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UTILIZATION OF A ROADSIDE SURVEY TECHNIQUE TO SURVEY BURROWING OWLS (*ATHENE CUNICULARIA HYPUGAEA*) IN SOUTHEASTERN ALBERTA

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Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

UTILIZATION OF A ROADSIDE SURVEY TECHNIQUE TO SURVEY BURROWING OWLS (*ATHENE CUNICULARIA HYPUGAEA*) IN SOUTHEASTERN ALBERTA

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EXECUTIVE SUMMARY

The western burrowing owl (*Athene cunicularia hypugaea*) has declined significantly over much of its range in Canada and the United States (Wellicome and Haug, 1995). The species is listed as "*Threatened*" in the Alberta Wildlife Act and is considered "*At Risk*" within the province (Alberta Sustainable Resource Development, 2001). Various conservation measures have been recommended including expanded monitoring of population distribution, productivity, and trends. Previous surveys of burrowing owls in Alberta have typically used trend block survey methods. In comparison, roadside surveys require less personnel and equipment, and reduce the need to gain access to private lands. Considering the merits of roadside surveys, the goal of this project was to (1) test the suitability of roadside surveys for surveying burrowing owls and (2) gather information on burrowing owl populations in southeastern Alberta where formal surveys had not been conducted for many years.

The study area for this project was the southeast corner of Alberta where large tracts of dry mixed-grass prairie occur. Established burrowing owl call playback survey protocol was used and one hundred and sixty five survey stops were completed on three different survey transects. Two confirmed nesting pairs of burrowing owls were located along these transects. One of these pairs was detected only after a response to the call playback. The nest density for native grassland habitat within the survey transects was 1.89 nests/100 km^2. This value is lower than estimates in other areas using trend block surveys. Despite this difference, roadside surveys have been shown to be effective in detecting owls in other studies. Weather conditions may have contributed to low numbers of owls detected in this survey. The survey was conducted in a year of a prolonged drought and the effect of this drought on burrowing owl abundance is unknown. Wind conditions during the survey period were also unfavorable. High winds were the cause of numerous delays in surveying, and windy conditions also caused less than ideal survey conditions on numerous days. Further study is needed to determine whether roadside surveys are as effective in detecting owls and nests as the trend block method. This will require comparing results of trend block and roadside surveys conducted in the same area.

1.0 INTRODUCTION

The western burrowing owl (*Athene cunicularia hypugaea*) has declined significantly over much of its range in Canada and the United States (Wellicome and Haug, 1995). It is listed as "*Threatened*" in the Alberta Wildlife Act and is considered "*At Risk*" within the province (Alberta Sustainable Resource Development, 2001). Recent data suggests that, over the past decade, burrowing owls have declined in Canada at a rate of 22% per year. It is expected that the burrowing owl will become extinct in Canada unless this trend is reversed (Environment Canada, 2002).

In order to effectively enact conservation measures for this species, a better understanding of burrowing owl population dynamics and distribution is required. In February 2000 the Alberta Minister of Environment, under recommendation from the provincial Endangered Species Conservation Committee, released an "Initial Conservation Action Statement" for the burrowing owl in Alberta. This statement recommended various conservation measures including expanded monitoring of distribution, productivity, and trends in southern Alberta.

Historically, burrowing owl monitoring in Alberta has been conducted somewhat sporadically. However, two established survey areas (trend blocks) near Hanna and Brooks have been monitored repeatedly in order to detect population trends (Shyry, 1999, Shyry et al., 2001). This work has shown a severe decline in the northern reaches of burrowing owl range (Hanna block) and a more stable population in the southern portion of its range (Brooks block). Although these two locations have been the subject of more intense research, there is little recent information available in many areas of the province known to historically contain burrowing owls. In particular, little information is available on burrowing owl populations in the extreme southeastern corner of Alberta where large tracts of contiguous short-grass prairie have been known to historically contain owls. When trend block style surveys were initiated in 1993, a survey area in the southeast near Cressday was included. However, the survey in this area was never replicated (Schmutz, 1994). In 1994 and 1995 surveys were conducted in southeastern Alberta within provincial Wildlife Management Units to obtain a provincial burrowing owl population estimate (Schmutz, 1996). No organised survey in southeastern Alberta has been undertaken since that time. Recently some data on burrowing owls in southeastern Alberta has been collected as a result of pre-development surveys performed for the oil and gas industry.

