Distribution and habitat associations of Baird's sparrows and Sprague's pipits on the Grand River National Grassland, South Dakota

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SUMMARY

Between May 14 and June 3, 2005 I conducted grassland bird surveys at 94 points distributed throughout the Grand River National Grassland (GRNG), focusing on Baird's sparrows (*Ammodramus bairdii*) and Sprague's pipits (*Anthus spragueii*). At each point I counted the number of birds within and outside a 100-m radius circle for 10 minutes, and characterized the surrounding habitat. In addition, I determined habitat characteristics at 24 points where I incidentally detected either Baird's sparrows or Sprague's pipits. The occurrence of both Baird's sparrows and Sprague's pipits increased with litter depth and with the occurrence of crested wheat-grass (*Agropyron desertorum*). The species differed in their response to the percentage of woody vegetation within a 300-m radius: whereas the probability of occurrence of Baird's sparrows decreased with increasing woody cover, the distribution of Sprague's pipits was not recognizably influenced by woody cover. However, the range of woody cover among census points was low (0-7%, $\bar{x} = 0.85\%$). The largest amount of variation in bird occurrence and vegetation variables was among sites, not among pastures. This indicates that differences in grazing pressures among pastures on Grand River National Grassland causes relatively little variation in the species' occurrence and in vegetation structure compared to other factors that vary among sites. Future research should (1) determine if the distribution of Sprague's pipits and Baird's sparrows across GRNG and the relation between bird distribution and vegetation variables are consistent among years, (2) conduct detailed observations of Sprague's pipits to better describe the habitat in which the species occurs on the ground, (3) determine if an increase in litter depth and vegetation height will cause an increase in the population of Sprague's pipits and Baird's sparrows on GRNG, (4) determine which factors are responsible for the greater variation in bird occurrence within pastures than among pastures, and (5) determine singing patterns of the species to develop a more reliable estimate of their distributions based on an index of detectability.

INTRODUCTION

Baird's sparrows and Sprague's pipits are both species of high conservation concern in South Dakota. Therefore the South Dakota Ornithologists' Union has identified the need for more surveys of both species (Peterson 1995). Both species reach their southern limit of their breeding range in northern South Dakota. Most research on these species has been conducted farther north, in more central portions of the species' ranges (Sutter and Brigham 1998, Davis et al.

1999, Madden et al. 2000, Davis 2003, Dieni and Jones 2003). However, both the abundance of grassland birds and the factors that influence their distributions can vary greatly among regions (Igl and Johnson 1999, Winter et al. 2005). Therefore, the features that have previously been described to influence the species' distribution in the center of their ranges might not apply to the populations breeding at the edge of the species' ranges (Brown et al. 1996). In fact, the factors that influence the distribution of the two species on the GRNG are mainly unknown (Dan Svingen, personal communication).

The GRNG provides one of the best breeding habitats for Baird's sparrows and Sprague's pipits in South Dakota. Appropriate management for these species within the GRNG is therefore of high conservation importance. In 2001, Knowles surveyed grassland birds at 133 points on the Grand River National Grassland. However, because of high variation in the distribution of many grassland passerines within and among years (Igl and Johnson 1997, Winter et al. 2005), single surveys may not accurately reflect the distribution of grassland birds in a given area. In addition, Knowles did not quantify the specific habitat features that were associated with the occurrence of the species.

Currently, the USDA Forest Service is revising the management guidelines for the GRNG. Additional information on the distribution, abundance, and habitat associations of these key species thus is timely and will help to make the forthcoming management revisions more effective in conserving the species.

METHODS

Study site. – Grand River National Grassland is the largest of the 3 National Grasslands in the Dakotas. It covers an area of 62,726 ha of mostly mixed grass prairie within rolling hills and buttes. This area is divided into > 60 different grazing allotments, most of which are subdivided into sub-pastures through which cattle rotates during the course of a grazing season.

Selection of point count stations. - I established 12 routes throughout GRNG along which I placed 94 point count stations within as many different pastures as possible in order to determine the effect of grazing regime on bird distribution (Fig. 1). Point count stations were located within 35 different pastures, and in 80 different sub-pastures. Large pastures were sampled at 1-3 points, whereas smaller pastures were sampled at one point only. Point count stations were (1) > 100 m from a fence-line, (2) > 100 m from a gravel road, (3) at a position that allowed for a relatively open view of at least 75% of a 100-m circle, (4) at least 500 m from another point count station, and (5) within the property of GRNG. Apart from these rules, I placed point count

stations haphazardly, depending on road conditions and travel time. I attempted to sample within as many pastures as possible, given these logistical constraints.

Bird censuses. - I conducted 94 point counts throughout the GRNG. Most species were counted within a 100-m fixed radius surrounding the point count station. The focal species (Sprague's pipits and Baird's sparrows), and large-bodied species such as raptors and sharp-tailed grouse, were also counted within an unlimited radius. Before the onset of each point count I categorized wind speed and cloud cover according to the BBIRD protocol, and measured air temperature.

