Status of Grasshopper Sparrow and Other Grassland-associated Bird Species at Naval Air Station Brunswick, Maine

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Introduction

The Grasshopper Sparrow (*Ammodramus savannarum*), a Maine Endangered Species, breeds at just four sites in Maine: Kennebunk Plains, Wells Barren, Sanford Airport, and Naval Air Station Brunswick (Maine Department of Inland Fisheries and Wildlife 1992). A survey of these four sites in 1997 estimated the state's total population of breeding males at just 77 individuals (Weik 1997). The species nests only in grassland habitats, which generally are maintained only through intensive management efforts.

At N.A.S. Brunswick, Grasshopper Sparrows nest in the approximately 200-ha area including and surrounding the airfield, which is a mosaic of graminoids, Lowbush Blueberry (*Vaccinium angustifolium*), marshy inclusions, and barren areas. The vegetation immediately surrounding the tarmac and lights is regularly mowed to maintain conditions compatible with airfield operations. The grassland area also hosts other grassland-associated species, including Upland Sandpiper (*Bartramia longicauda*)—a Maine Threatened Species.

We initiated a point count survey during the 2005 breeding season at the N.A.S. Brunswick grasslands to assess the local status of Grasshopper Sparrow and other grassland-associated species. Improved knowledge about the status of grassland bird species at N.A.S. Brunswick was needed to complement the ongoing Monitoring Avian Productivity and Survivorship (MAPS) efforts (DeSante et al. 2005), which provide information on the population status and demography of the base's forest bird species, as well as other ongoing surveys conducted by Brunswick personnel. Better information on the current status of Grasshopper Sparrow and other grassland-associated species might inform proactive conservation measures, and serve as a baseline for assessing future population and community changes.

Methods

Sampling Design

Beginning with a randomly selected starting point, we defined a systematic grid of point count stations, 250-m apart, covering the mapped extent of Brunswick's grassland area ("grassland.shp", provided by K. Moore), which includes and surrounds the airfield. This process yielded 57 points arrayed in a uniform grid across the length and breadth of the grassland area (Fig. 1). Geographic coordinates of all point count stations are provided in Table 1.

Data Collection

We conducted five-minute variable circular plot (VCP) point counts (Fancy and Sauer 2000; Siegel 2000) at each of the 57 point count stations twice during the 2005 breeding season; once between 07 June and 11 June, and then again between 26 June and 29 June. VCP point counts entailed recording the horizontal distance, estimated to the

nearest meter, to every bird seen or heard during the point count. All point counts were conducted by Danielle Kaschube.

Danielle located pre-selected starting points in the field with GIS-produced maps and a hand-held GPS unit. Points that fell directly on the runways were offset to the nearest runway edge. Point counts began within ten minutes of local sunrise, and continued until 3.5 hours after local sunrise. 'Flyovers'— defined as birds that flew over the top of the vegetation canopy, never touched down in the observer's field of view, and did not appear to be foraging, displaying, or behaving in any other way that might suggest a link to the habitat below— were tallied separately from other bird detections. Birds thought to have been recorded previously at another point were marked accordingly on the data forms. Danielle recorded whether each bird was initially detected during the first three minutes or last two minutes of the point count, in order to facilitate any future comparisons with data from the Breeding Bird Survey (BBS), which utilizes three-minute counts. She also recorded whether each bird was initially detected visually or aurally, and whether the bird sang at any time during the count. Finally, Danielle noted whether each detected bird was within or beyond the grassland boundary.

Data Entry and Verification

All data were entered into DBASE databases, which were then checked for errors using an array of automated and manual data verification routines. Copies of the electronic data accompany this report.

Data Analysis

The detectability of birds during point counts varies substantially across habitats, among observers, and between species (Burnham 1981; Barker and Sauer 1995; Buckland et al. 2001). Detection probability is seldom 100%, even for 50-m radius point counts. Reporting density, rather than merely indexing relative abundance, therefore generally requires first estimating detectability, and then correcting density estimates accordingly. In the present survey, habitat structure was relatively constant across the study area, and a single observer conducted all the counts. However it was still necessary to estimate detectability on a species-specific basis, as detectability depends on volume and pitch of vocalizations, as well as other aspects of behavior that make some species more or less conspicuous than others.

We used the computer program DISTANCE 5.0 Release 4 (Thomas et al. 2005) to model detectability and then estimate density of grassland species. Distance-sampling experts generally advise that at least 60 detections are necessary for reliably modeling the relationship between detection probability and distance from the observer (Buckland et al. 2001). We used DISTANCE to fit detection functions for each species with at least 60 detections (pooled across both the early-June and the late-June visit to the survey points). We set the data filter to truncate the largest 10% of observations (Buckland et al. 2001), and then fit models using the half-normal, hazard, and uniform key functions and both the cosine and polynomial series expansions. We used the Akaike Information Criterion

(AIC) to select among models with different forms and numbers of expansion terms (Akaike 1973; Burnham and Anderson 1998). We then applied the selected species-specific detection function obtained from the pooled data set (two counts conducted at each point count station) to estimate the species' density across the grassland area.

For the remaining species that have a clear grassland affinity, but were not detected frequently enough to permit detectability modeling, we were unable to estimate absolute density, but instead calculated the average number of detections per point count.

Results

We recorded 1,138 detections of 45 species during the grassland point counts (Table 2). Fourteen of these were recorded at least once within the boundaries of the grasslands, whereas the other 31 species were only detected as relatively distant birds vocalizing from the wooded or developed areas outside the grassland boundary (Table 2).

We amassed only seven Grasshopper Sparrow detections during point counts, and therefore were unable to model the species' detectability and estimate its density, using the methods described above. All the detections were clustered at the north end of the airfield, in a relatively circumscribed area that Danielle was able to repeatedly search at times when she was not conducting point counts. Although she did not conduct formal territory mapping, Danielle estimated that there were five singing male Grasshopper Sparrows in the area. Danielle's estimation of the center of activity for each territory is presented in Figure 2.

We amassed enough detections (>60) to model the detectability of just three species—Savannah Sparrow, Bobolink, and Eastern Meadowlark. Goodness-of-fit statistics suggested that all three were modeled adequately well ($p>0.05$; Table 3) but for Savannah Sparrow and Bobolink the selected models incorporated the uniform key function with the cosine expansion series, whereas for Eastern Meadowlark the selected model was based on the half-normal key function with the polynomial expansion series (Table 2). We estimated Savannah Sparrow, the most frequently detected species on the airfield grasslands, to occur at a density nearly ten times greater than the next most frequently detected species, Eastern Meadowlark (Table 4). Point count stations where each of these three species were detected are mapped in Figures 3-5.

For the six other species (Grasshopper Sparrow as well as Killdeer, Upland Sandpiper, Horned Lark, Field Sparrow, and Red-winged Blackbird) with clear grassland affiliations that were detected too infrequently to allow for detectability modeling and density estimation, we present only indices of relative abundance (Table 4). Point count stations where each of these six species were detected are mapped in Figures 6-11. The map of point count stations where Upland Sandpiper was detected (Fig.8) may be somewhat misleading. Although the species was detected at numerous points, the detections comprised just a few individual birds that ranged widely across the airfield grasslands. Danielle never saw more than three birds at the same time, and believes that two pairs occupied the airfield grasslands, with the center of their activity seeming to

occur near the center of the airfield grasslands, around point count stations 12, 13, 19, and 20.

