Monitoring Birds on Little Missouri, Sheyenne and Grand River National Grasslands

Photo by Bill Schmoker

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ROCKY MOUNTAIN BIRD OBSERVATORY

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Rocky Mountain Bird Observatory is a nonprofit dedicated to bird conservation.
Mission*: To conserve birds and their habitats*

Vision*: Native bird populations are sustained in healthy ecosystems*

Core Values*: (Our goals for achieving our mission)*

1. ***Science*** *provides the foundation for effective bird conservation.*
2. ***Education*** *is critical to the success of bird conservation.*
3. ***Stewardship*** *of birds and their habitats is a shared responsibility.*

RMBO accomplishes its mission by:

• ***Monitoring*** *long-term bird population trends to provide a scientific foundation for conservation action.*

• ***Researching*** *bird ecology and population response to anthropogenic and natural processes to evaluate and adjust management and conservation strategies using the best available science.*

• ***Educating*** *people of all ages through active, experiential programs that create an awareness and appreciation for birds.*

• ***Fostering*** *good stewardship on private and public lands through voluntary, cooperative partnerships that create win-win situations for wildlife and people.*

• ***Partnering*** *with state and federal natural resource agencies, private citizens, schools, universities, and other non-governmental organizations to build synergy and consensus for bird conservation.*

• ***Sharing*** *the latest information on bird populations, land management and conservation practices to create informed publics.*

• ***Delivering*** *bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in western North America.*

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Executive Summary

Monitoring wildlife populations can be an effective tool for guiding land management decisions. The USDA Forest Service and Rocky Mountain Bird Observatory recognized the need for monitoring breeding bird populations on the Little Missouri, Sheyenne, and Grand River National Grasslands in 2004 and have since collected data on birds occupying these National Grasslands. The objective of this program is to use state-of-the-art monitoring techniques and statistical analyses to determine population trends and distributions of breeding birds that inhabit these National Grasslands.

In 2010, we conducted 32 transects on 16 blocks in Little Missouri, Sheyenne and Grand River National Grasslands using a point-transect survey method developed by Rocky Mountain Bird Observatory (Leukering 2000). Data from the 2010 transects provided density estimates for 35 bird species and abundance information for 97 species.

A hierarchical distance sampling model was used to model covariate effects on density for Sprague's Pipit using 2008-2010 data and an information theoretic approach was used for model selection. There were 4 competing models which included a combination of 3 variables, percent shrub cover, percent grass cover and grass height. Percent shrub cover had a strong negative effect on density.

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Introduction

Historically, the Great Plains were heavily influenced by natural cycles of drought, grazing, and fire (Fuhlendorf and Engle 2001). Today, center-pivot irrigation systems water crops on demand and grazing and fire are controlled as much as possible to benefit mankind. The changes that have come to the prairie have taken a toll on the wildlife that inhabits this region. Today, the North American prairie is considered one of the continent's most endangered ecosystems (Sampson et al. 2004). Many of the bird species that developed unique adaptations to the harsh life on the prairie are declining. In Bird Conservation Region (BCR) 11, an estimated 41% of the upland breeding grassland bird species are declining and insufficient data exists for assessing population trends for 30% (Partners in Flight Species Assessment Database 2004). In BCR 17, 38% of the upland breeding grassland bird species are declining and insufficient data exists for 31% (Partners in Flight Species Assessment Database 2004). Boundaries designated by the North American Bird Conservation Initiative place the Little Missouri and Grand River National Grasslands in BCR 17 and Sheyenne National Grassland in BCR 11 (Figure 1).

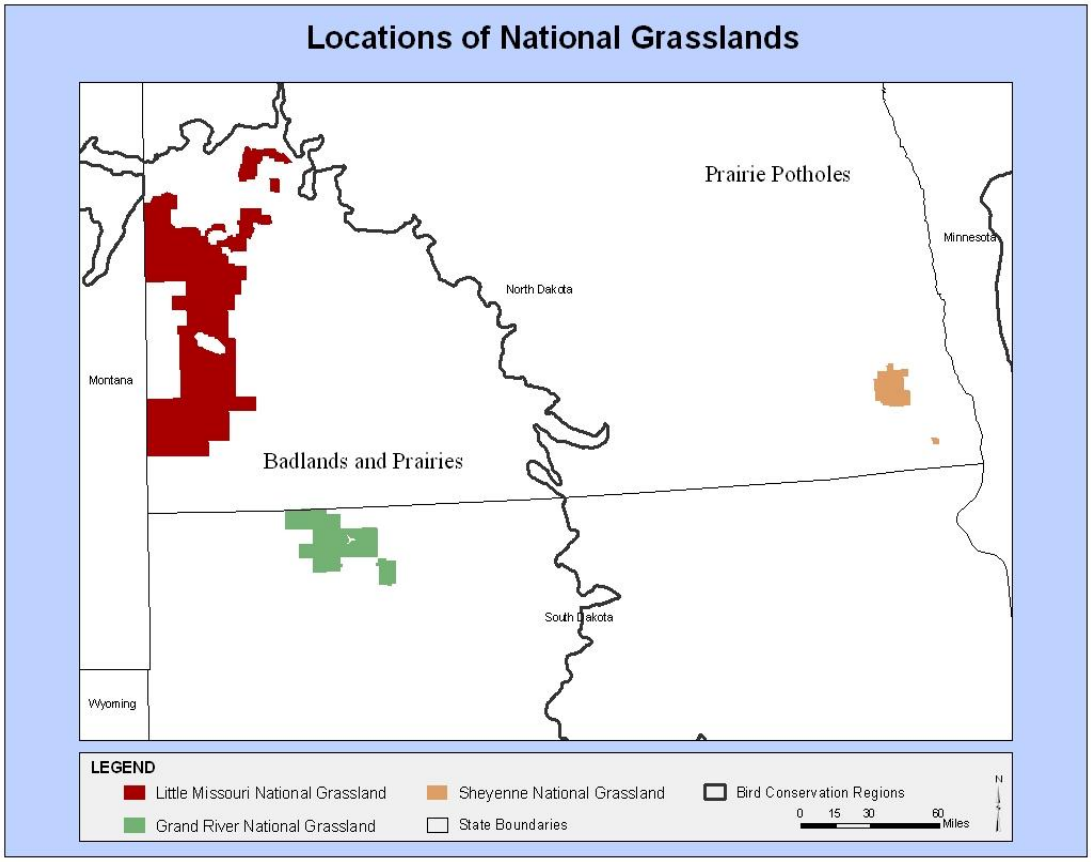

Figure 1. Study Area.

Land managers rely on data derived from the Breeding Bird Survey (BBS), which is currently the most extensive dataset available for monitoring bird populations (Robbins et al. 1989, Sauer 1993). The BBS, initiated in the Great Plains in 1967, uses volunteers to conduct roadside surveys of birds across North America and produces indices of population abundance at the continental scale for many common bird species (Robbins et al. 1989). BBS data and analyses are relatively inexpensive and have proven to be a valuable source of information on bird population trends. BBS data can be used to produce continental-scale maps, which provide reasonably good indications of the relative abundances of species that are well sampled by the BBS. However, many species and habitats are inadequately sampled by the BBS (Robbins et al. 1993, Sauer 1993) and BBS data do not reliably predict population trends at small geographic scales such as a National Grassland (Sauer 2000). For these and other reasons, BBS data are generally insufficient to guide local and regional management decisions (Leukering et al. 2000).