Generally, I conducted censuses between 5 am and 11 am, but on several days strong winds prevented me from surveying after 9 am, and on days with rainy mornings I also conducted afternoon and evening surveys. I did not census during rain. However, the prevalence of windy days during the course of the study required that I also conducted censuses at relatively high wind speeds. I visited each point count station twice, rotating the starting time between censuses.

Habitat characterization. - At each point count station I measured the exact geographic position and the elevation of survey points with a Garmin V GPS unit. From these data, information on slope and aspect of each point was determined using ARC/GIS. Elevation data derived from the DEM-layer in ARC/GIS greatly correlated with the elevation data derived from the GPS unit ($r = 0.96$, $P < 0.001$, $n = 93$), confirming that elevation data derived from the GPS unit are correct. I estimated the percentage of woody vegetation (shrubs and trees) within a 300-m radius, and used a laser range finder to measure the distance to the closest tall (> 1 m) shrub or tree. Any distance greater than 600 m (=infinite) was set to 1000 m in order to have only numerical data for analyses.

I measured ground cover, litter depth, and vegetation height at eight equally spaced vegetation points around a 20-m radius circle around each census point. At each vegetation point I used a 20*50 cm Daubenmire frame to determine the percentage of ground cover by bare soil and litter. At each of the 4 corners of the Daubenmire frame I measured litter depth and vegetation height. For analysis, I used the mean value for the 8 cover values, and for the 32 measurements of litter depth and vegetation height, that were collected at each census point. I also noted if crested wheat-grass and Kentucky bluegrass were abundant within 20 m of a census point. In addition, I characterized habitat at 24 sites where I incidentally observed either Sprague's pipits or Baird's sparrows.

Grazing information. - Grazing data for individual pastures were obtained from Dan Svingen (U.S. Forest Service, Bismarck, ND). I used the number of acres per animal month as indicators for grazing intensity in the analysis.

ANALYSIS

I compared vegetation and topographical characteristics between sites where I did and did not detect the focal species, using a t-test (PROC TTEST; SAS 1999). For this analysis I used the point count sites plus the sites where I had detected either one of the two species. Because many vegetation variables were highly correlated, I used principal components analysis to identify a reduced and relatively independent set of variables for my analyses (PROC PRINCOMP; SAS 1999). I selected 3 variables that had high loadings on one of the first 3 principal components (Table 1): woody cover within a 300-m radius, litter depth, and presence of crested wheat-grass. I selected the percentage of woody cover within a 300-m radius instead of the distance to shrubs or to trees, because it better describes the amount of woody vegetation in the entire surrounding of a point. I restricted all further analyses to those three variables. However, it is important to keep in mind that high woody cover within a 300-m radius was correlated with shorter distances to shrubs ($r = -0.55$) and trees ($r = -0.52$); deep litter was correlated with low soil cover ($r = -0.61$), high litter cover ($r = 0.65$), and tall vegetation ($r = 0.68$); and presence of crested wheat-grass was correlated with tall vegetation ($r = 0.26$) and deep litter ($r = 0.21$; $n = 118$). The species' responses to the selected variables might therefore be either due to a direct response to the variable in the statistical models or due to a response to other correlated variables. I also used t-tests to determine if the 3 selected variables differed between sites where Baird's sparrows were present compared to sites where Sprague's pipits were present. To investigate if the presence of Baird's sparrows was related to the presence of Sprague's pipits, I used a χ^2 contingency-table test.

Relative abundance of the two focal species was so low that at most census points I only observed zero or one of the focal species. To determine the influence of the 3 selected vegetation variables on the species' distribution, I therefore analyzed presence/absence data only, using the GLIMMIX macro in association with PROC MIXED in SAS, with 2 random variables: pasture, and sub-pasture within pasture. For this analysis I used the combined data set of point count sites plus sites where I had observed at least one of the focal species. To present the results from the analyses graphically, I calculated predicted values of the species' relative abundances given a specific percentage of woody vegetation, litter height, and probability of

presence of crested wheat-grass. In addition, I used the GLIMMIX macro to investigate the influence of geographic position, elevation, slope, aspect, windspeed, and temperature on the distribution of the species, using point count sites only.

I used the maximum likelihood approach in PROC VARCOMP (SAS 1999) to quantify the partitioning of variance of vegetation features and bird occurrence among sub-pastures within pastures, and among pastures. I then calculated the proportion of variation accounted for by each random effect and by the error estimate (sites within sub-pasture).

I restricted all analyses to the birds detected inside a 100-m radius, because birds detected outside of this circle are likely not associated with vegetation features measured within a 20-m radius around a census point.

RESULTS

During point counts I detected 40 bird species (Appendix). The most abundant species were grasshopper sparrows and chestnut-collared longspurs (Table 2). Baird's sparrows and Sprague's pipits were two of the least abundant grassland passerines. Baird's sparrow was almost twice as abundant as Sprague's pipit, but it was less widely distributed across GRNG: whereas Baird's sparrows were detected at only 19% of all point count sites, Sprague's pipits were detected at 24% of the sites (n = 94 sites).