Discussion

The grassland area at N.A.S. Brunswick is clearly a locally important resource for grassland-associated species, harboring substantial populations of more common species like Savannah Sparrow, Bobolink and Eastern Meadowlark, as well as small populations of rarer species like Grassland Sparrow and Upland Sandpiper. However, we were somewhat surprised by how few Grasshopper Sparrows we detected, as numbers appear to have been substantially higher during the 2004 breeding season (K. Moore, *personal communication*). Small songbird populations can fluctuate considerably from year to year, and 2005 may have been a poor year for Grasshopper Sparrow at Brunswick. Regardless of whether 2005 marked a waypoint in an ongoing decline, or was merely an aberrantly poor year, an isolated population consisting of approximately five breeding territories is highly vulnerable to local extirpation.

Blueberry cover at Brunswick appears to be increasing (K. Moore, *personal communication*), a process that may signal trouble for Grasshopper Sparrow. Although much of the published literature on Grasshopper Sparrow habitat associations and management guidelines is not specific to the northeastern U.S., some common themes may be appropriate for consideration at N.A.S. Brunswick. In particular, most sources advise land managers to discourage woody plants (Whitmore 1981) in favor of relatively sparse, grass-dominated vegetation (Bollinger and Gavin 1992; Bollinger 1995). Bunchgrasses, which allow openings in the vegetation that facilitate foraging, are believed to be especially conducive to the species (Smith 1963; Whitmore 1981). Maintaining or encouraging grass-dominated plant communities may be achieved through mowing, burning or perhaps even grazing, but these practices are best implemented prior to or after the breeding season—not during the breeding season, when they may disturb nesting activities and/or destroy nests (Whitmore 1981; Frawley and Best 1991; Rodenhouse et al. 1995).

If the Grasshopper Sparrow population at N.A.S. Brunswick is to be maintained, we strongly recommend that species-specific habitat enhancement efforts of the sort described above be considered and pursued, as appropriate. We also recommend that any substantial habitat enhancement measures be implemented in the context of continued monitoring, so that their efficacy can be assessed. Given the small size of Brunswick's Grasshopper Sparrow population, point counts might best be replaced or supplemented with a more intensive and focused territory mapping and/or nest monitoring program that would more efficiently and conclusively determine the exact number of nesting territories in the study area, and perhaps also provide information on reproductive success.

Acknowledgments

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Table 1. Locations of grassland point count stations at N.A.S. Brunswick. Coordinates are based on NAD 83, Zone 19.

Point Number	Easting	Northing	Point Number	Easting	Northing
01	423926	4861668	30	424726	4861868
02	423926	4861468	31	424726	4861668
03	423926	4861268	32	424726	4861468
04	424126	4861668	33	424726	4861268
05	424126	4861468	34	424726	4861068
06	424126	4861268	35	424726	4860868
07	424326	4861868	36	424726	4860668
08	424326	4861668	37	424726	4860468
09	424326	4861468	38	424726	4860268
10	424326	4861268	39	424726	4860068
11	424326	4861068	40	424726	4859868
12	424326	4860868	41	424726	4859668
13	424326	4860668	42	424726	4859468
14	424526	4861868	43	424726	4859268
15	424526	4861668	44	424726	4859068
16	424526	4861468	45	424726	4858868
17	424526	4861268	46	424926	4861868
18	424526	4861068	47	424926	4861668
19	424526	4860868	48	424926	4861468
20	424526	4860668	49	424926	4861268
21	424526	4860468	50	424926	4860068
22	424526	4860268	51	424926	4859868
23	424526	4860068	52	424926	4859668
24	424526	4859868	53	424926	4859468
25	424526	4859668	54	424926	4859268
26	424526	4859468	55	424926	4859068
27	424526	4859268	56	424926	4858868
28	424526	4859068	57	424926	4858668
29	424526	4858868			

Table 2. Species detected during two visits to 57 grassland point count stations at N.A.S. Brunswick.

Species Common Name	Species Latin Name	Total No. of Detections[a]	Detections within the Grassland Area
Common Loon	*Gavia immer*	1	0
Double-crested Cormorant	*Phalacrocorax auritus*	5	0
Great Blue Heron	*Ardea herodias*	2	0
Turkey Vulture	*Cathartes aura*	2	0
Canada Goose	*Branta canadensis*	2	0
Osprey	*Pandion haliaetus*	8	0
Killdeer	*Charadrius vociferus*	16	15
Upland Sandpiper	*Bartramia longicauda*	22	21
Herring Gull	*Larus argentatus*	19	0
Great Black-backed Gull	*Larus marinus*	6	0
Rock Pigeon	*Columba livia*	0	0
Mourning Dove	*Zenaida macroura*	15	7
Eastern Wood-Pewee	*Contopus virens*	1	0
Least Flycatcher	*Empidonax minimus*	2	0
Eastern Phoebe	*Sayornis phoebe*	2	0
Great Crested Flycatcher	*Myiarchus crinitus*	2	0
Red-eyed Vireo	*Vireo olivaceus*	1	0
Blue Jay	*Cyanocitta cristata*	41	0
American Crow	*Corvus brachyrhynchos*	87	26
Horned Lark	*Eremophila alpestris*	1	1
Tree Swallow	*Tachycineta bicolor*	3	3
Black-capped Chickadee	*Poecile atricapillus*	11	0
Tufted Titmouse	*Baeolophus bicolor*	7	0
Red-breasted Nuthatch	*Sitta canadensis*	2	0
Swainson's Thrush	*Catharus ustulatus*	3	0
American Robin	*Turdus migratorius*	31	0
Northern Mockingbird	*Mimus polyglottos*	2	0
European Starling	*Sturnus vulgaris*	2	0
Yellow Warbler	*Dendroica petechia*	11	0
Black-throated Green Warbler	*Dendroica virens*	5	0
Black-and-white Warbler	*Mniotilta varia*	2	0
Ovenbird	*Seiurus aurocapilla*	13	0
Common Yellowthroat	*Geothlypis trichas*	32	1
Scarlet Tanager	*Piranga olivacea*	2	0
Chipping Sparrow	*Spizella passerina*	2	0
Field Sparrow	*Spizella pusilla*	4	4
Savannah Sparrow	*Passerculus sandwichensis*	364	361
Grasshopper Sparrow	*Ammodramus savannarum*	7	7
White-throated Sparrow	*Zonotrichia albicollis*	1	0
Northern Cardinal	*Cardinalis cardinalis*	10	0
Bobolink	*Dolichonyx oryzivorus*	79	78
Red-winged Blackbird	*Agelaius phoeniceus*	2	2
Eastern Meadowlark	*Sturnella magna*	241	239

Table 2, continued.

Species Common Name	Species Latin Name	Total No. of Detections[a]	Detections within the Grassland Area
Common Grackle	*Quiscalus quiscula*	3	0
American Goldfinch	*Carduelis tristis*	34	14

[a]Although all point count stations were located with the grassland area, many of these detections were of distant birds vocalizing from the surrounding habitats.

Table 3. Model selection and detectability parameter values for species detected at least 60 times during grassland point counts at N.A.S. Brunswick.

