1992

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Jodie L. Provost  
University of North Dakota

Thomas A. Provost  
University of North Dakota

Stephen J. Maxson  
Wetland Wildlife Populations and Research Group

Richard D. Crawford  
University of North Dakota

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BREEDING BIOLOGY OF GREATER SANDHILL CRANES ON THE ROSEAU RIVER WILDLIFE MANAGEMENT AREA, MINNESOTA

JODIE L. PROVOST,1 Biology Department, University of North Dakota, Grand Forks, ND 58202
THOMAS A. PROVOST,1 Biology Department, University of North Dakota, Grand Forks, ND 58202
STEPHEN J. MAXSON, Wetland Wildlife Populations and Research Group, Minnesota Department of Natural Resources, 102 23rd Street, Bemidji, MN 56601
RICHARD D. CRAWFORD, Biology Department, University of North Dakota, Grand Forks, ND 58202

Abstract: The breeding biology of greater sandhill cranes (Grus canadensis tabida) on the Roseau River Wildlife Management Area in northwestern Minnesota was studied from April 1989 to October 1990. A minimum of 0.25 breeding pair per km² of wetland and upland nested on the study area. Except for distances to nearest shrub from nest and random sites ($P = 0.047$), there were no significant differences among mean habitat values or distributions of variables measured at nest and random sites ($P > 0.05$). Mean clutch size was $1.88 \pm 0.33$ (SD) eggs for 17 clutches in 1989 and 1990. In 1990, estimated hatch dates for 13 clutches ranged from 21 May to 12 June ($\bar{x} = 30$ May $\pm 6.6$ days [SD]), apparent egg hatching success was 69.2% ($n = 26$), and apparent and Mayfield corrected nest success were 73.3% ($n = 15$) and 53.8% ($n = 14$), respectively.

Key Words: greater sandhill cranes, Grus canadensis tabida, Minnesota, nesting habitat preference, Roseau River Wildlife Management Area

Prior to 1875–80, greater sandhill cranes commonly nested south and west of the heavily wooded northeastern region of Minnesota (Roberts 1932). However, rapid settlement of the prairie and unregulated market and subsistence hunting resulted in a dramatic decline in their numbers (Johnson 1976a). By 1900, sandhill cranes were described as rare in Minnesota (Swanson 1940). Sightings of sandhill cranes have become increasingly frequent in Minnesota in recent decades. In 1985, Tacha and Tacha (1985) estimated that 760–1,160 and 87–109 pairs nested in the northwestern and east-central portions of the state, respectively. The Minnesota Department of Natural Resources (MDNR) realized the need to develop a management plan for cranes and identify resident populations, migration routes, and habitat requirements (Tacha and Tacha 1985). In this study, we determined breeding pair density, nesting habitat preference, and nest success.

We thank personnel at the Roseau River Wildlife Management Area for their assistance and cooperation and the MDNR for provision of housing, vehicles, and fuel. A. J. Bennett provided many helpful comments and suggestions regarding this manuscript. Grants were provided by the University of North Dakota Biology Department and Graduate School, and Minnesota Non-game Wildlife Program.

STUDY AREA AND METHODS

The study area (111.4 km²) was located on the Roseau River Wildlife Management Area (RRWMA) in Roseau County, northwestern Minnesota (Fig. 1). A very large wetland complex, dominated by seasonally and semipermanently flooded emergent wetlands, comprised approximately 85% of the study area. This complex also included saturated, deciduous scrub-shrub, and coniferous wetlands. Dominant wetland vegetation included Typha spp., Carex spp., Phragmites australis, Phalaris arundinacea, and Salix spp. Upland habitat included old fields, agricultural fields, and aspen (Populus spp.) stands.

RRWMA was developed to maintain and improve waterfowl habitat and provide public hunting. Management practices include controlled burning, cutting and dozing trees, mowing, haying, water level manipulation, and growing of grain, sunflowers, corn, and alfalfa.

Breeding Pair Density

Breeding pairs were located in April and May by listening for unison calls from 0.5 hour before to 2 hours after sunrise and by playing tape-recorded unison calls (Bennett 1978a). We also located cranes by helicopter when searching for nests and while walking or driving through the study area. Observation of an active nest, a single crane on a territory during nesting, and/or chicks indicated that a pair was breeding.
Fig. 1. Location of study area on the Roseau River Wildlife Management Area, Minnesota, 1989–90.