Baird's sparrow. - Sites where Baird's sparrows were detected (BAIS-sites) differed from sites where the species was not detected in the following characteristics (Table 3): BAIS-sites were grazed less intensively (as reflected by a lower grazing code), had a higher occurrence of crested wheat-grass and Kentucky bluegrass, a lower percentage of woody vegetation within a 300-m radius, less bare soil, a higher ground cover by litter, deeper litter, higher vegetation, and a slightly larger distance to the closest tree.

Baird's sparrows preferred areas where crested wheat-grass was present (Table 4, Fig. 2 c), potentially because vegetation was higher (11.56 ± 0.73 cm vs. 9.37 ± 0.39 cm, t = -2.89, P = 0.005, df= 116, n = 119), and litter was deeper (0.52 ± 0.07 cm vs. 0.33 ± 0.04, t = - 2.30, P = 0.02, df = 116, n = 119) in areas with crested wheat-grass.

The only topographic variable that influenced the distribution of Baird's sparrows was slope: the probability of encountering the species decreased in steeper areas (Table 5). Slope was correlated with two variables that influenced the distribution of this species: the percentage of woody vegetation within a 300-m radius (r = 0.28, P = 0.006, n = 94), and the probability of

crested wheat-grass occurrence (r = -0.22, P = 0.03, N = 94). Weather variables had no detectable effect on the probability of detecting the species (Table 5).

Sprague's pipit. – Sprague's pipits were associated with very similar vegetation variables as Baird's sparrows. SPPI-sites were less intensively grazed, had a higher occurrence of crested wheat-grass and Kentucky bluegrass, lower ground cover by bare soil, higher ground cover by litter, deeper litter, and higher vegetation (Table 3). However, contrary to Baird's sparrows, the species did not recognizably avoid woody vegetation (Table 3). The only detectable difference between BAIS- and SPPI-sites was therefore the percentage of woody vegetation within a 300-m radius (Tables 3, 6): SPPI-sites had a significantly higher percentage of woody vegetation close by than BAIS-sites.

As for Baird's sparrows, the probability of Sprague's pipit occurrence increased with the presence of crested wheat-grass and litter depth. These relationships were weaker than in the Baird's sparrow, as is indicated by shallower slopes of the regression coefficients (Table 4, Fig. 2. The amount of woody vegetation within a 300-m radius had no recognizable effect on the species (Table 4, Fig. 2 a). Topographic and climatic variables also had no recognizable effect on the occurrence of the pipit (Table 5).

Sprague's pipits and Baird's sparrows were positively associated ($\chi^2 = 15.15$, $P < 0.001$, n = 118). Baird's sparrows were detected at 61% of the sites where Sprague's pipits occurred (19 out of 31 points), whereas Sprague's pipits occurred at 49% of the sites where Baird's sparrows were present (19 out of 39 points).

Grazing.- The amount of variation in vegetation variables and bird occurrence among pastures was smaller than the amount of variation among sub-pastures within pastures (Table 6). The largest variation occurred among sites within sub-pastures (Table 6). Acres per animal month did not affect the distribution of either Baird's sparrows (-0.38 ± 0.52, P = 0.47, n = 81) or Sprague's pipits (0.14 ± 0.57, P = 0.81, N = 81).

DISCUSSION AND FUTURE NEEDS

The relationships between the occurrence of Baird's sparrows and Sprague's pipits with vegetation variables indicate that on GRNG the best predictor for the presence of both species is litter depth. This result is not surprising, because both species are known to require ground cover for feeding and nesting (Green et al. 2002, Robbins and Dale 1999). Whereas I found that the probability of the species' occurrences increases with litter depth, other studies described that the

species prefer an intermediate thickness of litter (e.g., Madden 1996, Winter 1999). This apparent difference likely is caused by the different amount of available litter on the different study sites. Mean litter depth on GRNG was very low ($x = 0.39 \pm 0.04$ cm), whereas, for example, mean litter depth in areas with highest Baird's sparrow density on Lostwood NWR, ND, was 2.8 ± 0.39 cm (Winter 1999).

The observation that Sprague's pipits were not negatively affected by proximity to woody cover is probably due to the low woody cover within 300 m of my census sites (0-7%). The species would likely show a negative response to woody cover if I had included more wooded areas in my censuses, as it has been demonstrated in other studies (Madden 1996, Sutter 1996). The apparent lack of woody plant avoidance of Sprague's pipits might also reflect the species' potential preference for sloping areas, because woody cover was positively associated with slope. However, I could not confirm statistically my personal impression that Sprague's pipits prefer sloping areas. Baird's sparrows, in contrast, seemed to prefer lower, flatter areas; although also not confirmed statistically, such a preference could be related to the species apparent avoidance of wooded sites or vice versa. Future studies should specifically investigate if Baird's sparrows and Sprague's pipits do have a preference for specific topographical features, independently of woody vegetation. If this were the case, then management could focus on those sites that are already more likely to support the species based on topographical features.