Species	Sample Width (m)[a]	Selected Model[b]	Goodness-of-Fit[c]		Detectability Parameters		
			D_n	p	P	SE	df
Savannah Sparrow	130	Uniform + cosine (2)	0.05	0.23	0.26	0.02	130
Bobolink	264	Uniform + cosine (1)	0.12	0.25	0.46	0.06	70
Eastern Meadowlark	260	Half-normal + polynomial (4)	0.07	0.15	0.33	0.02	250

[a]Calculated as the 90th percentile of all distance estimates for the indicated species.
[b]Number in parentheses indicates the number of adjustment terms in models that incorporate an expansion series.
[c]Kolmogorov-Smirnov goodness-of-fit test that the model fits the data.

Table 4. Relative abundance indices and density estimates of grassland-associated species at N.A.S. Brunswick.

Species	Percent of Points with Detections[a]	Relative Abundance (Detections/Point)[b]	**Density (Birds/ha)[c]**	Percent CV	df	Lower 95% CI	Upper 95% CI
Killdeer	21	0.14	**--**	--	--	--	--
Upland Sandpiper	28	0.19	**--**	--	--	--	--
Horned Lark	2	0.01	**--**	--	--	--	--
Field Sparrow	7	0.04	**--**	--	--	--	--
Savannah Sparrow	100	3.19	**2.27**	9.5	241	1.89	2.73
Grasshopper Sparrow	9	0.06	**--**	--	--	--	--
Bobolink	47	0.69	**0.06**	21.9	181	0.04	0.09
Red-winged Blackbird	4	0.02	**--**	--	--	--	--
Eastern Meadowlark	96	2.11	**0.26**	9.5	340	0.22	0.32

[a]Percent of points where the indicated species was detected at any distance during at least one of the two visits.
[b]Calculated as the average value for the two visits.
[c]Calculated only for species for which we amassed adequate data for detectability modeling.

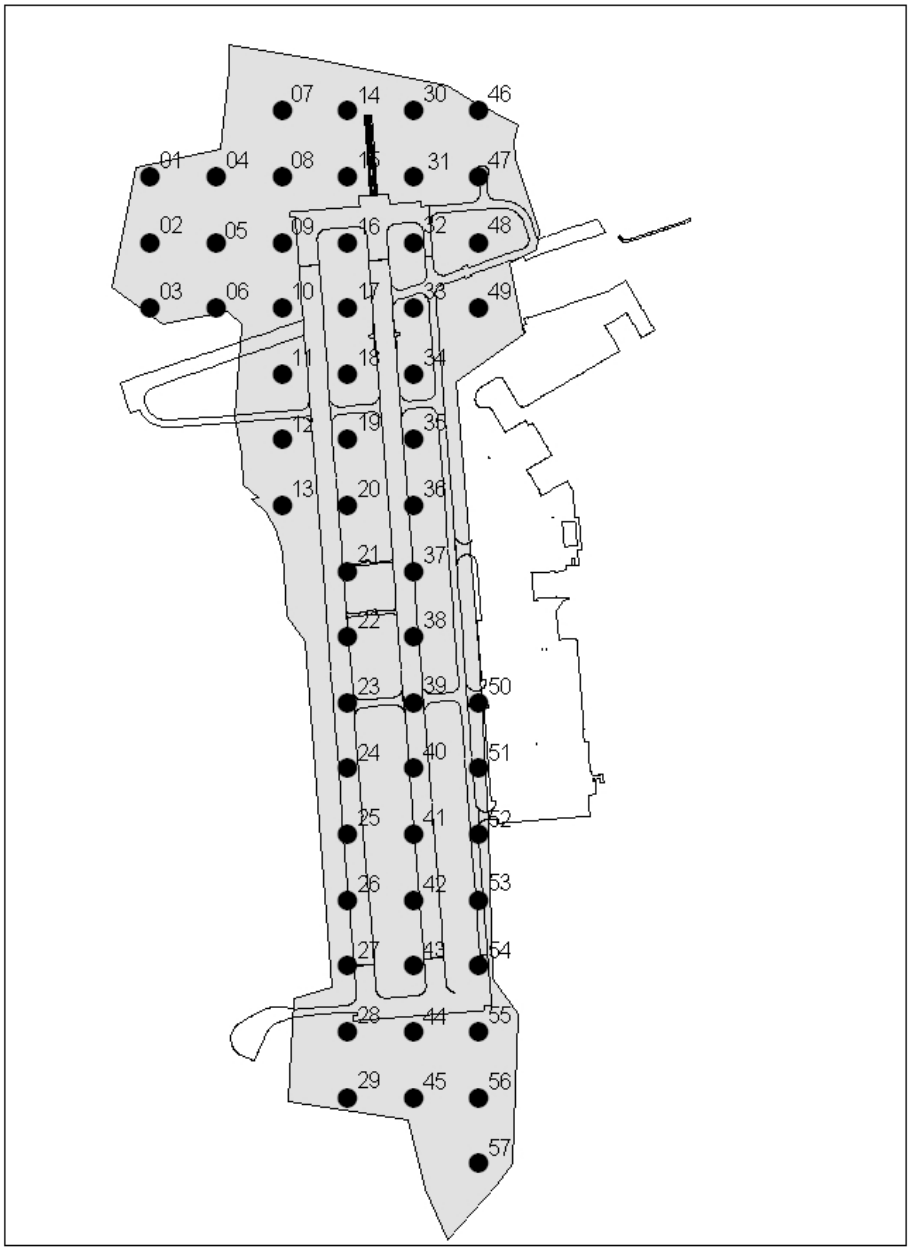

Figure 1. Grassland point count stations at N.A.S. Brunswick.