Methodology

In 2010, data were collected on three National Grasslands (Little Missouri, Sheyenne and Grand River) from 18 May to 26 June. Experienced field biologists trained in bird identification and point transect methodology conducted all field work.

Block Selection

In spring 2003 the U.S. Forest Service investigated 24 randomly chosen blocks and selected the 17 blocks that best met design criteria (e.g., containing a minimum number of grouse leks, minimum road access network, etc.). The total acreage of all 17 blocks is 136,960 acres. Two point transects were established in each block. (Figure 2), with each transect starting point established systematically and subsequent points established along a random bearing.

Point Transect Protocol

RMBO surveyed bird populations in each block selected for monitoring using the point transect method (Buckland et al. 1993). Each transect was surveyed by one observer following protocol established by Leukering (2000). Observers conducted up to eight five-minute point counts at stations located at 250 meter intervals along each point transect, recording all bird detections on standardized forms. The observer began the point transect at the first count station and then continued along the pre-selected bearing for all remaining points if possible.

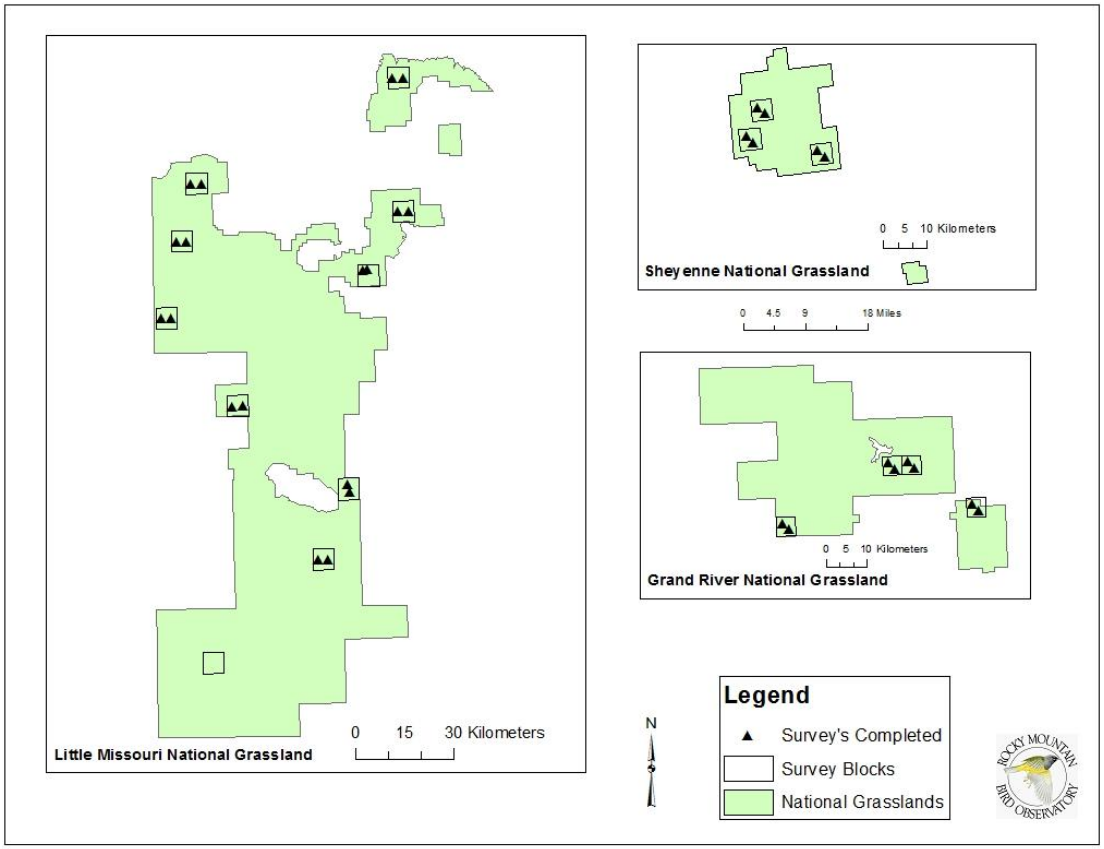

Figure 2. Monitoring blocks and transect locations.

We recorded distance from observer to the point of first detection for as many birds as possible using rangefinders. The method of detection (e.g., visually, aurally), sex (if known), and habitat (e.g., shrub, ground, fence, etc.) were recorded. Birds flying over, and not actually using the area, were tallied separately. Locations of each point were recorded using Garmin *etrex* global positioning system (GPS) units in NAD 83 UTM.

Observers conducted point counts from sunrise until no later than 1100 hrs when detectable activity typically slowed or ceased. Surveys were not conducted during times of rain or wind in excess of 18 mph. Observers recorded weather conditions such as percent cloud cover, wind speed (Beaufort Scale), and temperature in Fahrenheit. We also recorded survey "start" and "end" times.

In addition to point count data, we documented vegetation characteristics, and locations of raptor nests and black-tailed prairie dog colonies. We recorded vegetation characteristics within a 50- m radius of each point count. Vegetation data collected included the percent coverage and types of shrubs and percent coverage of ground cover. Percent coverage of ground cover was collected within 4 categories, woody/cacti, bare ground/litter, herbaceous and grass.

Data Analysis

We used program Distance 6.0 release 2 (Thomas et al. 2009) to generate density estimates (*D*) using only data collected at point-transect stations. Buckland et al. (1993) developed the notation, concepts, and analysis methods of Distance. In Distance analysis, a unique detection function is fit to each distribution of distances associated with a species in a given habitat. Because the detection function is unique to each species in each habitat, Distance analysis avoids some serious problems inherent in traditional analyses of point-transect data (e.g., unquantifiable differences in detectability among habitats, species, and years). Distance analysis relies on three assumptions, all of which are reasonably accomplished: 1) all birds at distance=0 are detected, 2) distances of birds close to the point are measured accurately, and 3) birds do not move in response to the observer's presence.

A hierarchical distance sampling model was used to explore grass height, shrub cover and grass cover effects on Sprague's Pipit density using 2008-2010 data. Grass height, percent shrub cover and percent grass cover were visually estimated at each point. This hierarchical distance sampling model allows modeling on both detection and density parameters using the unconditional likelihood (Royle et al. 2004). An information theoretic approach was used to select the best model (Burnham and Anderson 2002). The unmarked package in Program R was used to run the hierarchical distance sampling models.