The preference of both species for crested wheat-grass is probably due to taller vegetation and deeper litter in areas where this introduced grass species is abundant. Other studies report that Sprague's pipits avoid crested wheat-grass (Dale 1990, Madden 1996), and list the introduction of non-native grasses as one of the major causes of the species' decline (summarized in Robbins and Dale 1999). This difference in the response to crested wheat-grass probably reflects the fact that litter depth was generally very low on GRNG; sites where crested wheat-grass occurred thus provided one of the more suitable habitats based on litter depth and vegetation height. It is important to recognize that some factors that are negative in one area can have a very different effect in other areas. This reconfirms the importance of duplicating studies across the entire range of a species' distribution; generalizations of results from one area to another might lead to inappropriate management decisions.

I expected that the number of cattle per area on a specific pasture would have an important influence on vegetation structure and the species' occurrences. Surprisingly, pasture (i.e. inter-pasture differences) was not the major cause for most variation in either vegetation variables or the species' distribution. Instead, most variation occurred among sites within sub-

pastures. This result likely indicates that at the present variation in stocking rates among pastures on GRNG the grazing pressure was so low that there is no recognizable effect of different grazing pressures on vegetation structure or the species' distribution. Instead, intrinsic differences among sites seem to have a greater effect on vegetation structure and bird distribution. Reconfirming this result, and detecting which features cause variation within sub-pastures will be one of my major tasks in the second year of this study.

Baird's sparrows were associated with the presence of Sprague's pipits, but Sprague's pipits were distributed over a wider area across GRNG. This indicates that Sprague's pipits might be somewhat more flexible in their habitat choice, accepting a wider range of habitat as suitable for nesting, but overlapping with the habitat requirements of Baird's sparrows. Specifically, Sprague's pipits require a less deep litter layer than Baird's sparrows (Green at al. 2002, Robbins and Dale 1999); consequently, many parts of GRNG are more suitable for Sprague's pipits than to Baird's sparrows.

Because populations of grassland nesting birds can vary greatly among years (Igl and Johnson 1999, Winter et al. 2005), management recommendations derived from my study cannot be safely given without reconfirming the described results in another year. Especially because the period of my study was quite windy and rainy, it would be important to repeat the study and thus to determine if my results can be generalized across years.

A continuation of the study would give a better understanding about the following questions:

1) Is the distribution of Sprague's pipits and Baird's sparrows consistent between years?
2) Are the habitat relationships consistent between years?
3) What is the relative role of woody vegetation and sloping areas for the distribution of Baird's sparrows and Sprague's pipits?
4) Is the presence of Baird's sparrows generally a good predictor for the presence of Sprague's pipits on GRNG? If this were the case, then management for pipits would be greatly simplified, because the occurrence of Baird's sparrows is more predictable, and the species is easier to detect.
5) What are the singing patterns of Sprague's pipits and Baird's sparrows? How frequently do they sing during the day? Automatic acoustical monitoring of the species would help to develop an index of detectability of the species on GRNG, and would thus give more reliable estimates of their distribution.

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LITERATURE CITATIONS

Brown, J. H., G. C. Stevens, and D. M. Kaufman. 1996. The geographic range: size, shape, boundaries, and internal structure. Annual Review of Ecology and Systematics 27: 597-623.

Dale, B. C. 1983. Habitat relationships of seven species of passerine birds at Last Mountain Lake, Saskatchewan. M.Sc. thesis, University of Regina, Regina, Saskatchewan.

Davis, S. K. 2003. Nesting ecology of mixed-grass prairie songbirds in southern Saskatchewan. Wilson Bulletin 115: 119-130.

Davis, S. K., D. C. Duncan, and M. Skeel. 1999. Distribution and habitat associations of three endemic grassland songbirds in southern Saskatchewan. Wilson Bulletin 111: 389-396.

Dieni, J. S., and S. L. Jones. 2003. Grassland songbird nest site selection patterns in north-central Montana. Wilson Bulletin 115: 388-396.

Green, M. T., P. E. Lowther, S. L. Jones, S. K. Davis, and B. C. Dale. 2002. Baird's Sparrow (*Ammodramus bairdii*). In The Birds of North America, No. 638 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Igl, L. D., and D. H. Johnson. 1997. Changes in breeding bird populations in North Dakota: 1967 to 1992-93. Auk 114: 74-92.

Igl, L. D., and D. H. Johnson. 1999. Le Conte's sparrows breeding in Conservation Reserve Program fields: precipitation and patterns of population change. Studies in Avian Biology 19: 178-186.

Knowles, C. 2001. A survey of the Grand River National Grassland, for Baird's sparrows, Sprague's pipits, burrowing owls, and other South Dakota sensitive bird species. South Dakota Department of Game, Fish and Parks, Pierre, SD.

Madden, E. M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixed-grass prairie in North Dakota. M.S. thesis, Montana State Univ., Bozeman.

