and the other person as the 'secondary' observer. Following Nichols et al. (2000), while walking the survey 'transect' single file within the 500 x 500 m sampling plot, the primary observer identified all birds observed and heard and communicated each individual detection, including species, detection type, and approximate location, to the secondary observer who recorded the information. In addition, the secondary observer recorded any detections not noted by the primary observer. The roles of primary and secondary observer within a survey team were alternated on consecutive dependent double observer transect surveys.

We conducted nest searching and monitoring to obtain our avian demographic parameter information. Nest searching was conducted in one of three ways: a systematic nest search at 100 m intervals (starting 50 m from the edge of the plot) using a rope/chain dragged through the plot; a dowel systematically swept over the top of sagebrush bushes (Ruehmann et al. 2011) at the same 100 m intervals; or behavioral observations conducted from walking transects on the 100 m intervals. In addition, opportunistic observations of nests occasionally occurred while the field crew was present in a survey plot. When a nest was located a waypoint was taken as close to the actual nest as possible without disturbing the nest and four pieces of flagging were placed in a concentric circle approximately 5 meters from the nest. Nest monitoring was conducted until at least one young fledged or the nest failed. We conducted a minimum of two nest monitoring visits to determine the fate of the nest. During each monitoring visit we recorded the stage of the young (eggs, nestling, fledgling), whether the nest was parasitized (and if so the stage of the parasite young), and the number of young at each stage. We assumed a nest had fledged if we had observed nestlings on the prior visit and observed an intact nest with signs of fledging (e.g. whitewash at the edge of the nest). Whenever a nest failed we used our best judgment to determine if the cause of failure was predation, weather, or unknown.

2013 Field Surveys

We conducted field surveys using the methods described above between April 26 and August 3, 2013 (Table 1). We repeated three rounds of walking transect surveys on 80 plots (40 plots per grazing regime). We conducted all transect surveys between sunrise (~0530 Mountain Standard Time [MST]) and 1100 MST. We did not nest search in plots while there were active greater sage-grouse (*Centrocercus urophasianus*) nests, which are part of another study in the same study area. As a result, there was not equal access to all plots for nest searching so we searched for nests on 31 plots in traditional grazing and 25 plots in rest-rotation grazing. We searched for nests at least one day after the walking transect surveys on the plot because nest searching causes disturbance on the plot and we wanted to minimize the effect of disturbance on both our survey methods. We did not conduct surveys or nest monitoring on days of high wind or inclement weather.

2013 Data Analysis

We summarized all data from the 2013 field season in Microsoft Access and the program R version 2.15.1 (R Core Team 2012). Microsoft Access was used for summarizing species and nest information at each plot. The program R was used to calculate and graphically compare the mean plot species richness between grazing regimes. We used the Huggins closed-captures model (Huggins 1989, 1991) in program MARK (White and Burnham 1999) to estimate abundance for each of our top five most common species. For these models we set the probability of recapture (c) to zero to simulate a removal model.

RESULTS

Overall species detections and top five most abundant species in 2013 were similar to data from the 2012 pilot season and similar between grazing regimes (Table 2). During the 2013 field surveys we had a total of 15,574 detections of 86 species (Table A-1, Appendix A). Based on observed abundances, the McCown's longspur (*Rhynchophanes mccownii*) was the most common species observed in both grazing regimes, both when calculated using observed abundance and estimated abundance (Tables 2 and 3). Vesper sparrow (*Pooecetes gramineus*), Brewer's sparrow (*Spizella breweri*), horned lark (*Eremophila alpestris*), and western meadowlark (*Sturnella neglecta*) were the remainder of the top five species observed in both grazing regimes. These were also the species with the highest probability of detection and showed a similar pattern in 2012 (Tables 2 and 3). While the 2013 field season resulted in far more detections (there were 5,324 detections in 2012) and number of species detected (only 48 were detected in 2012), we expected this because of the increased duration and technician field effort in 2013.