Results

Density Estimates

We conducted a total of 32 point transects in 2010; 18 on the Little Missouri, six on the Sheyenne, and eight on the Grand River National Grassland. We observed 97 species in 2010 (Appendix B); 47 species on Grand River (Table 1), 76 species on Little Missouri (Table 2), and 53 species on Sheyenne (Table 3). Species of interest detected in USFS Region 1 over the duration of this monitoring program were; Sharp-tailed Grouse, Burrowing Owl, Loggerhead Shrike, Sprague's Pipit and Baird's Sparrow. Sharp-tailed Grouse have been detected in all three grasslands with the highest number of observations in Little Missouri. In 2010, four Sharp-tailed Grouse were recorded in Little Missouri and one in Grand River. Two Burrowing Owls were detected historically on Little Missouri, but none were recorded in 2010. Loggerhead Shrike has been detected in low numbers in Grand River and Little Missouri and in 2010 there were no detections. Sprague's Pipit has been detected historically in higher numbers on Little Missouri and continued this trend in 2010. We estimated density for 5 species of interest (Table 4, Figure 3) across the 3 national grasslands. Among the species of interest Grasshopper Sparrow and Chestnut-collared Longspur had highest densities across all 3 grasslands (Table 4). Density estimates for 5 species of interest showed a high amount of variation in density from year to year (Fig. 3). Sprague's Pipit was the species with the highest percent change in density among six years followed by Chestnut-collared Longspur. Grasshopper Sparrow had the least amount of variation in density among years. Significant differences from 2009 to 2010 were evident for Chestnut-collated Longspur,

Sprague's Pipit and Upland Sandpiper. Sprague's Pipit and Chestnut-collared Longspur density estimates increased significantly from 2008 to 2009 and decreased significantly from 2009 to 2010. Upland Sandpiper's density estimate decreased significantly from 2008 to 2009 and then increased significantly from 2009 to 2010. Sprague's Pipit and Mourning Dove decreased significantly in 2 grasslands from 2009 to 2010. We were able to calculate density estimates for thirty-two species using a global detection function to estimate density per year.

The top hierarchical model for Sprague's Pipit contained percent shrub cover followed by the model containing percent shrub cover and grass height (Table 5). The standard errors were large for grass height and percent grass cover parameter estimates (Table 6). The negative parameter estimate and standard error for shrub cover indicates a strong negative effect on density (Table 6). Using the shrub cover parameter estimate to predict density at shrub cover values of 5% (density= 8.63 birds/km$^{2)}$, 10% (density = 4.26 birds/km$^{2)}$, 25% (density = 1.45 birds/km$^{2)}$, 50% (density = 0.2 birds/km$^{2)}$ and 100% (density = 0.007 birds/km^{2}), while grass height (mean= 20 cm) and percent grass cover (mean = 64%) are held at their mean shows the negative effects percent shrub cover has on density.

Table 1. Grand River National Grassland density estimates of breeding birds by year.

D = Density estimate expressed in birds/ km^2, LCL & UCL = 90% lower and upper confidence limits of D, n = number of detections used to obtain density estimates, %CV = percent coefficient of variation.

Common Name	Year	D	%CV	LCL	UCL	n
Ring-necked Pheasant	2004	0.48	13	0.39	0.59	5
	2005	0.00				0
	2006	0.00				0
	2007	1.63	14	1.28	2.07	17
	2008	2.14	17	1.59	2.88	15
	2009	2.30	17	1.74	3.05	24
	2010	4.25	27	2.74	6.60	17
Killdeer	2004	1.30	13	1.05	1.61	5
	2005	1.19	13	0.96	1.47	4
	2006	5.00	20	3.61	6.92	18
	2007	3.37	20	2.40	4.73	11
	2008	3.09	14	2.43	3.93	8
	2009	1.30	13	1.05	1.61	5
	2010	3.43	20	2.47	4.76	7
Upland Sandpiper	2004	27.67	17	20.69	37.01	50
	2005	4.88	54	2.03	11.75	20
	2006	16.54	24	11.11	24.61	62
	2007	13.33	25	8.80	20.19	75
	2008	47.14	50	18.32	121.31	65
	2009	11.46	19	8.29	15.83	32
	2010	15.69	10	13.01	18.82	26

Common Name	Year	D	%CV	LCL	UCL	n
Mourning Dove	2004	7.09	28	4.51	11.15	21
	2005	4.36	21	3.07	6.19	12
	2006	6.00	22	4.16	8.65	19
	2007	10.09	22	7.01	14.52	33
	2008	5.68	25	3.76	8.59	12
	2009	15.27	27	9.69	24.07	53
	2010	6.21	10	5.22	7.39	13
Western Kingbird	2004	0.87	62	0.26	2.93	6
	2005	6.44	83	0.07	619.45	2
	2006	2.34	37	1.14	4.81	4
	2007	3.79	25	2.46	5.84	13
	2008	9.57	51	3.97	23.06	9
	2009	9.53	34	5.39	16.88	17
	2010	9.54	25	8.43	19.24	10
Eastern Kingbird	2004	5.12	16	3.95	6.63	14
	2005	0.84	15	0.65	1.07	2
	2006	1.46	15	1.14	1.87	4
	2007	7.31	16	5.60	9.56	20
	2008	1.80	24	1.10	2.95	3
	2009	10.24	18	7.61	13.78	23
	2010	6.30	15	4.95	8.01	10
Horned Lark	2004	14.32	53	6.14	33.40	23
	2005	62.95	32	37.52	105.63	29
	2006	70.46	30	43.35	114.52	75
	2007	78.57	34	43.94	140.48	110
	2008	51.14	37	27.57	94.86	21
	2009	61.28	27	39.13	95.99	58
	2010	77.82	12	63.00	96.10	41
Sprague's Pipit	2004	1.80	19	1.31	2.46	6
	2005	13.00	24	8.71	19.41	38
	2006	2.99	20	2.17	4.14	10
	2007	1.80	19	1.31	2.46	6
	2008	0.45	19	0.33	0.61	1
	2009	5.69	20	4.10	7.90	19
	2010	1.90	14	1.51	2.39	4
Lark Bunting	2004	11.10	31	6.26	19.65	36
	2005	30.16	30	17.82	51.05	64
	2006	16.49	21	11.36	23.95	51
	2007	45.88	32	25.49	82.57	141
	2008	8.93	22	5.81	13.70	20
	2009	5.40	19	3.90	7.47	14
	2010	12.48	18	9.02	17.27	27
Grasshopper Sparrow	2004	33.25	12	27.34	40.43	36
	2005	88.66	26	55.14	142.56	84
	2006	52.64	15	40.63	68.21	57
	2007	70.19	19	50.56	97.44	76
	2008	79.73	36	40.12	158.45	56
	2009	88.66	24	57.85	135.89	95

Common Name	Year	D	%CV	LCL	UCL	n
	2010	67.77	13	54.45	84.34	404
Chestnut-collared Longspur	2004	9.51	93	2.25	40.25	11
	2005	29.04	34	16.36	51.55	13
	2006	19.15	34	10.43	35.15	8
	2007	31.79	34	18.04	56.04	78
	2008	46.50	51	19.31	111.98	10
	2009	85.44	30	52.16	139.97	55
	2010	45.24	15	34.76	58.86	32
Red-winged Blackbird	2004	6.36	17	4.81	8.40	16
	2005	5.90	23	3.99	8.74	9
	2006	3.97	14	3.14	5.03	10
	2007	5.96	18	4.45	7.99	12
	2008	5.32	19	3.86	7.34	8
	2009	11.52	21	8.20	16.19	23
	2010	9.69	11	8.08	11.63	18
Western Meadowlark	2004	60.34	39	31.70	114.85	139
	2005	34.61	39	18.27	65.56	101
	2006	143.83	51	59.38	348.38	256
	2007	46.75	35	26.20	83.45	130
	2008	193.22	57	68.13	547.97	148
	2009	75.60	46	34.91	163.74	177
	2010	8.50	34	42.75	151.57	169
Brown-headed Cowbird	2004	81.00	34	46.62	140.74	72
	2005	21.83	49	9.88	48.20	19
	2006	117.77	29	73.06	189.85	102
	2007	44.75	33	26.34	76.04	76
	2008	40.43	41	20.71	78.95	31
	2009	106.09	26	67.98	165.54	102
	2010	71.99	14	55.74	92.97	55

Table 2. Little Missouri National Grassland density estimates of breeding birds by year.