Trend block surveys involve an intensive cross-country survey using all-terrain vehicles and multiple observers. A diurnal call playback is broadcast from the centre of each quarter section within the established survey blocks, and the numbers of owls detected audibly or visibly by the observers are compared among years. Recently, trend block surveys have become increasingly difficult to complete due to difficulty in attaining access to survey blocks, apparently due to landowners' fears of federal endangered species legislation (Scobie and Russell, 2000, Scobie, 2002). Trend block surveys also require a large amount of personnel and equipment for completion.

A range-wide North American survey of burrowing owls has been suggested to collect information on species status, range, and baseline population size (Duxbury and Holdroyd, 1999). A roadside survey has been deemed the most suitable methodology due to the magnitude of this survey. Considering the merits of a roadside survey, this project aimed to (1) test the suitability of roadside surveys to monitor burrowing owls, and (2) gather information on burrowing owl populations in southeastern Alberta where formal surveys have not been conducted for several years. Additionally, if roadside surveys are deemed valuable, the survey routes could be established as permanent roadside monitoring transects for burrowing owls.

2.0 STUDY AREA

The study area for this project was concentrated in the southeast corner Alberta. Three road transects were chosen and surveyed during this project. The transects were contained within townships one to13 and ranges one to eight. The majority of the project was completed south of the Cypress Hills, south of township seven. Locations of transects surveyed during the study are shown in Figure 1. This area is predominately native dry mixed-grass prairie interspersed with cultivation. Much of the native grassland is under public ownership and is under grazing disposition. Traffic volumes on the gravel roads are generally light.

Few roads occur within the study area. The choice and positioning of transects reflected the positioning of these roads within the study area. Transect 1 commenced at Wildhorse, progressed north, and ended south of Fox Lake. Transect 2 commenced at the east end of Secondary Highway 501 where it intersects the Alberta/Saskatchewan border, progressed west, and ended at the junction of Secondary Highway 501 and Secondary Highway 885. Transect 3 commenced north of the town of Irvine on range road 30 and ended due east of Veinerville. Transect 3 was considerably shorter than the other two because time constraints and weather conditions did not allow further surveys to be completed along this route as originally planned.

3.0 METHODS

Surveys were conducted between 14 May and 28 June 2001. Surveys were performed in the early morning until 13:00, seven days per week, weather permitting. Surveys were not conducted in winds greater than 20 km/hr or when it was raining (Scobie and Russell, 2000). During the study, wind velocity was the main factor limiting how many days surveys could be conducted.

Universal Transverse Mercator (UTM) coordinates were recorded for each survey stop with a Global Positioning System (GPS) unit using North American Datum 1983 (NAD 83). The GPS unit was also used to measure distances between survey stops. The distance between survey stops was approximately 1 km depending on terrain and field of view. The observer subjectively decided if the terrain warranted additional survey stops due to extensive portions of habitat being out of view due to topography. If the distance travelled was less than 1 km between stops, the reason was noted. Weather information was recorded at each stop, including % cloud cover,