Preliminary data analysis revealed little difference in observed nest abundance between the two grazing regimes. We calculated nest abundance results strictly from observations and did not take into account probability of detection or the disparity in effort for each grazing regime sample. When we take opportunistic nest observations into account, however, nests that were identified and monitored are from 33 plots in traditional grazing and 36 plots in rest-rotation grazing systems (Table A-2, Appendix A). The nest data also shows that the observed nesting species generally match with the top five most abundant species observed in both grazing regimes (Table 4).

Preliminary data analysis also revealed little difference in observed plot species richness between grazing regimes. Figure 1 shows a comparison of this species richness by plot and the frequency at which these values occur for each grazing regimes. Figure 2 shows a comparison of mean species richness and distribution of the mean by each grazing regime. The variation in the rest-rotation grazing regime is higher, which could be due to the variation of grazing practices within the rest-rotation grazing system.

FUTURE WORK

We will conduct additional data analysis and future field work to continue to address our research goals. The data analysis will include nest abundance and success, as well as further analysis of species richness. We will use distance sampling to determine probability of detection for nests that were found during nest searching efforts and estimate abundance of nests. We also plan to select focal species based on nesting substrate (ground, shrub, etc.) and perform nest success analysis. We will conduct additional species richness analysis that incorporates covariates, such as time, and use multi-species hierarchical community modeling to estimate total species richness for the plots. In addition, we plan to expand our spatial-scale inference by analyzing diversity at different spatial scales using additional diversity measures that can be calculated from the community data already collected. We plan to model potential population effects resulting from differences in nest density and success. Field work will continue in 2014 with the same sampling scheme and protocols.

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Table 1. Survey Effort. The number of sampling plots surveyed using walking transects and nest search, on BLM and private lands near Roundup, Montana, in April through August 2013.

Sampling Occasion	Date	Survey Method	
		Walking Transects	Nest Searching
1	April 26 – July 1	80	56
2	June 4 – July 31	80	-
3	June 9 – August 3	80	-
Total		240	56

Table 2. Top Five Most Abundant Species. The most common species detected during walking transect surveys in 2012 and 2013 on BLM and private lands near Roundup, Montana.

Common Name	Scientific Name	2013 Observed Abundance	
		Traditional Grazing *(BLM land)*	Rest-Rotation Grazing *(private land)*
McCown's longspur	*Rhynchophanes mccownii*	1,037	2,[illegible]
vesper sparrow	*Pooecetes gramineus*	1,077	946
Brewer's sparrow	*Spizella breweri*	980	1,039
horned lark	*Eremophila alpestris*	597	1,103
western meadowlark	*Sturnella neglecta*	802	407

Common Name	Scientific Name	2012 Observed Abundance	
		Traditional Grazing *(BLM land)*	Rest-Rotation Grazing *(private land)*
vesper sparrow	*Pooecetes gramineus*	1,085	-
Brewer's sparrow	*Spizella breweri*	577	-
western meadowlark	*Sturnella neglecta*	384	-
horned lark	*Eremophila alpestris*	338	-
McCown's longspur	*Rhynchophanes mccownii*	276	-

Table 3. Abundance and Probability of Detection Estimates for Top Five Most Abundant Species. Detection probability and estimates abundances for the top five most commonly identified species using walking transect surveys in 2013 on BLM and private lands near Roundup, Montana. Standard errors of detection probability are shown in parentheses.

Common Name	Detection Probability	Estimated Abundance**
	Walking Transects	Walking Transects
McCown's longspur	0.90 (0.006)	3,812
vesper sparrow	0.81 (0.011)	2,104
Brewer's sparrow	0.79 (0.013)	1,860
horned lark	0.82 (0.012)	1,757
western meadowlark	0.84 (0.014)	1,243

**Abundance estimates for each species are reported as the estimated number of individuals present in the surveys covered a total of 1,000 hectares.

Table 4. Top Six Most Abundant Nesting Species. The most common species detected during walking transect surveys in 2012 and 2013 on BLM and private lands near Roundup, Montana.