D = Density estimate expressed in birds/ km^2, LCL & UCL = 90% lower and upper confidence limits of D, n = number of detections used to obtain density estimates, %CV = percent coefficient of variation.

Common Name	Year	D	%CV	LCL	UCL	n
Ring-necked Pheasant	2004	0.65	17	0.49	0.86	11
	2005	0.42	17	0.32	0.56	8
	2006	0.05	17	0.00	0.07	1
	2007	0.53	17	0.40	0.71	7
	2008	1.88	18	1.40	2.51	28
	2009	1.47	18	1.10	1.96	25
	2010	1.16	12	0.95	1.41	16
Killdeer	2004	0.31	96	0.19	51.78	2
	2005	3.74	45	1.71	8.18	9
	2006	0.94	42	0.46	1.93	11

Common Name	Year	D	%CV	LCL	UCL	n
	2007	0.57	48	0.25	1.30	11
	2008	0.47	43	0.20	1.15	5
	2009	1.43	34	0.78	2.66	9
	2010	1.14	16	0.87	1.48	7
Upland Sandpiper	2004	0.89	21	0.63	1.25	13
	2005	0.49	21	0.35	0.69	8
	2006	1.40	21	1.00	1.97	24
	2007	0.53	21	0.38	0.75	6
	2008	2.43	21	1.72	3.42	28
	2009	0.69	21	0.49	0.96	10
	2010	4.79	16	3.65	6.28	37
Mourning Dove	2004	1.06	18	0.79	1.42	11
	2005	1.46	30	0.89	2.39	13
	2006	3.43	18	2.54	4.64	39
	2007	2.73	19	2.00	3.71	21
	2008	1.64	19	1.20	2.25	14
	2009	6.53	19	4.80	8.87	65
	2010	4.68	11	3.91	5.60	36
Western Kingbird	2004	0.90	21	0.63	1.27	4
	2005	2.41	22	1.66	3.49	11
	2006	0.73	29	0.44	1.22	4
	2007	1.16	21	0.82	1.64	4
	2008	0.76	27	0.48	1.19	5
	2009	4.93	26	3.20	7.59	14
	2010	1.48	41	1.11	1.97	5
Eastern Kingbird	2004	2.89	16	2.22	3.77	14
	2005	1.30	16	1.00	1.69	7
	2006	2.81	18	2.09	3.79	14
	2007	3.74	16	2.86	4.88	14
	2008	1.42	16	1.09	1.84	6
	2009	3.72	18	2.78	4.98	16
	2010	3.69	15	2.90	4.70	9
Red-eyed Vireo	2004	1.40	12	1.15	1.70	7
	2005	3.23	12	2.65	3.94	18
	2006	2.90	12	2.38	3.53	17
	2007	3.63	13	2.91	4.51	14
	2008	2.29	12	1.87	2.79	10
	2009	4.01	15	3.12	5.15	19
	2010	3.63	16	2.80	4.72	13
American Crow	2004	0.43	17	0.33	0.58	11
	2005	1.41	19	1.04	1.92	36
	2006	0.67	19	0.49	0.92	17
	2007	1.17	18	0.88	1.57	23
	2008	0.90	19	0.66	1.22	18
	2009	0.71	28	0.44	1.14	14
	2010	0.89	24	0.60	1.32	14
Horned Lark	2004	4.52	60	1.39	14.66	6
	2005	5.01	93	1.25	20.07	16

Common Name	Year	D	%CV	LCL	UCL	n
	2006	8.53	62	3.25	22.39	42
	2007	3.99	91	1.06	15.06	25
	2008	15.82	49	7.23	34.61	34
	2009	7.05	54	3.02	16.47	40
	2010	10.94	9	9.43	12.70	42
Rock Wren	2004	0.58	16	0.44	0.75	5
	2005	0.41	16	0.32	0.54	4
	2006	1.47	16	1.14	1.91	15
	2007	0.90	16	0.69	1.16	6
	2008	0.40	16	0.30	0.51	3
	2009	2.08	16	1.59	2.72	18
	2011	1.10	14	0.88	1.37	8
House Wren	2004	2.07	13	1.67	2.58	10
	2005	3.34	13	2.69	4.16	18
	2006	8.65	14	6.91	10.82	49
	2007	7.50	14	5.96	9.44	28
	2008	3.79	13	3.04	4.71	16
	2009	7.05	14	5.59	8.89	32
	2010	13.55	9	11.66	15.76	40
Sprague's Pipit	2004	3.35	8	2.95	3.80	24
	2005	11.74	7	10.53	13.10	94
	2006	1.90	5	1.74	2.08	16
	2007	9.56	15	7.29	12.52	53
	2008	0.80	5	0.74	0.86	5
	2009	8.09	8	7.06	9.27	58
	2010	2.75	8	2.41	3.13	18
Yellow Warbler	2004	19.91	28	12.39	31.99	30
	2005	24.78	25	16.37	37.53	49
	2006	10.21	50	4.62	22.58	59
	2007	14.24	36	7.93	25.55	45
	2008	15.95	37	8.68	29.31	45
	2009	42.84	20	31.05	59.10	74
	2010	20.62	12	16.88	25.19	48
Ovenbird	2004	0.50	12	0.41	0.61	6
	2005	1.18	12	0.97	1.45	16
	2006	0.84	12	0.69	1.03	12
	2007	0.32	12	0.26	0.39	3
	2008	1.32	12	1.08	1.62	14
	2009	1.82	14	1.43	2.31	21
	2010	0.98	13	0.79	1.23	9
Yellow-breasted Chat	2004	7.91	83	2.24	27.94	19
	2005	5.14	36	2.83	9.34	25
	2006	7.48	51	3.33	16.80	62
	2007	5.91	50	2.68	13.05	45
	2008	6.95	56	2.87	16.82	34
	2009	13.17	34	7.59	22.86	65
	2010	4.68	10	3.97	5.53	25
Spotted Towhee	2004	26.25	42	13.45	51.23	59