Madden, E. M., R. K. Murphy, A. J. Hansen, and L. Murray. 2000. Models for guiding management of prairie bird habitat in northwestern North Dakota. American Midland Naturalist 144: 377-392.

Peterson, R. A. 1995. The South Dakota breeding bird atlas. South Dakota Ornithologists' Union. 276 pages.

Robbins, M. B., and B. C. Dale. 1999. Sprague's Pipit (*Anthus spragueii*). In The Birds of North America, No. 439 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

SAS Institute Inc. 1999. The SAS system for Windows, version 8.0. SAS Institute Inc., Cary, North Carolina, USA.

Sutter, G. C. 1996. Habitat selection and prairie drought in relation to grassland bird community structure and the nesting ecology of Sprague's Pipit, *Anthus spragueii*. Ph.D. diss., Univ. of Regina, Regina, Saskatchewan.

Sutter, G. C., and R. M. Brigham. 1998. Avifaunal and habitat changes resulting from conversion of native prairie to crested wheat grass: patterns at songbird community and species levels. Canadian Journal of Zoology 76: 869-875.

Winter, M. 1999. Impacts of fire on Baird's Sparrow habitat in northern mixed-grass prairie. Studies in Avian Biology 19:171-177.

Winter, M., D. H. Johnson, and J. D. Shaffer. 2005. Variability in vegetation effects on density and nesting success of grassland birds. Journal of Wildlife Management 69:185-197.

Fig. 1. Location of the 94 point count stations on Grand River National Grassland, 2005.

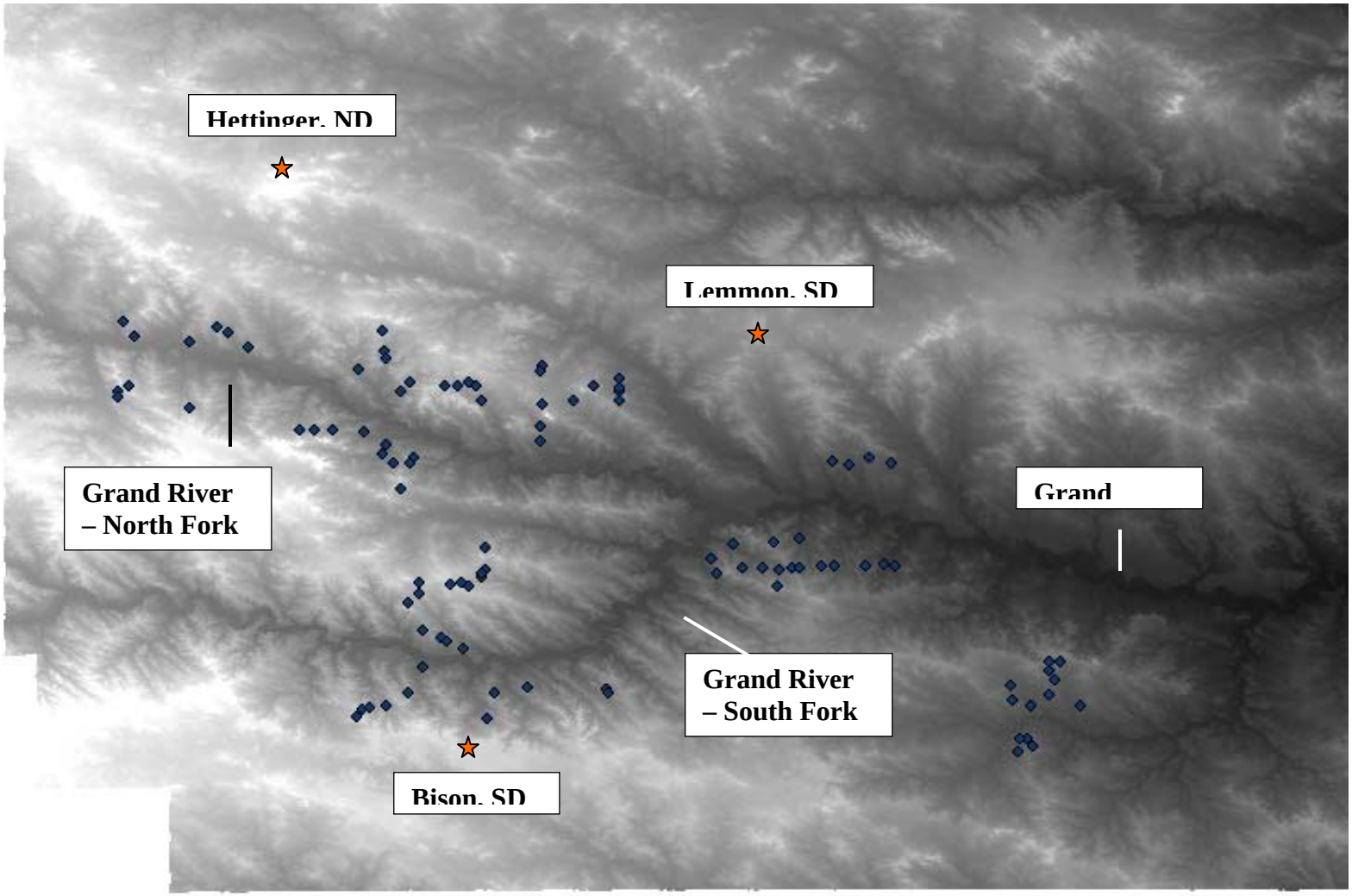

Figure 2. Predicted changes in relative abundance of Baird's sparrows and Sprague's pipits with a) woody vegetation within a 300-m radius, b) litter depth, and c) probability of presence of crested wheat-grass; Grand River National Grassland, South Dakota, 2005 (n = 118).