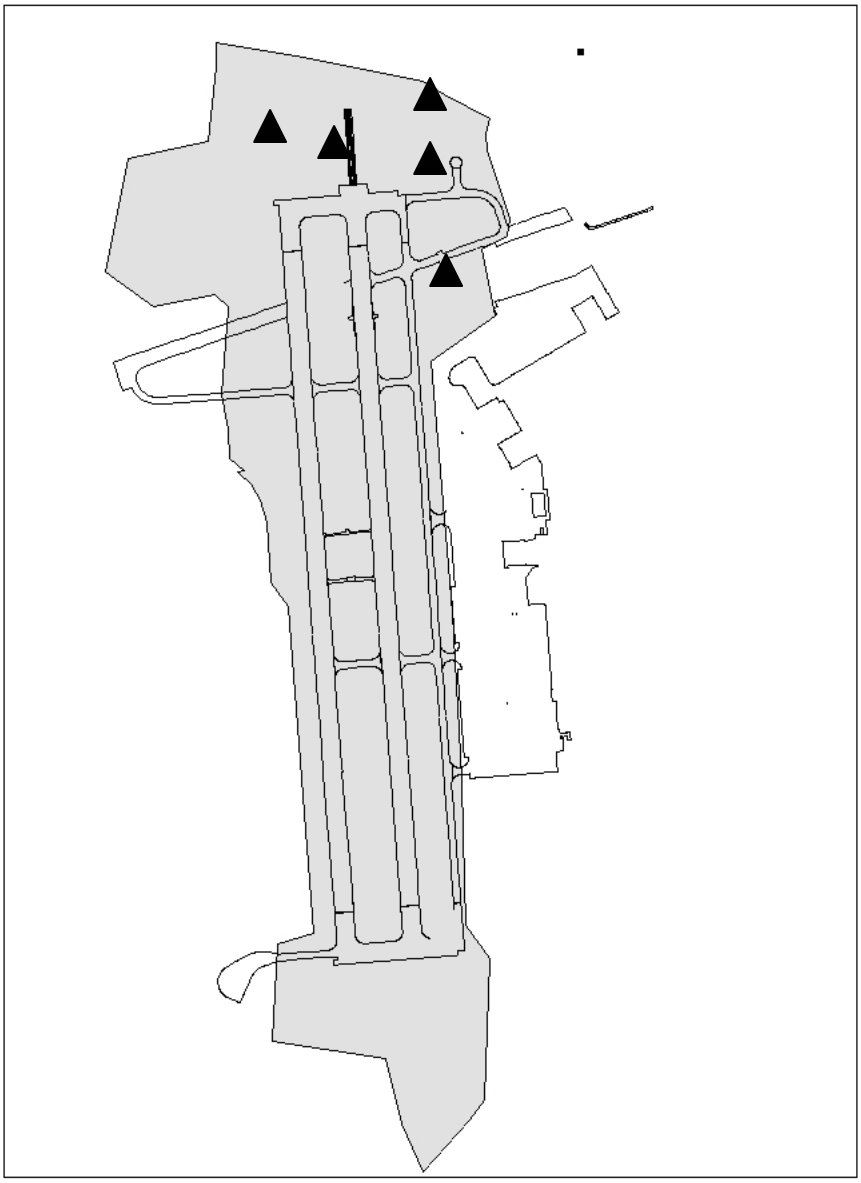

Figure 2. Approximate centers of activity of territorial Grasshopper Sparrows observed on the airfield grasslands at N.A.S. Brunswick; activity centers were determined from a combination of point count data and informal area searches.

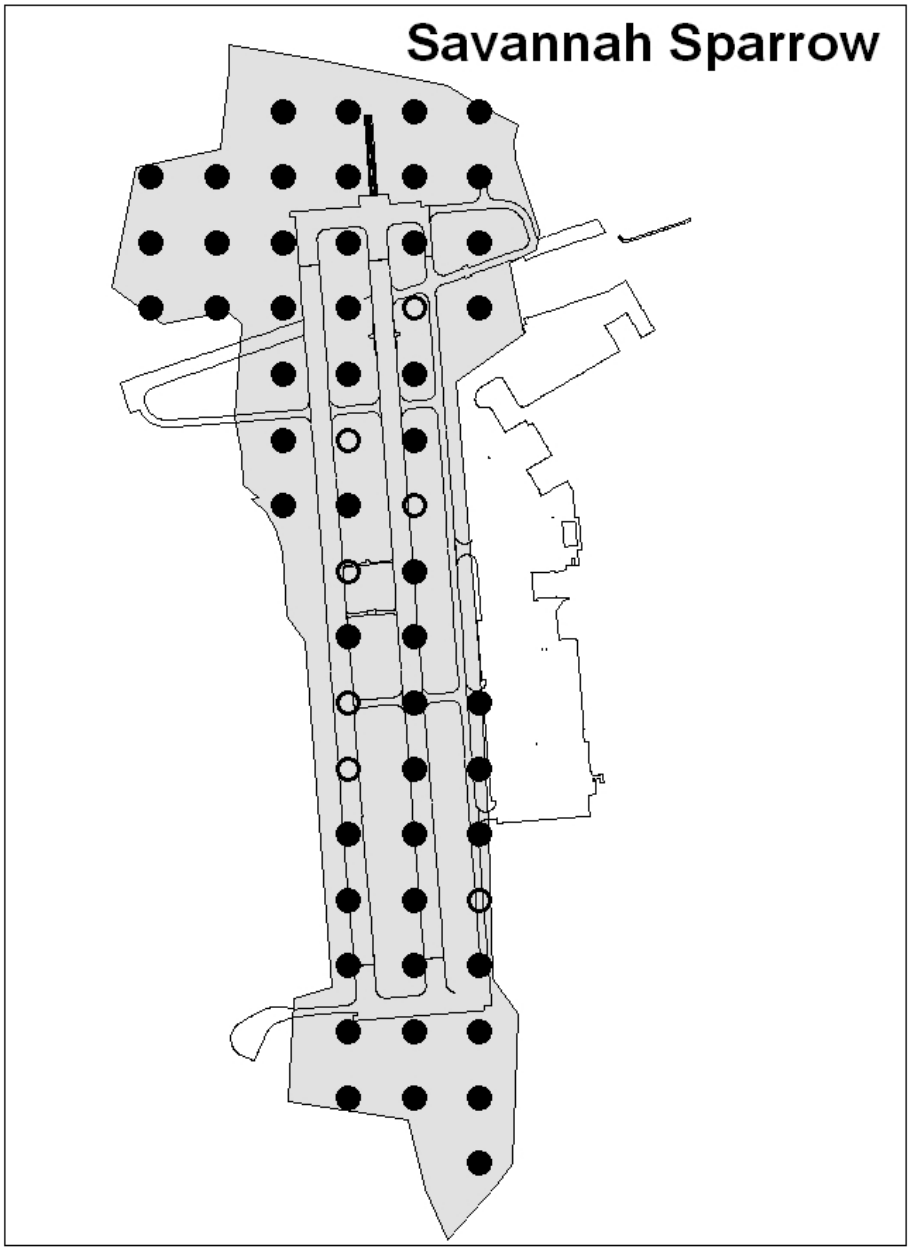

Figure 3. Grassland point count stations where Savannah Sparrow was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