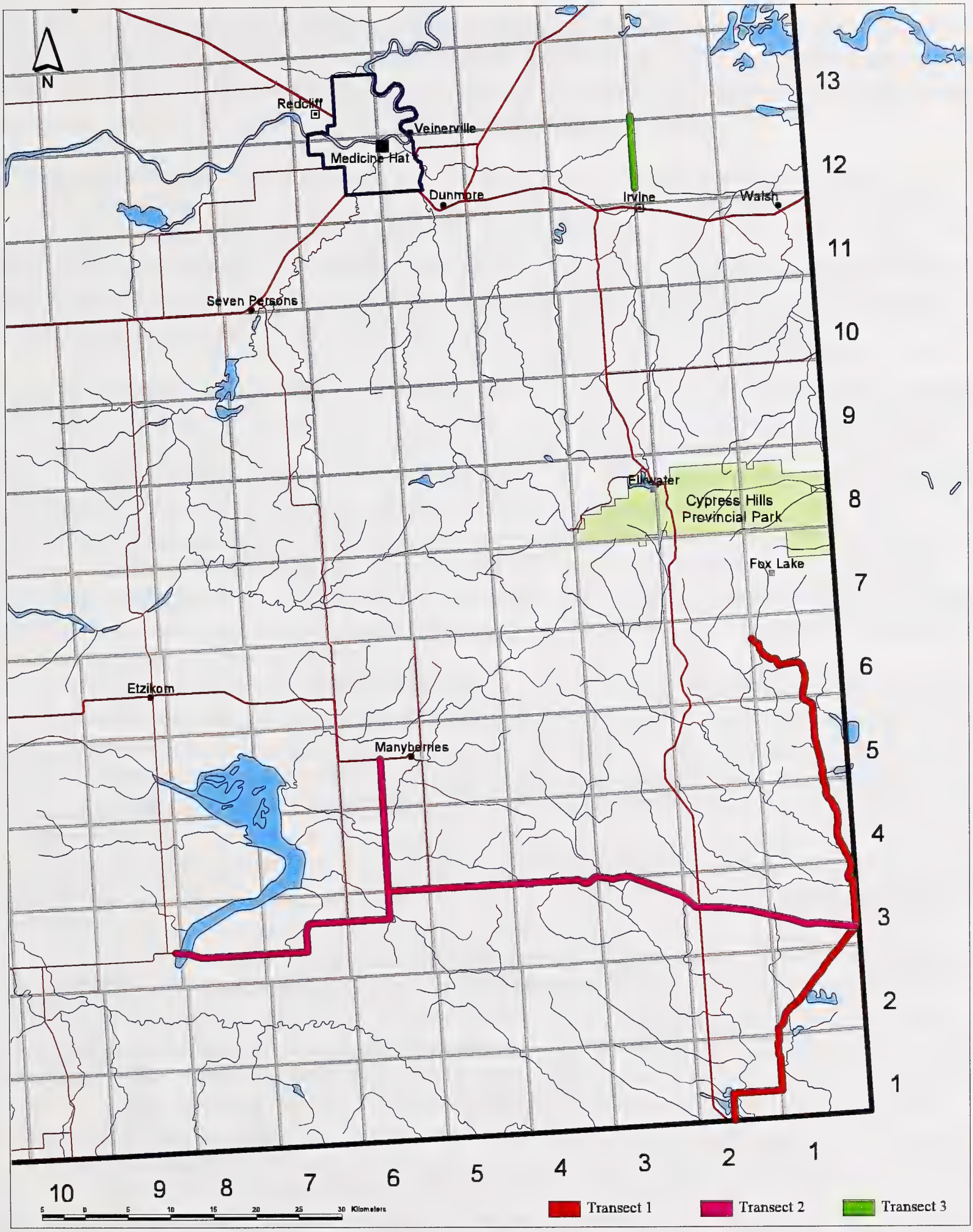

Figure 1. Burrowing owl (*Athene cunicularia hypugaea*) study area showing survey transects.

temperature, and wind speed. Wind speed was measured using the Beaufort scale (World Meteorological Organization 1970) or a Skymate SM-18 anemometer. Field of view was recorded as percent area visible from the bed of the truck. If the entire area was not visible, the reason was noted. Vegetation type (e.g., cropland, native prairie) was also noted.

Surveys were conducted using established burrowing owl call playback survey protocol (Scobie and Russell 2000). The burrowing owl diurnal call playback survey was conducted from the bed of a truck using a 5-5-5-3 method at each survey stop. The first 5 minutes of the survey were used to scan the area in a 360 degree radius using binoculars, and to let the disturbance of the vehicle dissipate. The observer stayed as still as possible while scanning. During the second 5 minute period the burrowing owl primary/breeding call (coo-coo) was broadcast using a Dennis Kirk Magnum portable game caller and the area was scanned for the presence of owls. The game caller was rotated 360 degrees during the playback in order to broadcast it over the entire survey area. The third 5 minute period was used to perform a final scan of the area. The last 3 minute period was used to do a Breeding Bird Survey (BBS) where all birds observed or heard from the survey point were recorded. The BBS survey was performed at each survey stop to maximize the amount of data collected from available resources. This point count provided data on other sensitive avian species associated with the short-grass prairie ecosystem. All birds that could be identified were recorded and species of concern were entered into the Biodiversity Species Observation Database (BSOD). Observations of other species of concern (non-avian) were also recorded and entered into BSOD.