Nesting Habitat Preference

Nest searches were conducted on foot in May and early June of 1989 and by helicopter for 1 hour on 8 May 1989 and 3 and 3.5 hours on 11 May and 22 May 1990, respectively. On the first visit to an active nest we measured water depth 1 m from the nest edge in each cardinal direction and floated the eggs to determine stage of incubation (Fisher and Swengel 1991). To prevent excessive disturbance at nest sites, habitat analyses were conducted after the estimated hatch date. Habitat measurements included (1) classifying the wetland according to Cowardin et al. (1979); (2) distance to nearest upland; (3) distance to nearest shrub (1990 only) and tree ≤400 m away; (4) water depth 1 m from the nest edge in each cardinal direction; (5) identifying species, number of clumps, and number of shrub stems ≥4 mm in diameter that were 30 cm above nest level and within 1.5 m of the nest edge; and (6) number of trees ≥3 cm DBH within 5 m of the nest edge. We measured nest concealment by residual vegetation at 3 33-cm height levels in each cardinal direction. A 25- × 99-cm density board was placed at the nest edge and observed from a distance of 5 m and an eye height of 1 m. Each 33-cm portion of the density board was divided into 25 rectangles. All rectangles 50% or more visible at each height level were summed and subtracted from 100 to yield concealment scores. Species composition and stem density were determined in 4 0.25-m² quadrats randomly placed within a 1- × 5-m strip radiating in each cardinal direction from the nest edge. Wetland basin size and distance to upland too large to measure from the ground were estimated from aerial photos or obtained from MDNR (1980).

Identical habitat analyses were performed at 1 and 2 randomly selected locations per nest in 1989 and 1990, respectively. These corresponding random sites were located in the same basin and analyzed on the same day as nest sites to determine if cranes selected nest sites nonrandomly within basins. They were located by placing a grid over a map of the basin, numbering all grid squares falling within the basin, randomly selecting a grid square, and locating the center of this square in the field. A predetermined random direction and distance was then walked from this first point. The second point was the random site. If the random site fell within open water or on upland, we returned to the first point and tried another predetermined random direction and distance.

More random sites per nest and analysis of basins unused by nesting cranes were desirable, however time constraints did not allow for these additional analyses. Means and distributions of variables measured at nest and random sites were compared by using t-tests and Kolmogorov-Smirnov 2-sample tests, respectively.

Nest Success

On the final visit, we determined egg fate. A nest was considered successful if at least 1 egg hatched. Apparent hatching success and Mayfield corrected nest success were determined (Klett et al. 1986).

RESULTS

Breeding Pair Density

At least 28 breeding pairs (0.25 breeding pair/km² of wetland and upland) were located on the study area. In addition, 23 pairs were territorial but not proven to be breeding. Density of all territorial pairs on the study area was 0.46 pair/km².

Nesting Habitat Preference

Two and 17 nests were located during the aerial surveys in 1989 and 1990, respectively. Seventeen nest sites were successfully relocated from the ground for habitat analysis and 31 random site habitat analyses were performed.

Nine basins that contained nests ranged in size from 0.6 to 1,862.3 ha. All nests and random sites were located in the palustrine system, emergent class, and persistent subclass. Eight vegetation dominance types (Fig. 2), 2
water regimes, and 8 plant genera (Fig. 3) were identified at sites. Compared to random sites, nest sites occurred more frequently in habitats dominated by Typha spp. and less frequently in habitats dominated by Phalaris arundinacea (Fig. 2). Percent occurrences of nest sites in Carex spp.- and Typha spp.-dominated habitats were equal. However, all nest sites had some Typha spp. present (Fig. 3). Typha spp. occurred more frequently and Phalaris arundinacea less frequently at nest sites than at random sites. There were no apparent differences among percent occurrences of nest and random sites in seasonally or semipermanently flooded wetlands.

Except for distances to nearest shrub (\( D = 0.429, P = 0.047; \) Fig. 4), no significant differences (\( P > 0.05 \)) existed among means or distributions of variables measured at nest and random sites (Table 1). The range of distances to nearest shrub from nest sites was narrower (0.0 – 55.5 m) than for random sites (0.0 – 235.0 m) and random sites were concentrated in the lower end of the distribution (Fig. 4). All shrubs within 1.5 m of sites were Salix spp.

Clutch Size, Hatching Dates, and Nest Success

Mean clutch size was 1.88 ± 0.33 (SD) eggs for 17 clutches in 1989 and 1990. Estimated hatch dates for 13 clutches in 1990 ranged from 21 May to 12 June (\( x = 30 \) May ± 6.6 [SD] days). Two chicks, approximately 2 weeks old, found on 10 July 1989, were probably the result of a second nesting attempt.

In 1989, 1 nest was successful and 1 nest was abandoned due to flooding. In 1990, 18 (69.2%) of 26 eggs in 14 nests hatched. Apparent nest success was 73.3% (\( n = 15 \)) and Mayfield corrected nest success was 53.8% (\( n = 14 \)). Of the 4 unsuccessful nests in 1990, 2 were depredated, 1 was abandoned, and 1 nest contained 2 addled eggs.