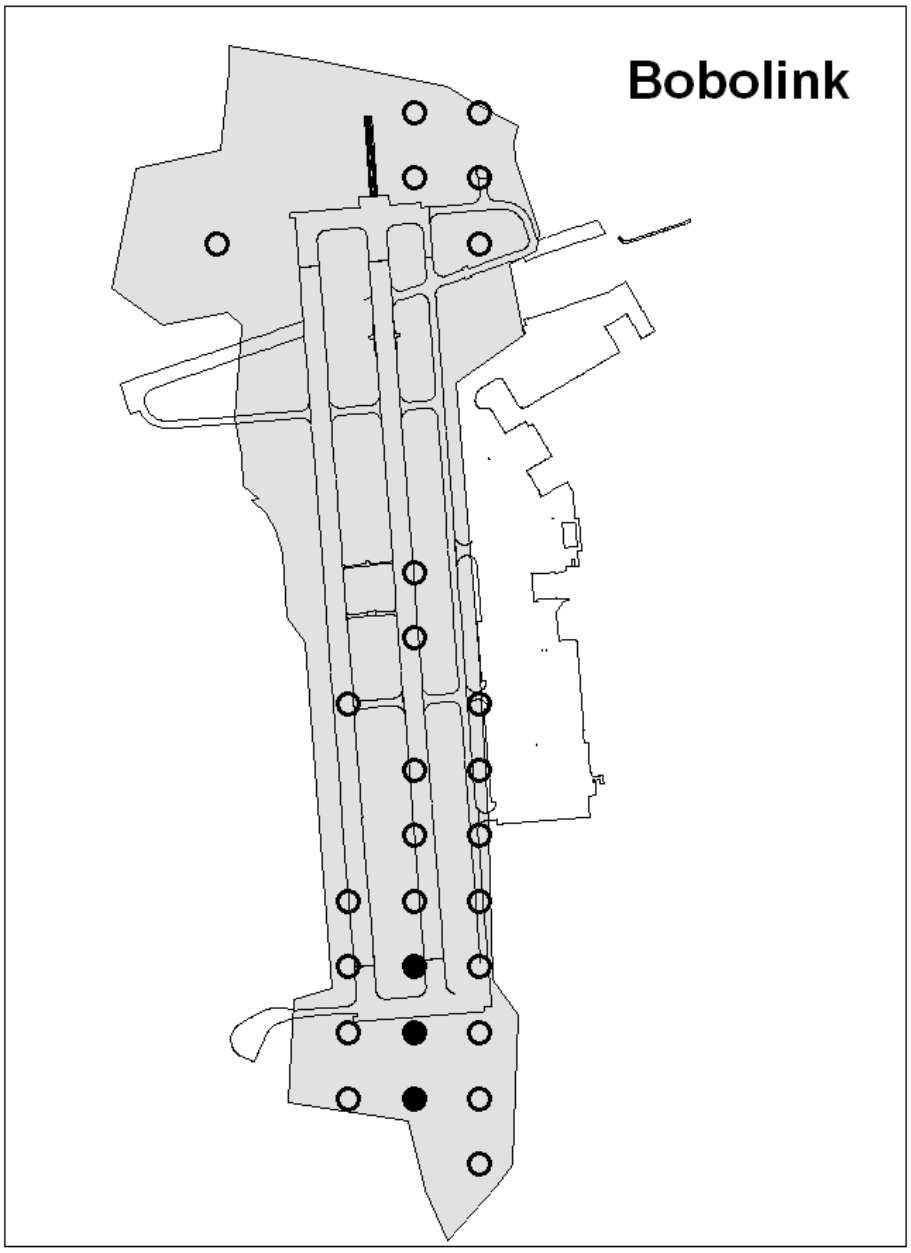

Figure 4. Grassland point count stations where Bobolink was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

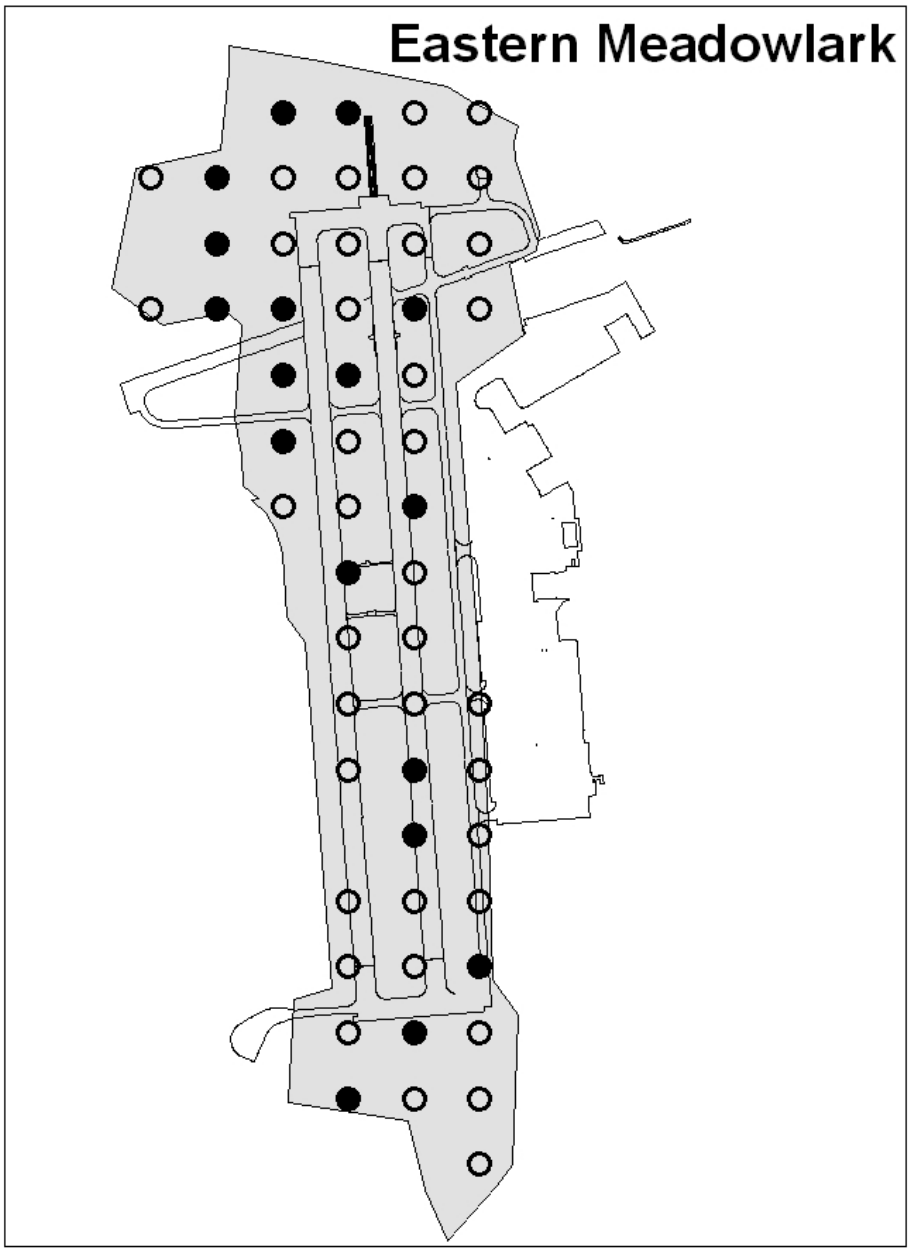

Figure 5. Grassland point count stations where Eastern Meadowlark was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