If a burrowing owl was spotted during the survey, identity was confirmed using a 15 – 45 X 60 Bushnell Natureview spotting scope. Following confirmation of an owl, the observer walked to the location to confirm the presence of a nest burrow. Nest burrows were confirmed by the presence of prey remains (e.g., bones, pellets), dried cattle manure in and around the nest burrow, whitewash, and/or the presence of juvenile owls at the burrow (Shyry et al., 2001). When a nest was located, productivity of the nest was monitored on several days during June and July using half hour observation periods (R. Sissons, unpubl. data), until it appeared that young were beginning to disperse.

Nesting sites of burrowing owls are generally more abundant in areas of native vegetation (Shyry et al., 2001). The Native Prairie Vegetation Baseline Inventory (NPVBI) was used to identify the amount of native graminoid coverage along each transect as well as the relative habitat contiguity in each transect. The NPVBI is a reconnaissance level inventory that classifies and maps native vegetation in the Grassland Natural Region of Alberta (Prairie Conservation Forum, 2002). This classification was completed to a quarter section (160 acre) resolution. The inventory classifies native vegetation into one of six cover classes: tree, shrub, graminoid, riparian, lake or wetland and the percentage of each cover class is estimated to the nearest five percent of each quarter section. The inventory was undertaken using mostly 1991 - 1993, 1:30,000 aerial photography. The inventory, completed by Alberta Environment for the Prairie Conservation Forum, was an objective in the Alberta Prairie Conservation Action Plan (1996-2000) to complete identification of native prairie (Prairie Conservation Forum, 2002). The inventory specifies a minimum interpretation accuracy of 80 percent. Accuracy of interpretation was monitored and statistical samples of the data set were analyzed and checked to ensure minimum accuracy requirements were met.

Historical data on nesting observations was obtained from BSOD in order to compare the number of nests found within survey transects in the past with the numbers obtained during this study. While these historical data were not collected in a standardized manner, they do indicate presence of burrowing owls in these areas within the past two decades.

4.0 RESULTS

One hundred and sixty five survey stops were completed across the three survey transects. Two confirmed nesting pairs of burrowing owls were located along the transects. One pair of owls was located along Transect 1, while the other pair was located along Transect 2.

The first burrowing owl nest was an incidental observation made while travelling along Transect 1 at 07:39 on 28 May. A lone burrowing owl was spotted crouched on the lee side of a burrow in high winds. On this day, the observer remained approximately 40 m north of the burrow. The site was revisited on 1 June while surveying Transect 2. A pair of owls was observed at the same location during the initial 5 minute scan of the area. The location of the nest burrow was confirmed on this day. Monitoring of productivity of the nest began on 20 June. On this day, one lone owl was spotted at the nest burrow. A second observation on 28 June revealed one adult and three young. On 3 July two adults and 5 young were observed. The estimated age of the young at this visit was 21 days, based on methods by Priest (1997). On 11 July two adults and five young were still using the nest burrow and surrounding satellite burrows. On 17 July the two adults and five young were observed feeding and resting at and around the nest burrow. On 25 July two adults and four young were observed. The young were noticeably more active. A final observation on 27 July detected five young and one adult. The adult and one juvenile were approximately 100 m east of the nest in another burrow, indicating that dispersal of young had started to occur.

The second nest was located on 21 June at 09:53. A pair of owls responded to the playback call and the adults were spotted standing on the nest burrow. The nest was confirmed on this day by the presence of cow dung, pellets, and feathers around the burrow. Productivity monitoring of this nest began on 28 June when the nest was discovered to have been flooded. A thunderstorm during the night of 27 June produced a substantial amount of rain, precipitating some flash flooding in the study area. One adult owl was spotted standing on a hill approximately 150 m east of the burrow. The burrow was examined and the cow dung, pellets and feathers were no longer present and appeared to be washed away. This nest was revisited on 3 July. The pair of owls was spotted repeatedly entering the burrow but no young were observed. A final visit to this nest site on 17 July revealed one adult owl sitting on some nearby water pipes. The owl was never observed in the vicinity of the nest burrow and no young or recent sign were present.