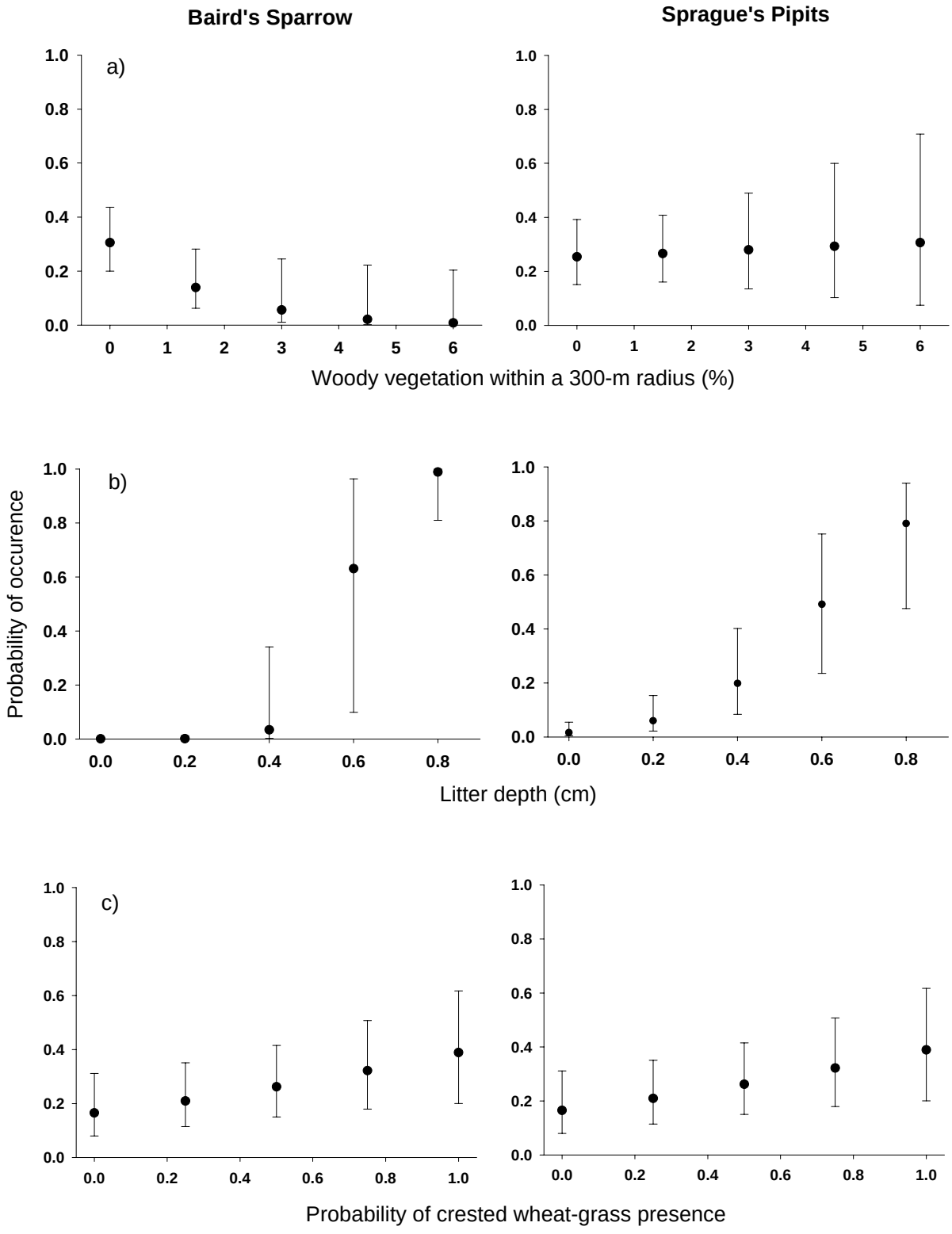

Table 1. Relative abundance of species within 94 100-m radius point count stations on the Grand River National Grassland, South Dakota, 2005. Species are sorted by their relative abundance.