Common Name	Year	D	%CV	LCL	UCL	n
	2005	26.88	25	17.75	40.70	47
	2006	48.39	21	34.43	68.00	165
	2007	29.62	32	17.50	50.14	82
	2008	30.16	32	17.99	50.56	87
	2009	26.11	32	15.57	43.77	86
	2010	15.31	9	13.07	17.93	42
Chipping Sparrow	2004	2.06	12	1.69	2.51	5
	2005	4.80	14	3.79	6.07	13
	2006	5.96	14	4.70	7.56	16
	2007	2.66	12	2.18	3.25	6
	2008	3.76	12	3.07	4.61	8
	2009	12.36	13	9.92	15.40	29
	2010	6.10	14	4.87	7.63	12
Clay-colored Sparrow	2004	0.00	0	0.00	0.00	0
	2005	5.22	14	4.13	6.60	20
	2006	4.21	14	3.34	5.32	17
	2007	2.26	14	1.79	2.85	6
	2008	2.99	14	2.36	3.80	9
	2009	6.12	15	4.78	7.83	21
	2010	4.12	15	3.22	5.27	12
Field Sparrow	2004	5.32	27	3.23	8.75	9
	2005	6.91	39	3.71	12.87	67
	2006	10.13	35	5.76	17.83	106
	2007	11.13	32	6.65	18.63	87
	2008	24.99	23	17.18	36.36	102
	2009	11.57	40	6.11	21.88	89
	2010	7.10	9	6.13	8.23	49
Vesper Sparrow	2004	10.90	42	5.51	21.55	39
	2005	16.21	26	10.54	24.92	91
	2006	24.85	28	15.89	38.85	160
	2007	7.84	44	3.88	15.81	77
	2008	40.37	23	27.42	59.42	64
	2009	10.97	39	5.88	20.45	72
	2010	17.27	77	15.30	19.50	65
Lark Sparrow	2004	2.30	18	1.72	3.09	9
	2005	1.38	18	1.03	1.84	6
	2006	4.79	19	3.49	6.58	19
	2007	13.90	19	10.20	18.94	42
	2008	2.34	18	1.74	3.14	8
	2009	4.35	25	2.87	6.61	10
	2010	10.34	23	7.06	14.15	26
Lark Bunting	2004	4.33	18	3.19	5.89	24
	2005	2.43	62	0.79	7.43	6
	2006	1.38	38	0.70	2.72	6
	2007	0.47	17	0.35	0.62	2
	2008	0.41	17	0.31	0.55	2
	2009	1.81	27	1.13	2.88	7
	2010	0.38	23	0.26	0.56	2

Common Name	Year	D	%CV	LCL	UCL	n
Savannah Sparrow	2004	2.21	15	1.72	2.83	5
	2005	3.96	18	2.93	5.34	9
	2006	1.13	15	0.88	1.45	3
	2007	3.43	15	2.67	4.40	6
	2008	5.55	16	4.23	7.27	11
	2009	6.19	16	4.72	8.11	14
	2010	3.64	15	2.83	4.70	48
Grasshopper Sparrow	2004	166.73	20	120.42	230.84	87
	2005	94.85	23	65.09	138.21	183
	2006	55.07	34	32.01	94.73	160
	2007	30.20	69	10.66	85.56	103
	2008	41.33	39	22.01	77.61	94
	2009	63.62	38	34.42	117.60	113
	2010	61.28	13	49.50	75.87	119
Chestnut-collared Longspur	2004	2.27	30	1.40	3.69	7
	2005	0.00	0	0.00	0.00	0
	2006	8.29	34	4.79	14.34	19
	2007	0.84	30	0.52	1.36	2
	2008	4.82	30	2.97	7.83	13
	2009	7.79	30	4.75	12.79	24
	2010	4.31	15	3.34	5.56	10
Lazuli Bunting	2004	1.04	15	0.80	1.34	3
	2005	1.24	15	0.96	1.60	4
	2006	1.47	15	1.14	1.90	5
	2007	7.14	17	5.41	9.43	16
	2008	2.76	15	2.14	3.56	7
	2009	4.49	16	3.45	5.84	13
	2010	2.48	16	1.89	3.26	5
Bobolink	2004	0.46	17	0.35	0.61	3
	2005	0.14	16	0.11	0.18	1
	2006	1.84	17	1.39	2.44	14
	2007	3.59	18	2.65	4.88	18
	2008	0.00	0	0.00	0.00	0
	2009	0.00	0	0.00	0.00	0
	2010	5.55	18	4.09	7.53	29
Red-winged Blackbird	2004	2.31	67	0.77	6.94	12
	2005	2.84	57	1.07	7.52	11
	2006	2.00	103	0.45	8.83	17
	2007	1.86	81	0.54	6.43	18
	2008	5.67	2	5.43	5.91	1
	2009	0.97	38	0.47	2.00	7
	2010	2.63	16	2.03	3.42	13
Western Meadowlark	2004	35.87	26	23.40	54.98	156
	2005	26.31	22	18.48	37.46	266
	2006	67.68	24	45.59	100.48	342
	2007	17.84	35	10.14	31.41	152
	2008	55.75	23	38.14	81.50	180
	2009	39.45	29	24.82	62.71	262

Common Name	Year	D	%CV	LCL	UCL	n
	2010	42.17	10	35.26	50.43	213
Brown-headed Cowbird	2004	27.52	28	17.48	43.33	36
	2005	7.78	55	3.23	18.71	26
	2006	22.20	35	12.61	39.11	84
	2007	7.53	62	2.85	19.92	32
	2008	9.48	72	3.05	29.46	18
	2009	27.82	26	18.31	42.27	58
	2010	22.28	8	19.59	25.34	51
American Goldfinch	2004	3.12	69	0.71	13.70	3
	2005	3.84	29	2.40	6.16	11
	2006	2.99	29	1.87	4.78	9
	2007	10.09	29	6.29	16.17	20
	2008	5.03	33	2.91	8.67	10
	2009	0.78	29	0.49	1.25	2
	2010	3.98	29	2.49	6.38	7

Table 3. Sheyenne National Grassland density estimates of breeding birds by year. D = Density estimate expressed in birds/ km^2, LCL & UCL = 90% lower and upper confidence limits of D, n = number of detections used to obtain density estimates, %CV = percent coefficient of variation.

Common Name	Year	D	%CV	LCL	UCL	n
Ring-necked Pheasant	2004	0.36	83	0.00	35.30	2
	2005	0.92	55	0.33	2.58	6
	2006	2.46	44	1.12	5.39	9
	2007	1.46	35	0.82	2.62	18
	2008	7.79	31	4.60	13.19	14
	2009	4.47	52	1.89	10.56	12
	2010	3.58	17	2.71	4.73	12
Killdeer	2004	11.03	2	10.55	11.53	1
	2005	3.03	41	1.46	6.29	8
	2006	1.76	76	0.39	8.04	4
	2007	1.79	31	1.05	3.06	11
	2008	41.88	62	13.90	126.18	6
	2009	16.34	62	5.38	49.61	6
	2010	10.58	21	7.50	14.93	9
Upland Sandpiper	2004	5.41	14	4.25	6.89	13
	2005	5.85	15	4.51	7.59	15
	2006	6.11	15	4.75	7.85	15
	2007	10.30	20	7.17	14.82	27
	2008	12.21	15	9.46	15.76	24
	2009	7.05	15	5.44	9.12	10
	2010	6.82	26	4.46	10.43	9
Wilson's Snipe	2004	0.24	36	0.14	0.43	1
	2005	1.37	36	0.77	2.45	6
	2006	0.67	49	0.26	1.74	2
	2007	6.26	38	3.40	11.54	27