Common Name	Scientific Name	2013 Observed Nests	
		Traditional Grazing (BLM land)	Rest-Rotation Grazing (private land)
vesper sparrow	*Pooecetes gramineus*	29	37
McCown's longspur	*Rhynchophanes mccownii*	10	24
Brewer's sparrow	*Spizella breweri*	17	19
horned lark	*Eremophila alpestris*	8	8
western meadowlark	*Sturnella neglecta*	6	5
chestnut-collared longspur	*Calcarius ornatus*	2	14
	Totals	**72**	**107**

Figure 1. Comparison of Plot Species Richness by Grazing Regime. The frequency of plot species richness values by grazing regime. Plot species richness which was calculated using all three walking transect sampling occasions to obtain a species richness for a specific plot. The walking transect surveys were conducted on BLM and private lands near Roundup, Montana, in April through August 2013.

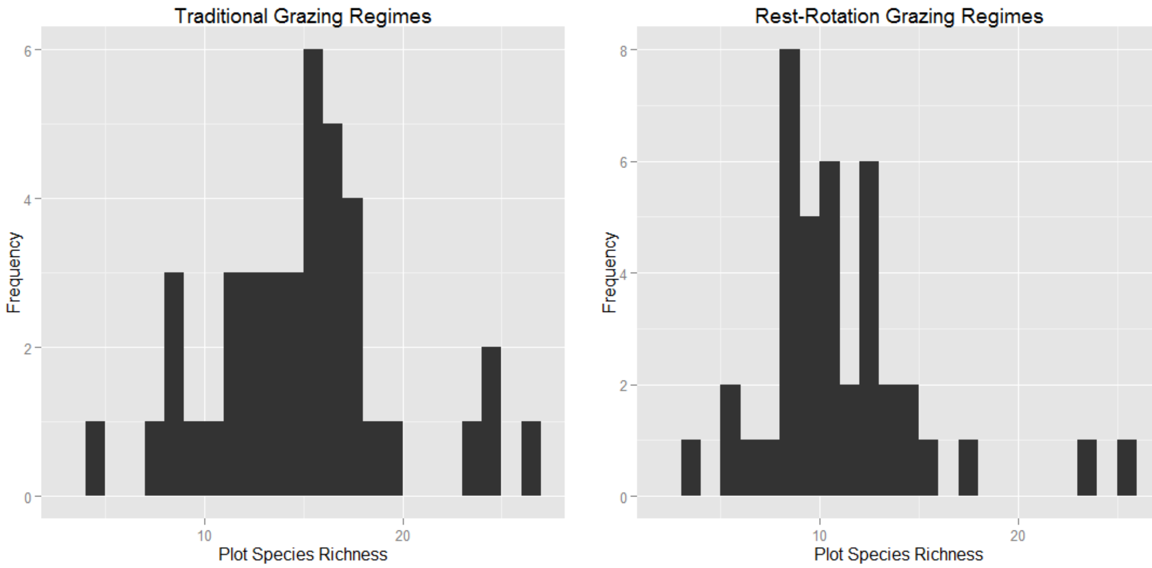
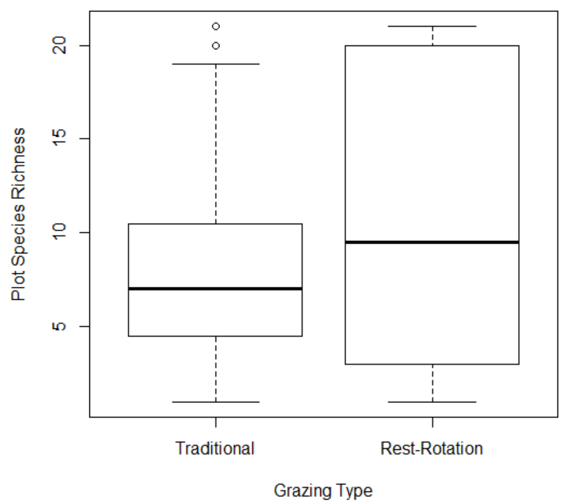