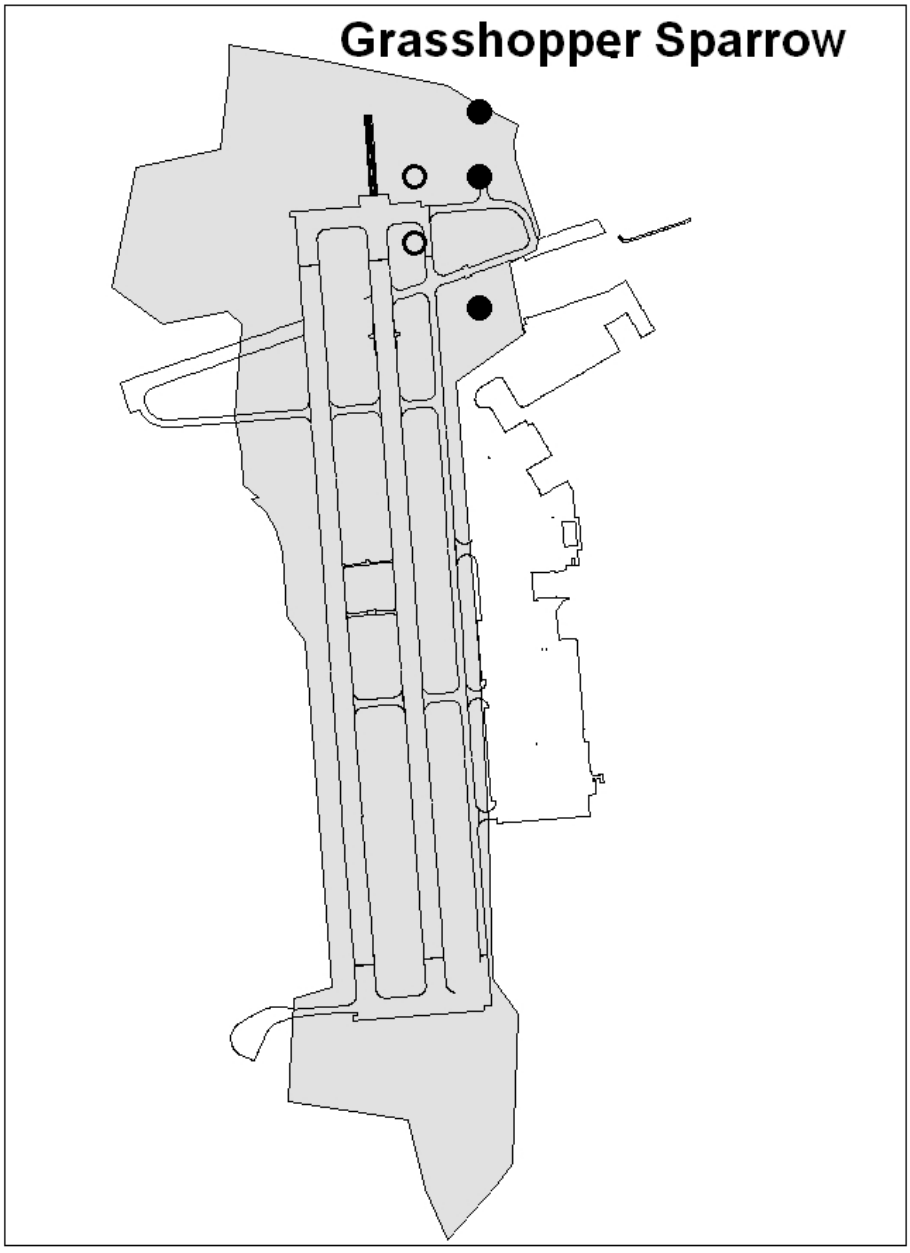

Figure 6. Grassland point count stations where Grasshopper Sparrow was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

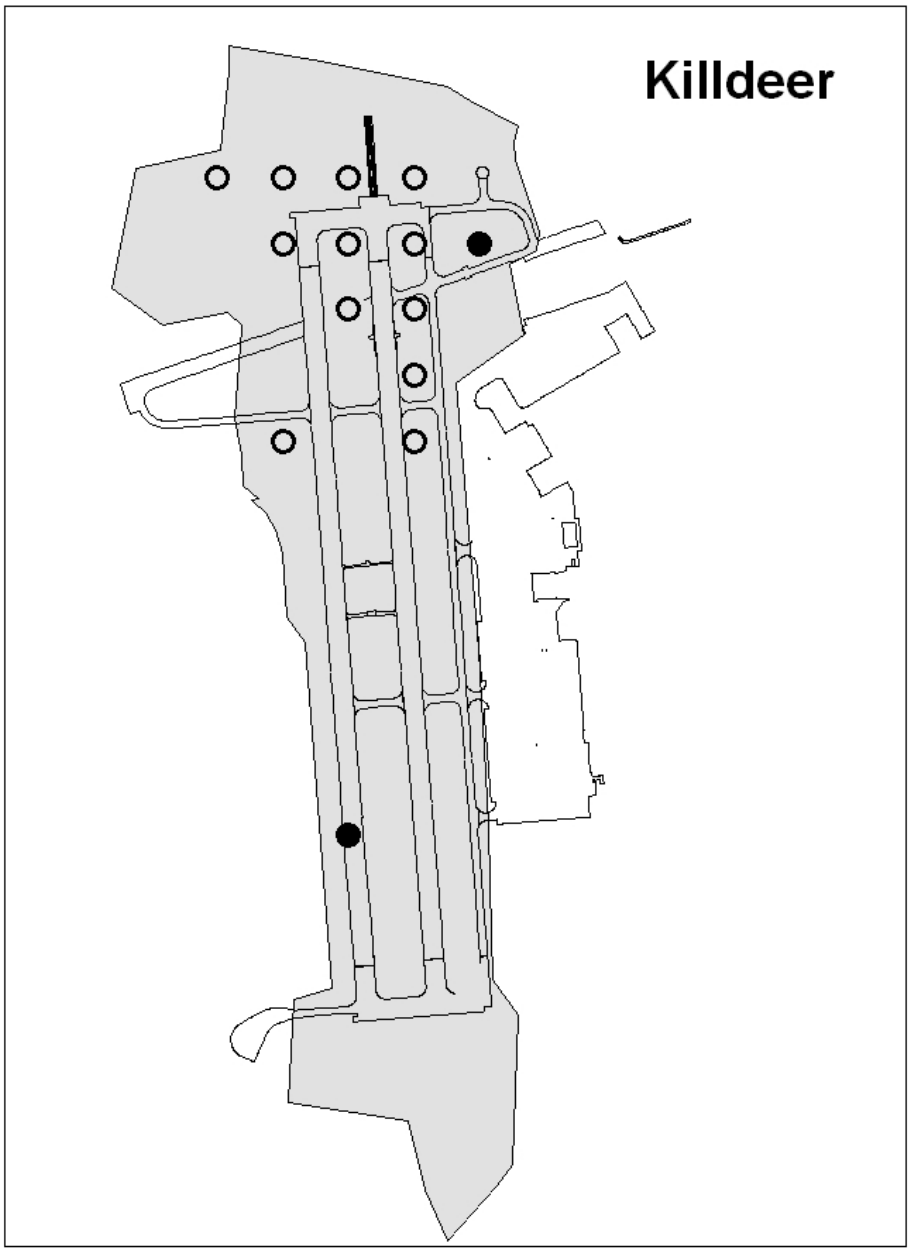

Figure 7. Grassland point count stations where Killdeer was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