Habitat analysis using the NPVBI inventory revealed that Transect 1 and Transect 2 had similar coverage of native graminoids and had much higher coverage of native graminoids than Transect 3. Over the entire study area, nest density was calculated to be 1.36 nests/100 km^2. Because burrowing owls are far more likely to nest on native grassland, nest density was also calculated based on the total area of native graminoids across transects. Nest density within areas of native grassland was 1.89 nests/100 km^2. The small number of owls observed during this study precluded a calculation of nest density within each transect and a comparison of owl density among transects differing in the amount of native vegetation.

Table 1. The area (km^2) of transects and of native graminoids (NG) in transects. BSOD data indicate the number of incidental observations of nests found in the transects.

Transect	Total Area	Area with NG	Percent area with NG	Area of NG in quarters with ≥50% NG	Number of quarters with ≥ 50% NG	Previous nests (BSOD 1982-2001)
1	57.53	42.41	73.72	40.9043	148 of 180	7
2	82.41	61.12	74.17	59.2019	214 of 267	9
3	7.15	2.26	31.61	1.9086	8 of 26	1
Total	**147.09**	**105.79**	**71.92**	**102.0148**	**370 of 473**	**17**

Several other species of concern were detected during the survey (Appendix 1). These records can now be added to the provincial database.

5.0 DISCUSSION

Two nest sites were detected using the roadside survey technique. One of these pairs was an incidental observation made while travelling to a survey stop. The other was detected in response to the call playback, indicating that call playbacks remain a useful tool for detecting owls. The overall low number of owls detected during the survey makes it difficult to determine whether the roadside survey method is as effective as the trend block survey method. Historical data indicates a number of casual observations of burrowing owl nests along survey routes in the recent past, however previous systematic surveys in the area have detected low densities of owls. Schmutz (1994) detected no owls after conducting call playback surveys on 112 randomly chosen quarter sections near Cressday. In addition, surveys conducted in Wildlife Management Units 102 and 118 in 1995 found no burrowing owls within the surveyed 343 quarter sections, but one owl nest was confirmed outside of the study area (Schmutz, 1996).

There is evidence that roadside surveys have been effective in locating owls in other studies. Duxbury and Holroyd (1999) used roadside surveys to locate burrowing owl nests. In their study, 12 of 15 nests were detected using roadside surveys. In addition, Conway et al. (2001) have used roadside surveys to detect breeding owls in a comprehensive monitoring program in Washington. Given the success of this method in previous studies, failure to detect a large number of owls in this study may be due to other factors. This study was conducted in an area experiencing a severe and prolonged drought. The effect of this drought on burrowing owl abundance is unknown. Wind conditions during the survey period also were unfavourable. High winds were the cause of numerous delays in surveying, and windy conditions caused less than ideal survey conditions on several days of the survey. Wind conditions may have biased detection rates of owls if vocalizations were not audible to observers or if owls were less active during periods of high winds.

The density of nests in the study area was 1.36 /100 km^2. Trend block surveys conducted in Brooks and Hanna from 1991 to 2000 show higher nest densities. The average nest density in Brooks was 8.9 nests/100 km^2 (range = 1.9 to 13.5) and in Hanna was (13.7 nests/100 km^2, range = 2.8 – 32.6) (Shyry et al, 2001). However, in some years, nest densities using trend block surveys were low and approached the value calculated in this study.

Burrowing owls are far more likely to nest on native grassland and current trend block surveys near Brooks and Hanna occur within native prairie. In this study, nest density within native grassland habitat was 1.89 nests/100 km^2. Analysis of habitat within transects showed that Transect 1 and 2 had similar cover of native grassland. Transect 3 had much lower cover of native grassland than Transect 1 or 2. The low number of owls detected during the survey precluded a comparison of nest densities among transects differing in cover of native grassland.

Further study is needed to determine whether roadside surveys are as effective in detecting owls and nests as trend block surveys. This will require comparing results of trend block and roadside surveys conducted in the same area. In addition, individual survey routes could be shortened and the total number of routes increased to allow for more even sampling across the landscape.