Common Name	Year	D	%CV	LCL	UCL	n
	2008	3.28	39	1.74	6.20	11
	2009	6.61	41	3.41	12.79	15
	2010	72.36	49	33.37	156.92	35
Mourning Dove	2004	2.74	17	2.08	3.61	8
	2005	8.01	21	5.63	11.39	25
	2006	6.59	20	4.75	9.14	20
	2007	18.20	25	11.90	27.82	49
	2008	2.51	26	1.61	3.91	5
	2009	8.69	32	4.71	16.02	15
	2010	2.98	19	2.19	4.05	6
Eastern Kingbird	2004	3.79	18	2.81	5.12	5
	2005	18.46	22	12.80	26.64	12
	2006	12.52	20	8.98	17.43	16
	2007	17.38	21	12.35	24.64	24
	2008	8.34	24	5.60	12.42	25
	2009	16.69	25	10.99	25.34	6
	2010	1.13	13	0.91	1.38	1
House Wren	2004	1.16	33	0.68	1.99	2
	2005	0.55	33	0.32	0.93	1
	2006	6.41	34	3.68	11.16	11
	2007	13.35	35	7.52	23.68	25
	2008	0.71	33	0.42	1.22	1
	2009	3.94	34	2.28	6.83	4
	2010	4.49	34	2.58	7.80	5
Sedge Wren	2004	0.00	0			0
	2005	0.00	0			0
	2006	70.69	34	38.75	128.95	46
	2007	36.61	47	15.31	87.59	70
	2008	82.94	24	54.54	126.13	28
	2009	0.00	0			0
	2010	21.96	19	15.97	30.19	14
Common Yellowthroat	2004	8.19	12	6.64	10.11	13
	2005	12.98	13	10.37	16.25	22
	2006	21.95	17	15.99	30.13	38
	2007	23.11	18	16.54	32.29	40
	2008	36.20	29	20.91	62.65	47
	2009	20.26	22	12.87	31.89	19
	2010	13.35	12	10.92	16.34	14
Clay-colored Sparrow	2004	12.14	17	9.00	16.37	21
	2005	19.48	24	12.58	30.16	36
	2006	13.25	16	10.06	17.45	25
	2007	31.79	30	18.01	56.12	60
	2008	24.02	26	14.66	39.34	34
	2009	12.72	16	9.35	17.29	13
	2010	15.86	15	12.13	20.74	18
Vesper Sparrow	2004	0.25	19	0.18	0.34	1
	2005	0.46	19	0.34	0.63	2
	2006	2.72	21	1.92	3.85	12

Common Name	Year	D	%CV	LCL	UCL	n
	2007	2.95	23	2.02	4.31	13
	2008	0.30	19	0.22	0.41	1
	2009	0.84	20	0.60	1.17	2
	2010	0				0
Savannah Sparrow	2004	13.86	25	9.21	20.88	9
	2005	11.54	23	7.86	16.94	8
	2006	18.36	27	11.77	28.64	13
	2007	16.95	25	11.24	25.55	12
	2008	43.30	34	24.32	77.10	23
	2009	10.43	24	7.06	15.39	4
	2010	56.38	45	24.30	130.84	24
Grasshopper Sparrow	2004	60.88	19	43.23	85.74	38
	2005	137.55	35	71.49	264.66	91
	2006	58.75	18	42.53	81.15	40
	2007	63.15	22	42.42	94.01	43
	2008	54.83	29	31.79	94.57	28
	2009	73.21	48	26.26	204.11	26
	2010	25.86	19	18.27	36.60	10
Dickcissel	2004	1.03	19	0.74	1.42	1
	2005	0.00				0
	2006	32.03	28	20.00	51.30	32
	2007	6.59	19	4.77	9.12	7
	2008	0.00				0
	2009	0.00				0
	2010	0				0
Bobolink	2004	10.92	14	8.64	13.82	11
	2005	38.12	21	26.00	55.89	41
	2006	15.48	17	11.71	20.45	15
	2007	17.39	37	9.32	32.44	12
	2008	24.27	44	10.86	54.27	16
	2009	38.65	29	21.42	69.75	23
	2010	49.46	21	33.88	72.22	26
Red-winged Blackbird	2004	18.41	68	6.46	52.46	32
	2005	26.52	40	13.85	50.77	35
	2006	64.66	45	30.97	134.99	69
	2007	71.57	40	35.66	143.63	77
	2008	137.10	53	53.89	348.79	67
	2009	194.79	66	51.34	739.00	69
	2010	122.97	40	56.74	266.55	87
Western Meadowlark	2004	17.47	19	12.42	24.57	35
	2005	44.38	44	19.19	102.65	95
	2006	37.51	37	18.55	75.85	82
	2007	18.18	21	12.29	26.88	40
	2008	26.84	28	15.87	45.39	43
	2009	39.69	48	14.08	111.94	45
	2010	17.12	18	12.17	24.24	29
Brown-headed Cowbird	2004	11.81	27	7.53	18.51	34
	2005	0.02	31	0.01	0.04	19

Common Name	Year	D	%CV	LCL	UCL	n
	2006	17.19	28	10.85	27.24	34
	2007	14.20	28	8.82	22.88	37
	2008	5.52	55	2.16	14.08	9
	2009	11.16	42	5.54	22.50	15
	2010	25.45	17	18.97	34.15	15
American Goldfinch	2004	0.00				0
	2005	2.07	42	0.73	5.82	3
	2006	4.45	14	3.52	5.62	11
	2007	12.54	21	8.72	18.03	31
	2008	0.00				0
	2009	9.71	22	6.50	14.49	12
	2010	12.10	41	6.23	23.49	11

Table 4. Density estimates for species of interest on 3 national grasslands, Little Missouri, Grand River and Sheyenne. Density estimates were calculated by combining Little Missouri, Grand River and Sheyenne detections. D = Density estimate expressed in birds/ km^2, LCL & UCL = 90% lower and upper confidence limits of D, n = number of detections used to obtain density estimates, %CV = percent coefficient of variation.

Common Name	Year	D	%CV	LCL	UCL	n
Upland Sandpiper	2004	8.59	8	7.57	9.75	74
	2005	4.22	8	3.73	4.78	38
	2006	11.15	8	9.70	12.81	98
	2007	9.00	8	7.88	10.28	69
	2008	16.29	9	13.97	19.00	114
	2009	6.26	8	5.46	7.19	46
	2010	10.78	5	9.96	11.68	70
Sprague's Pipit	2004	2.04	8	1.80	2.31	30
	2005	8.34	8	7.35	9.45	128
	2006	1.59	7	1.41	1.79	26
	2007	4.28	9	3.67	5.00	56
	2008	0.25	7	0.22	0.28	3
	2009	5.44	8	4.78	6.18	74
	2010	2.03	7	1.80	2.28	24
Lark Bunting	2004	5.54	50	2.50	12.28	56
	2005	16.46	26	10.84	24.99	69
	2006	3.94	46	1.90	8.19	51
	2007	10.05	29	6.24	16.17	133
	2008	5.07	57	2.02	12.70	21
	2009	7.63	31	4.55	12.80	21
	2010	4.00	7.51	3.53	4.53	29
Chestnut-collared Longspur	2004	4.52	15	3.52	5.81	18
	2005	4.09	20	2.94	5.67	14

	2006	8.79	19	6.48	11.93	27
	2007	22.02	16	16.81	28.84	78
	2008	7.11	15	5.53	9.14	23
	2009	23.04	16	17.75	29.90	79
	2010	13.00	7	11.63	14.61	42
Grasshopper Sparrow	2004	114.89	21	81.92	161.13	161
	2005	109.77	16	84.92	141.91	349
	2006	52.19	26	34.46	79.04	265
	2007	23.89	12	19.76	28.90	194
	2008	48.98	29	30.71	78.13	172
	2009	85.82	24	57.84	127.33	234
	2010	67.20	6.13	60.71	74.38	220