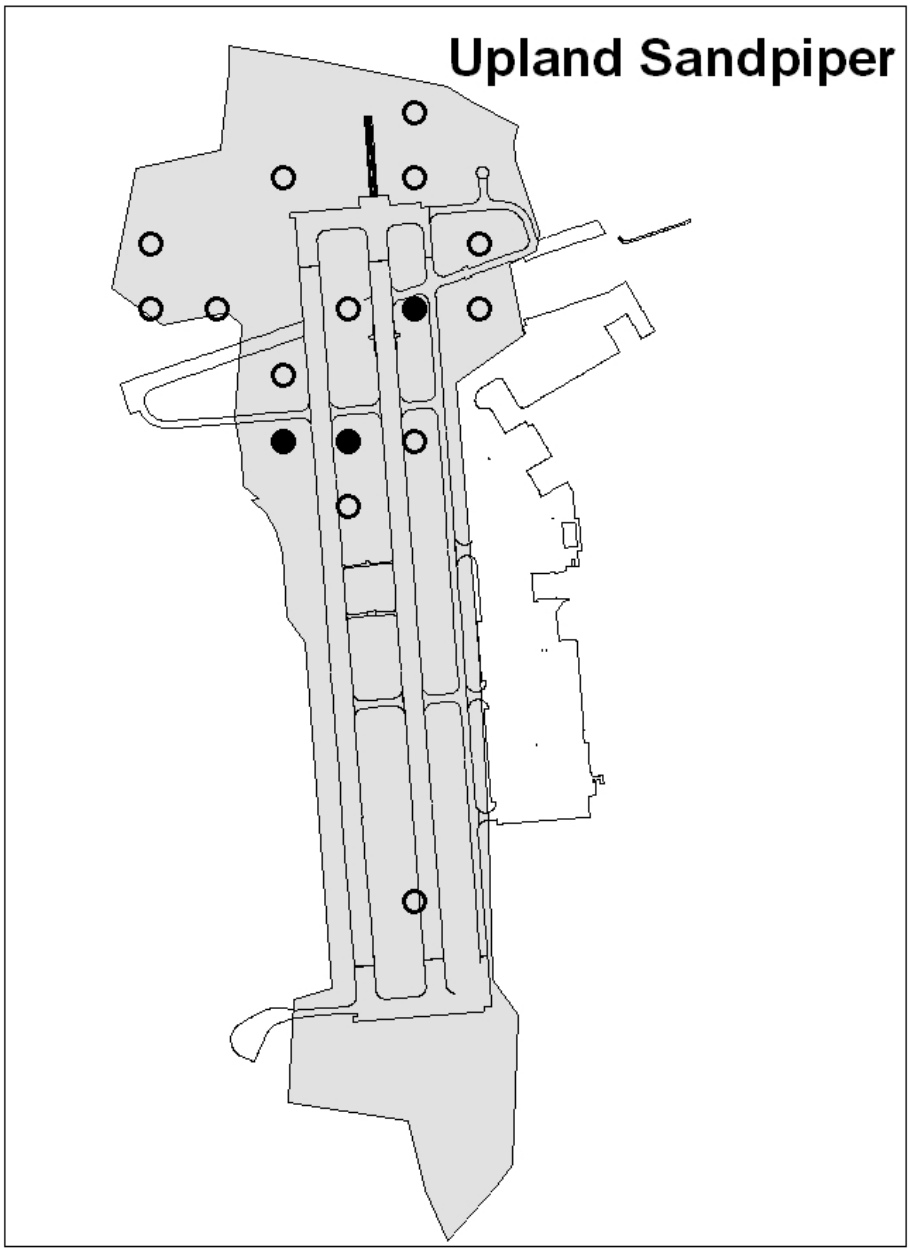

Figure 8. Grassland point count stations where Upland Sandpiper was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; closed circles indicate points where the species was detected within a 50-m radius.

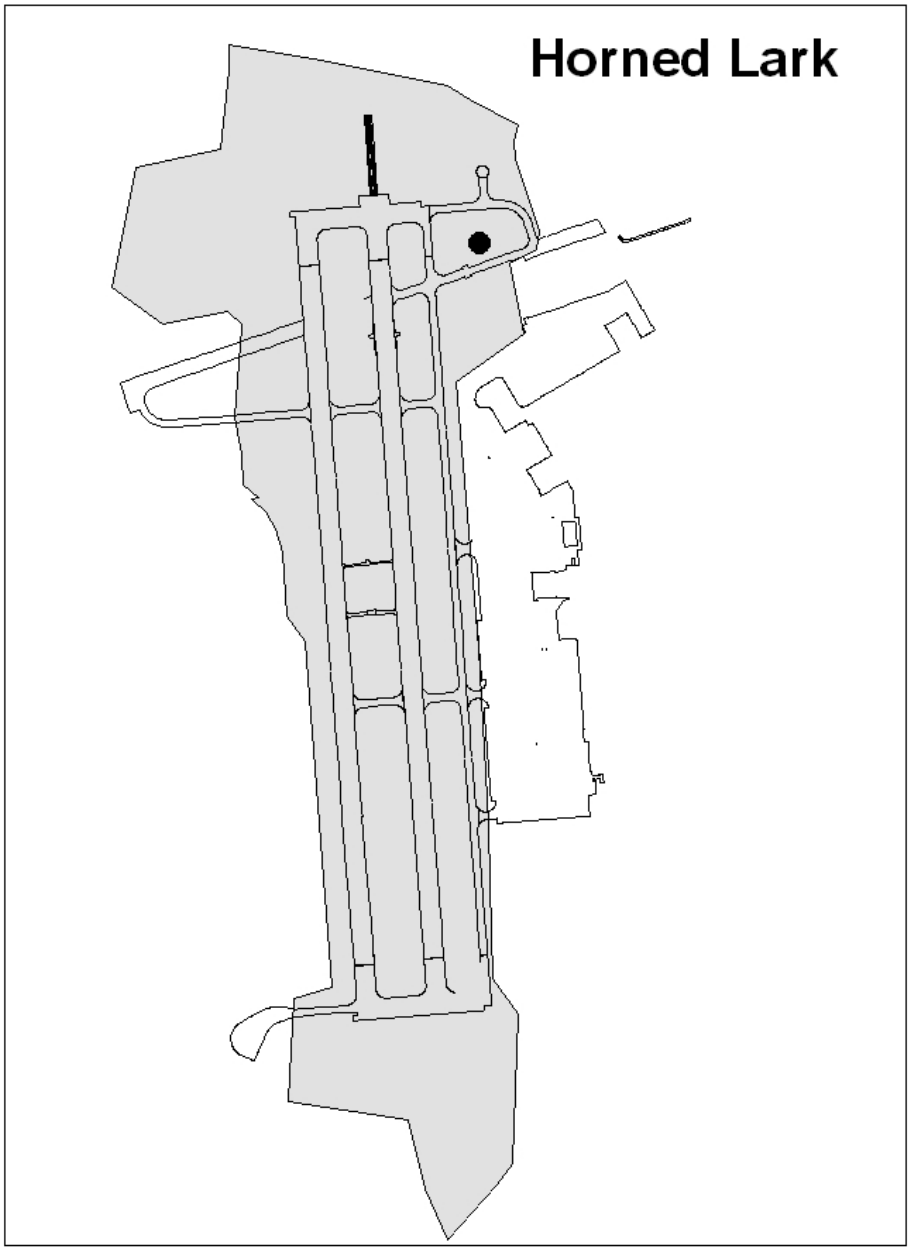

Figure 9. The single grassland point count station where Horned Lark was detected. The bird was within 50 m of the survey point.