Species	Scientific name	Mean	SE
Grasshopper sparrow	*Ammodramus savannarum*	0.657	0.041
Chestnut-collared longspur	*Calcarius ornatus*	0.596	0.058
Horned lark	*Eremophila alpestris*	0.419	0.046
Western meadowlark	*Sturnella neglecta*	0.412	0.036
Lark bunting	*Calamospiza melanocorys*	0.348	0.047
Brown-headed cowbird	*Molothrus ater*	0.104	0.027
Baird's sparrow	*Ammodramus bairdii*	0.080	0.026
Sprague's pipit	*Anthus spragueii*	0.047	0.013
Eastern kingbird	*Tyrannus tyrannus*	0.027	0.010
Upland sandpiper	*Bartramia longicauda*	0.020	0.008
Red-winged blackbird	*Agelaius phoeniceus*	0.013	0.008
Bobolink	*Dolichonyx oryzivorus*	0.010	0.006
Killdeer	*Charadrius vociferus*	0.010	0.006
Sharp-tailed grouse	*Tympanuchus phasianellus*	0.010	0.006
Northern flicker	*Colaptes auratus*	0.010	0.006
Western kingbird	*Tyrannus verticalis*	0.007	0.005
American goldfinch	*Carduelis tristis*	0.003	0.003
Marbled godwit	*Limosa fedoa*	0.003	0.003
Mourning dove	*Zenaida macroura*	0.003	0.003
Savannah sparrow	*Passerculus sandwichensis*	0.003	0.003

Table 2. Principal component scores for topographical and vegetation variables collected at the Grand River National Grassland, 2005 (N = 119).

Variable	Prin1	Prin2	Prin3
Grazing Code	-0.38	0.21	0.13
Presence of crested wheat-grass	0.07	0.25	0.65
Presence of Kentucky bluegrass	0.19	-0.01	-0.63
Woody cover within a 300-m radius (%)	-0.09	-0.53	-0.07
Distance to shrub (m)	0.05	0.57	-0.16
Distance to tree (m)	0.14	0.52	-0.27
Ground cover by soil (%)	-0.44	0.15	-0.01
Ground cover by litter (%)	0.45	0.02	0.12
Litter depth (cm)	0.45	-0.05	0.04
Vegetation height (cm)	0.43	-0.03	0.21

Table 3. Average vegetation and topographical characteristics of sites on which Baird's sparrows or Sprague's pipits where or where not detected, Grand River National Grassland, SD, 2005. Vegetation data include point count sites and additional sites where the species was detected (N = 119), whereas geographical data include point count sites only (N = 95)

	Baird's sparrow				Sprague's pipit			
	Absent		Present		Absent		Present	
	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Grazing Code	1.9	0.1	1.3	0.1***	1.8	0.1	1.5	0.1**
Crested Wheatgrass	0.3	0.0	0.5	0.1**	0.3	0.1	0.4	0.1
Kentucky Bluegrass	0.3	0.0	0.6	0.1**	0.3	0.1	0.6	0.1**
Woody cover (300m)	1.1	0.2	0.3	0.1**	0.7	0.2	1.1	0.3*
Woody cover (20m)	0.5	0.1	0.2	0.1	0.3	0.1	0.5	0.2
Distance to shrub (m)	766.3	37.3	876.6	47.6	843.7	33.1	700.1	60.3
Distance to tree (m)	745.3	37.9	865.6	42.5*	838.5	32.2	655.3	60.0**
Ground cover (%)								
Soil	20.7	1.3	11.1	1.4***	20.1	1.2	14.0	2.0**
Litter	37.5	1.1	46.0	1.8**	37.9	1.1	43.7	2.0**
Litter depth (cm)	0.3	0.0	0.7	0.1***	0.3	0.0	0.6	0.1***
Vegetation height (cm)	8.7	0.3	14.0	0.7***	9.3	0.4	11.8	0.6**
Aspect	148.4	11.8	159.4	26.4	154.9	12.2	137.2	22.5
Slope	3.2	0.3	2.4	0.4	3.1	0.3	2.9	0.4
Elevation	771.8	4.5	790.1	6.4	774.3	4.5	778.3	7.9

* $0.05 > \bar{x} > 0.01$ ** $0.01 > \bar{x} > 0.001$ *** $0.001 > \bar{x}$

Table 4. Effect of selected vegetation variables on the occurrence of Baird's sparrows (BAIS) and Sprague's pipits (SPPI) on the Grand River National Grassland, 2005. For analysis I used PROC MIXED with the GLIMMIX macro in SAS 8.0, with sub-pasture and pasture as random effects (N = 119).

Species	Variable	Slope	SE	P
BAIS	Woody cover within a 300m radius (%)	-0.67	0.30	0.0308
	Litter depth (cm)	19.48	1.87	<.0001
	Presence of Crested Wheatgrass	1.53	0.46	0.0022
SPPI	Woody cover within a 300m radius (%)	0.04	0.15	0.7705
	Litter depth (cm)	6.80	1.12	<.0001
	Presence of Crested Wheatgrass	1.17	0.53	0.0352

Table 5. Effect of topographical and climatic variables on the occurrence of Baird's sparrows (BAIS) and Sprague's pipits (SPPI) on the Grand River National Grassland, 2005. For analysis I used PROC MIXED with the GLIMMIX macro in SAS 8.0, with sub-pasture and pasture as random effects (N = 94).