Figure 2. Comparison of Mean Plot Species Richness by Grazing Treatment. A comparison of the mean plot species richness and the distribution of the mean values by grazing treatment. Plot species richness which was calculated using all three walking transect sampling occasions to obtain a species richness for a specific plot. The thick black lines represent median values, the box represents the most common values, and the dotted lines represent the smallest and largest values in the data set. The dots outside the plot in the traditional grazing represent outliers in the data set. The walking transect surveys were conducted on BLM and private lands near Roundup, Montana, in April through August 2013.



APPENDIX A

Table A-1. Total Avian Observations in 2013 and 2012. The species detected during walking transect surveys on BLM and private lands near Roundup, Montana, in April through August 2013.

Common Name	Scientific Name	Total Observations	
		2013	2012
red-winged blackbird	*Agelaius phoeniceus*	109	30
Baird's sparrow	*Ammodramus savannarum*	10	-
grasshopper sparrow	*Ammodramus savannarum*	82	72
northern pintail	*Anas acuta*	4	-
American wigeon	*Anas americana*	20	-
northern shoveler	*Anas clypeata*	4	-
cinnamon teal	*Anas cyanoptera*	8	-
blue-winged teal	*Anas discors*	17	2
mallard	*Anas platyrhynchos*	30	5
gadwall	*Anas strepera*	11	-
Sprauge's pipit	*Anthus spraguei*	6	-
golden eagle	*Aquila chrysaetos*	3	-
great blue heron	*Ardea herodias*	3	-
short-eared owl	*Asio flammeus*	-	7
upland sandpiper	*Bartramia longicauda*	33	3
cedar waxwing	*Bombycilla cedrorum*	10	-
Canada goose	*Branta canadensis*	167	-
red-tailed hawk	*Buteo jamaicensis*	14	-
rough-legged hawk	*Buteo lagopus*	1	-
ferruginous hawk	*Buteo regalis*	2	2
Swainson's hawk	*Buteo swainsoni*	1	1
lark bunting	*Calamospiza melanocorys*	459	179
chestnut-collared longspur	*Calcarius ornatus*	496	63
turkey vulture	*Cathartes aura*	10	-

Common Name	Scientific Name	Total Observations	
		2013	2012
greater sage-grouse	*Centrocercus urophasianus*	5	1
mountain plover	*Charadrius montanus*	4	-
semipalmated plover	*Charadrius semipalmatus*	22	-
killdeer	*Charadrius vociferus*	35	16
lark sparrow	*Chondestes grammacus*	107	9
common nighthawk	*Chordeiles minor*	5	2
northern harrier	*Circus cyaneus*	28	8
northern flicker	*Colaptes auratus*	30	11
rock pigeon	*Columba livia*	5	19
American crow	*Corvus brachyrhynchos*	13	-
common raven	*Corvus corax*	26	6
tundra swan	*Cygnus columbianus*	2	-
horned lark	*Eremophila alpestris*	1,700	338
Brewer's blackbird	*Euphagus cyanocephalus*	186	122
prairie falcon	*Falco mexicanus*	2	-
peregrine falcon	*Falco peregrinus*	1	-
American kestrel	*Falco sparvarius*	47	4
pinyon jay	*Gymnorhinus cyanocephalus*	8	-
barn swallow	*Hirundo rustica*	17	13
loggerhead shrike	*Lanius ludovicianus*	28	1
herring gull	*Larus argentatus*	1	-
California gull	*Larus californicus*	19	-
ring-billed gull	*Larus delawarensis*	3	-
Franklin's gull	*Leucophaeus pipixcan*	13	-
marbled godwit	*Limosa fedoa*	9	5
brown-headed cowbird	*Molothrus ater*	352	72
Clark's nutcracker	*Nucifraga columbiana*	3	-