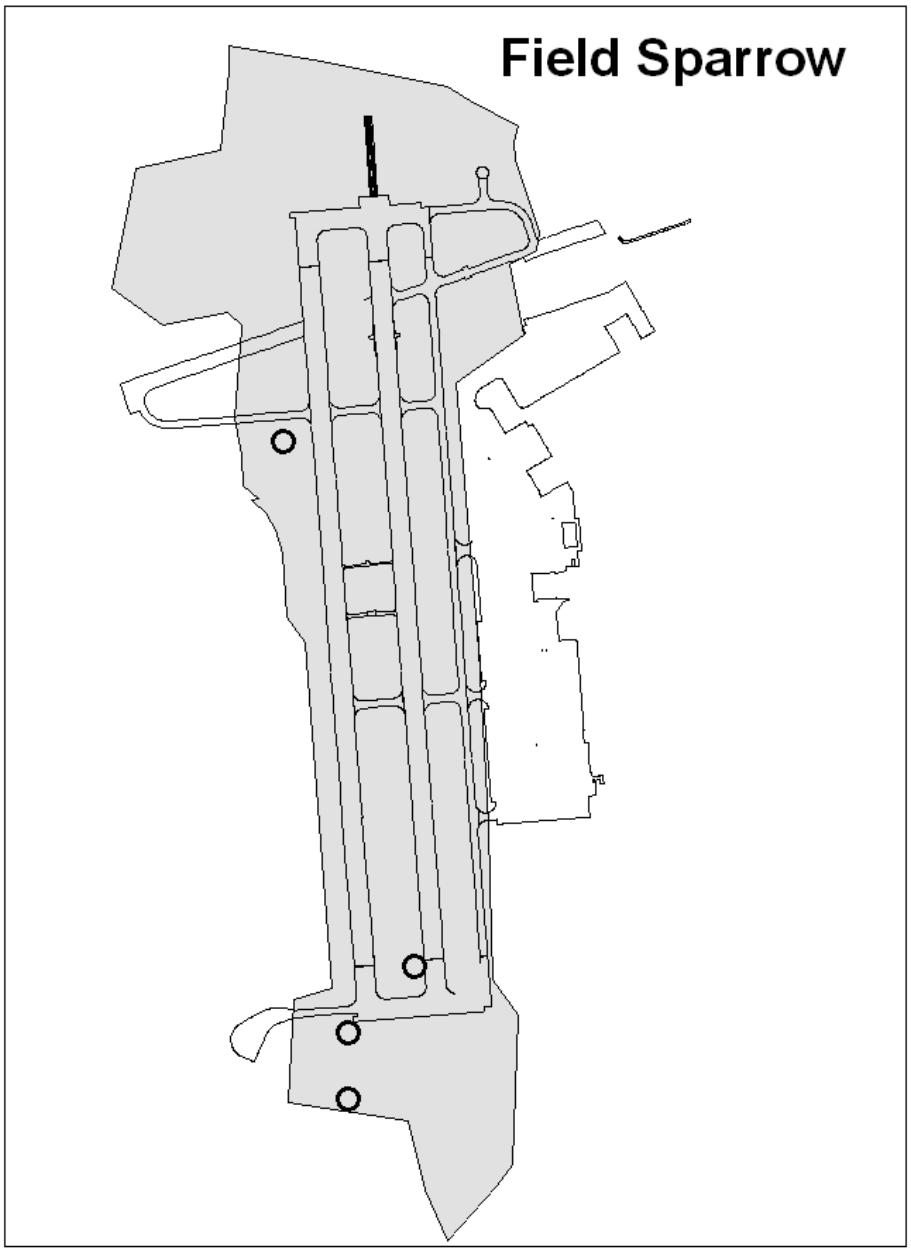

Figure 10. Grassland point count stations where Field Sparrow was detected. Open circles indicate points where the species was detected only from a distance greater than 50 m; the species was never detected within a 50-m radius.

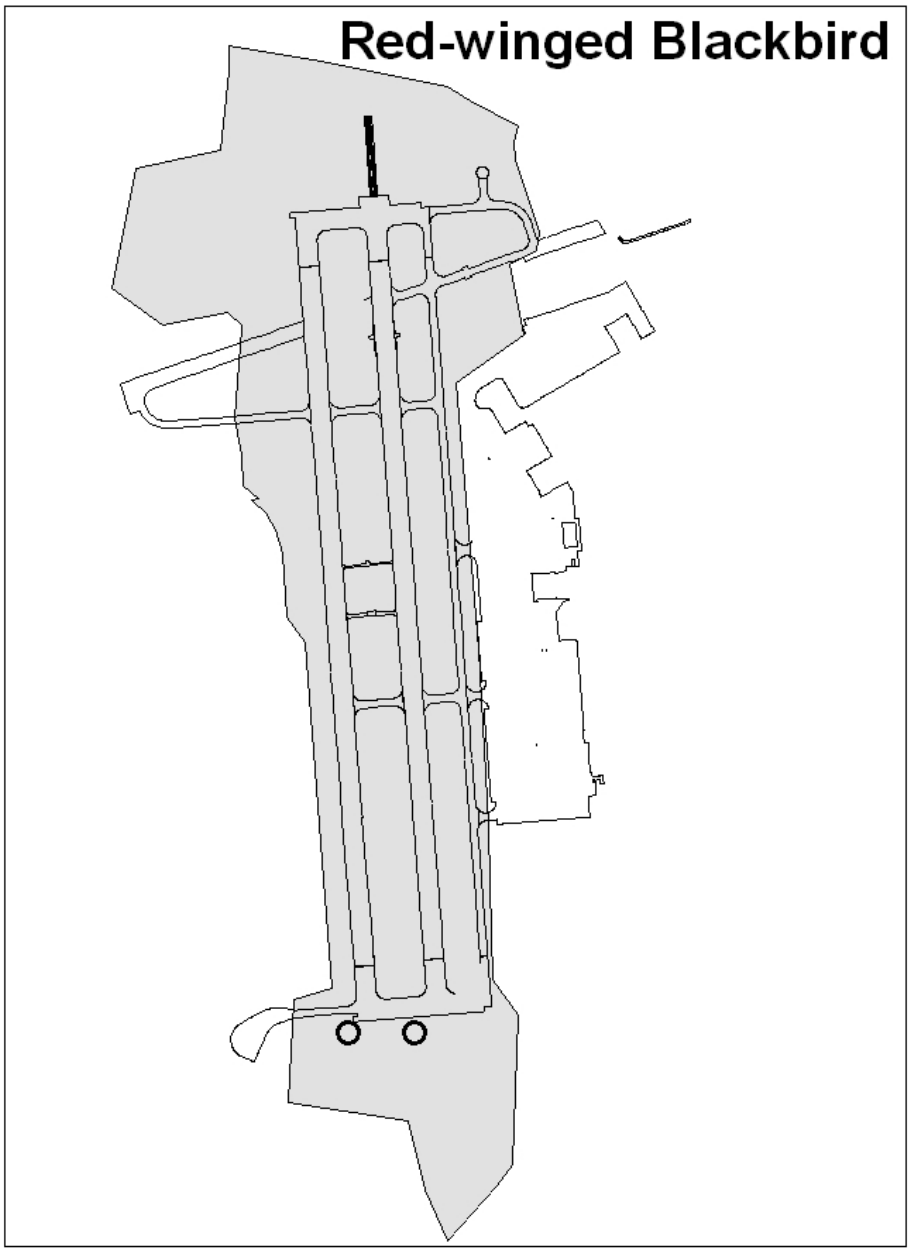

Figure 11. The two grassland point count stations where Red-winged Blackbird was detected. Both detections were of birds more than 50 m away from the point count station.