Species	Variable	Slope	SE	P
BAIS	Geographic position			
	North	<0.0001	<0.0001	0.99
	West	1.80	1.24	0.16
	Slope	-0.40	0.18	0.04
	Aspect	0.002	0.002	0.35
	Windspeed	0.16	0.20	0.45
	Temperature	-0.06	0.08	0.41
	Sky	0.32	0.31	0.31
SPPI	Geographic position			
	North	-1.51	2.12	0.49
	West	0.56	1.12	0.62
	Slope	-0.06	0.12	0.59
	Aspect	-0.002	0.002	0.38
	Windspeed	-0.16	0.18	0.38
	Temperature	0.02	0.07	0.83
	Sky	-0.22	0.30	0.46

Table 6. Comparison of vegetation characteristics between sites where Baird's sparrows (BAIS, N = 32) and where Sprague's pipits (SPPI, N = 38) occur on the Grand River National Grassland, SD, 2005 (N = 119).

Variable	BAIS	SPPI	df	t	P
Presence of crested wheat-grass	0.53 ± 0.09	0.38 ± 0.08	69.0	1.23	0.22
Litter depth (cm)	0.73 ± 0.09	0.64 ± 0.08	69.0	0.69	0.49
Woody cover within a 300m radius (%)	0.25 ± 0.11	1.10 ± 0.29	48.1	-2.70	0.01

Table 7. Partitioning sources of variances in vegetation structure and occurrence of Baird's sparrow (BAIS) and Sprague's pipit (SPPI) among pastures (pasture), among sub-pastures within pastures (sub-pasture[pasture]), and among sites within sub-pastures (Site[sub-pasture]) on the Grand River National Grassland, South Dakota (n = 119). Numbers of percentages of total variance found within each level of organization. For example, 60% variance in crested wheat-grass occurring among sites within individual sub-pastures indicates that the majority of variances in wheat-grass presence can be found within individual sub-pastures and that there is little systematic variation in wheat-grass prevalence among either sub-pastures (within a pasture) or among pastures. Percentages are derived from the maximum likelihood analysis using PROC VARCOMP (SAS/STAT 1995).

						Bird occurrence	
	Crest[a]	Soil[b]	Depth[c]	Height[d]	Wood[e]	BAIS	SPPI
Pasture	19	23	7	0	50	18	27
Sub-pastures (pasture)	21	4	16	29	13	2	12
Sites (sub-pasture)	60	73	77	71	37	81	61

[a] Presence of crested wheat-grass [b] Ground cover by soil (%) [c] Litter depth (cm)

[d] Height of the highest plant (cm) [e] Woody cover within a 300-m radius (%)

Appendix. List of species detected within and outside of a 100-m radius at 94 point count stations on Grand River National Grassland, South Dakota, 2005. Species are ordered taxonomically.

Species	Scientific name
Canada goose	*Branta canadensis*
Mallard	*Anas platyrhynchos*
American wigeon	*Anas americana*
Northern harrier	*Circus cyaneus*
Swainson's hawk	*Buteo swainsoni*
Ferruginous hawk	*Buteo regalis*
American kestrel	*Falco sparverius*
Ring-necked pheasant	*Phasianus colchicus*
Sharp-tailed grouse	*Tympanuchus phasianellus*
Killdeer	*Charadrius vociferus*
Upland sandpiper	*Bartramia longicauda*
Marbled godwit	*Limosa fedoa*
Common snipe	*Gallinago gallinago*
Wilson's phalarope	*Phalaropus tricolor*
Mourning dove	*Zenaida macroura*
Short-eared owl	*Asio flammeus*
Common nighthawk	*Chordeiles minor*
Northern flicker	*Colaptes auratus*
Least flycatcher	*Empidonax minimus*
Eastern kingbird	*Tyrannus tyrannus*
Western kingbird	*Tyrannus verticalis*
Horned lark	*Eremophila alpestris*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Cliff swallow	*Petrochelidon pyrrhonta*
Barn swallow	*Hirundo rustica*
Rock wren	*Salpinctes obsoletes*
Sprague's pipit	*Anthus spragueii*

Species	Scientific name
Yellow warbler	*Dendroica petechia*
Field sparrow	*Spizella pusilla*
Baird's sparrow	*Ammodramus bairdii*
Grasshopper sparrow	*Ammodramus savannarum*
Savannah sparrow	*Passerculus sandwichensis*
Lark bunting	*Calamospiza melanocorys*
Lark sparrow	*Chondestes grammacus*
Chestnut-collared longspur	*Calcarius ornatus*
Western meadowlark	*Sturnella neglecta*
Bobolink	*Dolichonyx oryzivorus*
Brown-headed cowbird	*Molothrus ater*
Red-winged blackbird	*Agelaius phoeniceus*
American goldfinch	*Carduelis tristis*