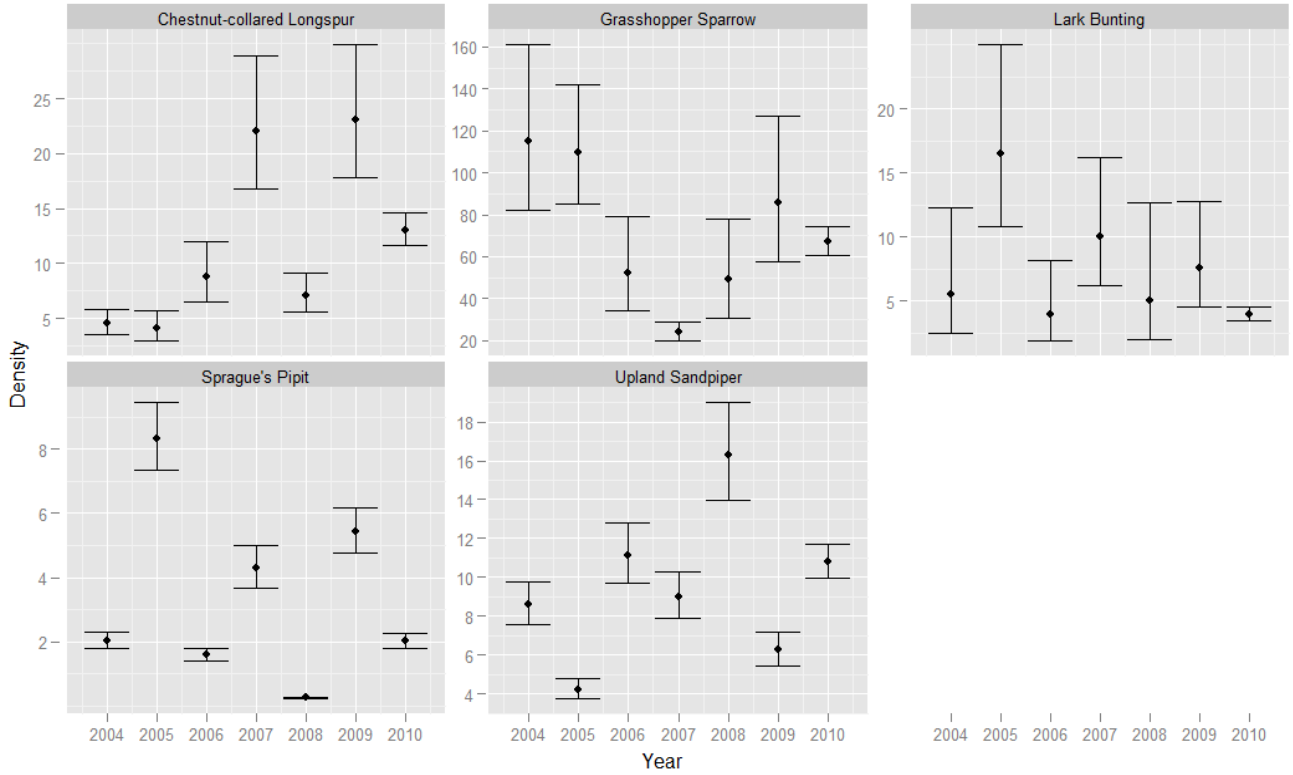

Figure 3. Species of interest density estimates (birds/km^2) by year with 90% confidence intervals.

Table 5. Hierarchical distance sampling model selection results for Sprague's Pipit. The Full model included 3 variables percent shrub cover, grass height and percent grass cover.

Model	K	AIC	ΔAIC	AIC wt
Shrub	3	809.39	0	0.34
Shrub + Grass Height	4	809.63	0.24	0.30
Grass Cover +Shrub	4	810.33	0.93	0.21
Full	5	811.02	1.62	0.15
Null	2	820.65	11.25	0.00
Grass Height	3	821.54	12.14	0.00
Grass Cover	3	821.89	12.5	0.00
Grass Cover + Grass Height	4	823.05	13.66	0.00

Table 6. Hierarchical distance sampling parameter estimates for Sprague's Pipit Full model.

	Estimate	SE	% CV
Intercept	1.82	0.19	10
Shrub Cover	-0.81	0.29	36
Grass Height	0.12	0.10	84
Grass Cover	0.09	0.12	128

Discussion

Density estimates will allow us to estimate population trends, a major conservation need for grassland birds. Density estimates showed a high amount of variability from year to year for most species. Mechanisms causing the variability in density are important to understand and may be addressed by using covariates thought to influence density and detection probabilities when estimating density. A hierarchical model may be used to estimate covariate effects on both density and detection.

Management actions may be assessed by observing patterns of change for a specific or group of species that are integral and assumed to sustain components and process that make the ecosystem function (Manley et al., 2004). These long term datasets can be used to develop management plans to sustain healthy bird populations and ecosystem integrity. Long term datasets will also help us predict and understand climate and landscape changes.

In 2010 the U.S Fish and Wildlife Service found that Sprague's Pipit warranted listing under the Endangered Species Act but was precluded due to other priority listing actions. Sprague's Pipit warrants listing due to loss of habitat and lack of existing regulations to protect current available habitat.
Competing hierarchical distance sampling models for Sprague's Pipit included a combination of 3 variables, percent shrub cover, percent grass cover and grass height. Grass cover and grass height were covariates in 3 of the 4 competing models with delta AICs less than 2 which indicate that these variables are important for modeling Sprague's Pipit density. However parameter estimates for both covariates had large standard errors making it difficult to make a statement on effect size for these covariates. We think that the large standard errors may be due to the ocular estimates used to collect the vegetation data. As expected shrub cover had a strong negative relationship on density. Using the shrub cover parameter estimate to predict density at different percent shrub cover values while grass height and percent grass cover are held at their mean showed that density fell below 1.45 birds/km^2 when percent shrub cover was higher than 25%. Based on Sprague's Pipit ecology and the hierarchical model results we recommend maintaining shrub cover below 5% and maximizing areas with grass cover greater than 50% and grass height > 15 cm when managing for Sprague's Pipits to help increase the probability for this species to persist.
To our knowledge this is the first model that takes both detection probability and covariates on density into account when modeling Sprague's Pipit density. When estimating abundance or occupancy state parameters it is important to estimate detection probabilities since it is impossible to determine whether a change in the number of individuals counted by surveys conducted at various points in time or space is due to a change in the size of the populations or to changes in detection probabilities (Mackenzie and Kendall 2002).

Recreational birding is a growing hobby in the United States and can have a positive impact on local economies. A report by the US Fish and Wildlife Service (2009) determined that 82 billion dollars was generated by the recreational birding industry and

11 billion in local, state and federal tax revenue in 2006. National Grasslands in the Dakotas are diverse and contain highly sought birds by birders such as Sprague's Pipit, Baird's Sparrow, Chestnut-collared Longspur and LeConte's Sparrow. Monitoring will have a positive impact on the local economy, conservation and recreational birding.

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APPENDIX A. List of Priority Species detected in 2010.