Common Name	Scientific Name	Total Observations	
		2013	2012
long-billed curlew	*Numenius americanus*	104	16
sage thrasher	*Oreoscoptes montanus*	11	5
savannah sparrow	*Passerculus sandwichensis*	8	2
grey partridge	*Perdix perdix*	2	-
cliff swallow	*Petrochelidon pyrrhonota*	491	21
double-crested cormorant	*Phalacrocorax auritus*	3	-
ring-necked pheasant	*Phasianus colchicus*	-	3
black-billed magpie	*Pica hudsonia*	25	3
pine grossbeak	*Pinicola enucleator*	-	4
black-capped chickadee	*Poecile atricapillus*	6	-
vesper sparrow	*Pooecetes gramineus*	2,023	1,085
common grackle	*Quiscalus quiscula*	1	-
American avocet	*Recurvirostra americana*	28	-
McCown's longspur	*Rhynchophanes mccownii*	3,774	276
rock wren	*Salpinctes obsoletus*	7	-
Say's pheobe	*Sayornis saya*	30	3
yellow-rumped warbler	*Setophaga coronata*	3	-
mountain bluebird	*Sialia currucoides*	19	-
American goldfinch	*Spinus tristis*	2	-
Brewer's sparrow	*Spizella breweri*	1,773	577
Clay-colored sparrow	*Spizella pallida*	2	-
chipping sparrow	*Spizella passerina*	15	-
Wilson's phalarope	*Steganopus tricolor*	116	-
western meadowlark	*Sturnella neglecta*	1,209	384
European starling	*Sturnus vulgaris*	27	-
tree swallow	*Tachycineta bicolor*	17	3
violet green swallow	*Tachycineta thalassina*	5	-

Common Name	Scientific Name	Total Observations	
		2013	2012
willet	*Tringa semipalmata*	19	-
sharp-shinned hawk	*Accipiter striatus*	1	-
house wren	*Troglodytes aedon*	1	-
American robin	*Turdus migratorius*	14	20
sharp-tailed grouse	*Tympanuchus phasianellus*	1	6
eastern kingbird	*Tyrannus tyrannus*	9	3
western kingbird	*Tyrannus verticalis*	2	3
Cassin's kingbird	*Tyrannus vociferans*	4	-
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	3	-
mourning dove	*Zenaida macroura*	179	53
White-crowned sparrow	*Zonotrichia leucophrys*	3	-
	Totals	**14,108**	**3,458**

Table A-2. Total Nest Observations in 2013. The species detected during nest searching surveys or opportunistic observations on BLM and private lands near Roundup, Montana, in April through July 2013.

Common Name	Scientific Name	2013 Observed/Successful Nests	
		BLM Land *(traditional grazing)*	Private Land *(rest-rotation grazing)*
red-winged blackbird	*Agelaius phoeniceus*	-	1
grasshopper sparrow	*Ammodramus savannarum*	1	-
lark bunting	*Calamospiza melanocorys*	1	1
chestnut-collared longspur	*Calcarius ornatus*	2	14
killdeer	*Charadrius vociferus*	1	-
lark sparrow	*Chondestes grammacus*	2	-
northern flicker	*Colaptes auratus*	1	1
horned lark	*Eremophila alpestris*	8	8
loggerhead shrike	*Lanius ludovicianus*	1	-

Common Name	Scientific Name	2013 Observed/Successful Nests	
		BLM Land (traditional grazing)	Private Land (rest-rotation grazing)
long-billed curlew	*Numenius americanus*	-	1
black-billed magpie	*Pica hudsonia*	1	-
vesper sparrow	*Pooecetes gramineus*	29	37
McCown's longspur	*Rhynchophanes mccownii*	10	24
Brewer's sparrow	*Spizella breweri*	17	19
chipping sparrow	*Spizella passerina*	1	-
western meadowlark	*Sturnella neglecta*	6	5
American robin	*Turdus migratorius*	1	-
mourning dove	*Zenaida macroura*	5	-
	Totals	**86**	**111**