6.0 MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

Both burrowing owl nests were located on public land, making these sites eligible for protection. Protective notations should be placed on these sites, as soon as possible, in order to protect them from industrial activities.

Due to the low number of nests detected during this survey, the value of continuing roadside surveys for burrowing owls and the scale at which these surveys need to be conducted should be investigated further. The status of burrowing owl populations in Alberta warrants that the most effective method for detecting owls and nests be determined and used in future surveys.

7.0 LITERATURE CITED

Alberta Sustainable Resource Development. 2001. The General Status of Alberta Wild Species 2000. Alberta Sustainable Resource Development, Fish and Wildlife Service.

Conway, C.J., P. Bartels, J. Stofel, E. Cummins, J. Tabor, and J. Whitney. 2001. Population Monitoring, Population Status, and Current Research Priorities of Burrowing Owls in Washington. Unpublished Report. Department of Natural Resource Sciences, Washington State University. Richland, Washington.

Duxbury, J.M. and G.L. Holroyd. 2001. A Standardized, Roadside Burrowing Owl Survey Technique. Unpublished Report. Canadian Wildlife Service, Environment Canada. Edmonton, AB.

Prairie Conservation Forum. 2002. http://www.albertapcf.ab.ca/background.htm.

Priest, J.E. 1997. Age Identification of Nestling Burrowing Owls. Journal of Raptor Research Report. 9: 125 – 127.

Schmutz, J.K. 1994. Counts of Breeding Burrowing Owls in Southeastern Alberta. Alberta Environmental Protection, Natural Resources Service. Edmonton, AB.

Schmutz, J.K. 1996. A Census of Breeding Burrowing Owls in southeastern Alberta. Alberta Environmental Protection, Natural Resources Service. Edmonton, AB.

Scobie, D. 2002. 2001 burrowing owl trend block survey and monitoring, Brooks and Hanna areas. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 51. Edmonton, AB.

Scobie, D. and Russell, R. 2000. Burrowing Owl Trend Block Survey and Monitoring, Brooks and Hanna Areas. Alberta Sustainable Resource Development, Fisheries and Wildlife Management Division, Alberta Species at Risk Report No. 8, Edmonton, AB. 11pp.

Shyry, D.T. 1999. A Summary Report on Burrowing Owl (*Athene cunicularia*) Population Trend Surveys in Southern Alberta: 1991 – 1998. Alberta Environment, Wildlife Management Division, Occasional Paper, Alberta Natural Resources Service, Edmonton, AB. 16 pp.

Shyry, D.T., T.I. Wellicome, J.K. Schmutz, G.L. Erickson, D.L. Scobie, R.F. Russell, R.G. Martin. 2001. Burrowing owl population-trend surveys in southern Alberta: 1991 – 2000. Journal of Raptor Research. 35(4): 310 – 315.

Wellicome, T.I. and E.A. Haug. 1995. Updated report on the status of the burrowing owl in Canada. Prepared for the Committee on the Status of Endangered Wildlife in Canada, Environment Canada, Ottawa, Ontario.

World Meteorological Association. 1970. The Beaufort Scale of Wind Force: (Technical and Operational Aspects) / Report submitted by the President of the Commission for Maritime Meteorology and the WMO Executive Committee as its twenty-second session. 22 pp.

APPENDIX 1. OTHER SPECIES OF CONCERN OBSERVED DURING THE SURVEY

Species (*Status in Alberta)**	**Number**	**Comments**
American Badger *(Sensitive)*	3	1 roadkill, 2 spotted during survey stops
Long-tailed Weasel *(May Be at Risk)*	2	2 spotted in native prairie 4 spotted concentrated around 1 burrow
Swift Fox *(At Risk)*	1	1 individual spotted
Ferruginous Hawk *(At Risk)*	4	3 spotted on BBS (1 on nest pole) 1 on nest in tree in Saskatchewan
Loggerhead Shrike *(Sensitive)*	3	1 spotted during BBS, 2 incidental sightings
Long-billed Curlew *(May Be at Risk)*	10	Heard or spotted during BBS
Sharp-tailed Grouse *(Sensitive)*	1	Lek in Saskatchewan, 4 birds dancing
Sprague's Pipit *(Sensitive)*	9	Heard during BBS

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