Common Name	BCR 17	BCR 11	NDGFD	USFS R1
Northern Pintail			LII	
Sharp-tailed Grouse	CS,RS	RC,CS,RS	LII	S
Northern Harrier	RC	RC,RS	LII	
Upland Sandpiper			LI	
Marbled Godwit			LI	
Wilson's Phalarope			LI	
Northern Flicker		RC		
Say's Phoebe	RS			
Horned Lark		RC,RS		
Mountain Bluebird	RC			
Brown Thrasher		RC		
Sprague's Pipit	CC,RC	CC,RC,CS,RS	LI	S
Clay-colored Sparrow		RC,RS		
Vesper Sparrow	RC			
Lark Bunting	RC,CS,RS	RC	LI	
Grasshopper Sparrow	RC,CS,RS	RC	LI	
Baird's Sparrow	CC,RC	CC,RC,CS,RS	LI	S
Chestnut-collared Longspur	RC,CS,RS	RC,CS,RS	LI	
Bobolink			LII	
Western Meadowlark		RC		

BCR 17 and 11 (PIF); cc= continental concern, rc =regional concern, cs= continental stewardship, rs = regional stewardship. North Dakota Game and Fish (NDGFD); LI= Level 1 (Species in greatest need of conservation), LII=Level 2 (Species in need of conservation, but that have had support from other wildlife programs), USFS Region 1 (USFS R1); S= sensitive species or management indicator species.

APPENDIX B - Species List. Number of detections for species recorded on Grand River, Little Missouri and Sheyenne National Grasslands in 2010.

Common Name	Scientific Name	Grand River	Little Missouri	Sheyenne	Grand Total
Gadwall	Anas strepera	6	7	1	14
Mallard	Anas platyrhynchos	10		15	25
Blue-winged Teal	Anas discors	1	1	20	22
Northern Shoveler	Anas clypeata	1	2	12	15
Northern Pintail	Anas acuta	1		12	13
Green-winged Teal	Anas crecca			1	1
Redhead	Aythya americana			1	1
Lesser Scaup	Aythya affinis		2		2
Ruddy Duck	Oxyura jamaicensis		1		1
Ring-necked Pheasant	Phasianus colchicus	17	16	12	45
Sharp-tailed Grouse	Tympanuchus phasianellus	1	5		6
Wild Turkey	Meleagris gallopavo	1	4		5
American White Pelican	Pelecanus erythrorhynchos	7	22		29
American Bittern	Botaurus lentiginosus			10	10
Great Blue Heron	Ardea herodias			1	1
Turkey Vulture	Cathartes aura		1		1
Bald Eagle	Haliaeetus leucocephalus			1	1
Northern Harrier	Circus cyaneus		2		2
Swainson's Hawk	Buteo swainsoni	1	5		6
Red-tailed Hawk	Buteo jamaicensis		1	3	4
Golden Eagle	Aquila chrysaetos		1		1
American Kestrel	Falco sparverius	2	2	2	6
Virginia Rail	Rallus limicola			2	2
Sora	Porzana carolina			27	27

Common Name	Scientific Name	Grand River	Little Missouri	Sheyenne	Grand Total
American Coot	Fulica americana		3	4	7
Killdeer	Charadrius vociferus	7	7	9	23
Solitary Sandpiper	Tringa solitaria			1	1
Willet	Catoptrophorus semipalmatus		1		1
Upland Sandpiper	Bartramia longicauda	29	37	9	75
Long-billed Curlew	Numenius americanus		1		1
Marbled Godwit	Limosa fedoa	9	6	8	23
Wilson's Snipe	Gallinago delicata		1	36	37
Wilson's Phalarope	Phalaropus tricolor	2	2	17	21
Mourning Dove	Zenaida macroura	18	45	6	69
Common Nighthawk	Chordeiles minor	2	2		4
Downy Woodpecker	Picoides pubescens		1		1
Hairy Woodpecker	Picoides villosus		1		1
Northern Flicker	Colaptes auratus	7	15	3	25
Least Flycatcher	Empidonax minimus	1	13	7	21
Say's Phoebe	Sayornis saya	1	2		3
Western Kingbird	Tyrannus verticalis	11	8		19
Eastern Kingbird	Tyrannus tyrannus	11	12	1	24
Warbling Vireo	Vireo gilvus	1			1
Red-eyed Vireo	Vireo olivaceus		14		14
Black-billed Magpie	Pica hudsonia		9		9
American Crow	Corvus brachyrhynchos	2	20	1	23
Common Raven	Corvus corax		1		1
Horned Lark	Eremophila alpestris	49	43		92
Tree Swallow	Tachycineta bicolor			8	8
Northern Rough-winged Swallow	Stelgidopteryx serripennis	2			2

Common Name	Scientific Name	Grand River	Little Missouri	Sheyenne	Grand Total
Cliff Swallow	Petrochelidon pyrrhonota	10	3		13
Barn Swallow	Hirundo rustica		2	5	7
Black-capped Chickadee	Poecile atricapillus			1	1
Rock Wren	Salpinctes obsoletus	1	9		10
House Wren	Troglodytes aedon	4	48	5	57
Sedge Wren	Cistothorus platensis			14	14
Marsh Wren	Cistothorus palustris			3	3
Eastern Bluebird	Sialia sialis			3	3
Mountain Bluebird	Sialia currucoides		8		8
American Robin	Turdus migratorius	3	3	4	10
Gray Catbird	Dumetella carolinensis		2		2
Brown Thrasher	Toxostoma rufum		2		2
European Starling	Sturnus vulgaris	2	2	12	16
Sprague's Pipit	Anthus spragueii	4	23		27
Cedar Waxwing	Bombycilla cedrorum		6		6
Yellow Warbler	Dendroica petechia	8	53	15	76
Black-and-white Warbler	Mniotilta varia		7		7
American Redstart	Setophaga ruticilla		7	3	10
Ovenbird	Seiurus aurocapilla		9		9
Common Yellowthroat	Geothlypis trichas	1	9	17	27
Wilson's Warbler	Wilsonia pusilla			1	1
Yellow-breasted Chat	Icteria virens		26		26
Spotted Towhee	Pipilo maculatus	1	47		48
Chipping Sparrow	Spizella passerina		14	1	15
Clay-colored Sparrow	Spizella pallida		14	18	32
Field Sparrow	Spizella pusilla		53		53

Common Name	Scientific Name	Grand River	Little Missouri	Sheyenne	Grand Total
Vesper Sparrow	Pooecetes gramineus	1	72		73
Lark Sparrow	Chondestes grammacus		27		27
Lark Bunting	Calamospiza melanocorys	29	2		31
Savannah Sparrow	Passerculus sandwichensis		11	28	39
Grasshopper Sparrow	Ammodramus savannarum	100	144	11	255
Baird's Sparrow	Ammodramus bairdii	4	20		24
Le Conte's Sparrow	Ammodramus leconteii			9	9
Song Sparrow	Melospiza melodia		1	1	2
Chestnut-collared Longspur	Calcarius ornatus	33	10		43
Black-headed Grosbeak	Pheucticus melanocephalus		3		3
Lazuli Bunting	Passerina amoena		6		6
Dickcissel	Spiza americana	1			1
Bobolink	Dolichonyx oryzivorus	3	31	29	63
Red-winged Blackbird	Agelaius phoeniceus	22	16	173	211
Western Meadowlark	Sturnella neglecta	177	229	29	435
Yellow-headed Blackbird	Xanthocephalus xanthocephalus		4	21	25
Brewer's Blackbird	Euphagus cyanocephalus		12		12
Common Grackle	Quiscalus quiscula	1		18	19
Brown-headed Cowbird	Molothrus ater	66	63	28	157
Bullock's Oriole	Icterus bullockii		1		1
American Goldfinch	Carduelis tristis	1	8	12	21