**DISCUSSION**

**Breeding Pair Density**

The minimum breeding pair density of 0.25 pair/km² on the study area is greater than densities observed elsewhere on Minnesota study areas comprised of wetland and upland. DiMatteo (in press) observed 0.13 pair/km² on Agassiz NWR, Maxson (unpub. data) observed 0.14–0.20 pair/km² in Kittson and Marshall Counties, and Johnson (1976b) reported 0.06 pair/km² in central Morrison County. Breeding pair densities on study areas comprised of wetland and upland have ranged from 0.02 pair/km² in southeastern Wisconsin (Bennett 1978b) to 2.00 pair/km² at Grays Lake, Idaho (Drewien 1973). Differences in breeding pair densities are probably due to differences in proportion of upland and wetland in study areas, habitat quality, and population size and status.
Nesting Habitat Preference

Basin sizes used by nesting sandhill cranes varied greatly in this study (0.6–1,862.3 ha). Such variation has also been observed in other studies. In Kittson and Marshall Counties of northwestern Minnesota, wetlands used by nesting cranes ranged from 0.04 to 601.2 ha (S. J. Maxson, unpubl. data). In Wisconsin, 143 wetlands used by nesting cranes ranged in size from 4.0 to >1,215 ha (Gluesing 1974). In Michigan, Taylor (1976) observed cranes nesting in wetlands which ranged in size from 0.2–810 ha.

Analysis of random sites determined the relative availability of habitat types. Comparison of these data to data collected at nest sites determined if nesting cranes preferred particular habitat types. Differences in the presence of Typha spp. and Phalaris arundinacea at nest and random sites (Figs. 2 and 3) suggest cranes may have preferred nesting in the former and avoided the latter. This possible preference is supported by a greater mean density of Typha spp. and a lower mean density of Phalaris arundinacea at nest sites than at random sites. Although several nests were located in areas dominated by Carex spp. (Fig. 2), Typha was also present at these sites (Fig. 3) and the mean density of Carex spp. stems was lower at nest sites than at random sites.

A possible preference by sandhill cranes for nesting in tall, robust, emergent vegetation, because it provides cover in early spring, has also been observed by other researchers (Johnson 1976b, Bennett 1978b, Tebbel 1981). Plant species observed adjacent to nest sites have varied greatly among studies (Provost 1991), and vegetation structure appears to be of greater importance than species composition in nest site selection, particularly where egg predation is an important natality factor (Drewien 1973).

The significant difference among distributions of distances to nearest shrub from nest and random sites (P = 0.047, Fig. 4) indicates that cranes preferred to nest farther from shrubs than most distances provided by the available habitat. This preference is also supported by a larger mean distance to nearest shrub from nest sites than for random sites (Table 1).

Shrubs can afford cranes nesting cover and isolation. Two nests in this study were located adjacent to or within shrub stems. They were also surrounded by water up to 70 cm deep. Several other studies have also observed nests adjacent to or within clumps of shrubs (Walkinshaw 1965, Littlefield and Ryder 1968, Blake 1974, Johnson 1976b, Carlisle 1979). However, when fire is prevented and wetlands are drained, shrubs may invade wetlands and form monotypic stands. Nesting cranes will vacate these areas (Bennett 1978b, Valentine 1982).

Nest sites were located closer to upland than random sites, thus cranes may have preferred to nest closer to upland than most distances provided by the available habitat. However, the mean distance from nests to dry land was greater in this study (286.9 m) than in others. In central Florida (Walkinshaw 1976), the Upper Peninsula of Michigan (Walkinshaw 1978), and central Alberta (Carlisle 1979), mean distances to dry land were 61.5 m, 30.8 m, and 50 m, respectively. The large mean we observed may have been due to the large wetland complex present on the study area (Fig. 1).

Nest sites were less concealed by residual herbaceous vegetation than random sites (Table 1). Maxson (unpubl. data) also found concealment to be less at nest sites than random sites. Lower concealment scores may have been caused by removal of some vegetation adjacent to nests during nest construction or cranes may have preferred cover with a structure and density that allowed them a clear view of their surroundings while incubating and free movement when walking to and from nests (Walkinshaw 1950, Bennett 1978b).

Possible explanations for the predominant lack of significant differences among means and distributions of variables measured at nest and random sites include (1) inadequate sample sizes; (2) data recorded in late May to mid-June may have not accurately represented habitat conditions in April when cranes selected nest sites; and (3) cranes may have selected nest sites based on habitat variables not studied.
Table 1. Mean habitat values at sandhill crane nest sites and random sites on the Roseau River Wildlife Management Area, Minnesota, 1989-90.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Nest sites</th>
<th>Random sites</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{x}$</td>
<td>SD/SD</td>
</tr>
<tr>
<td>Distance to upland (m)</td>
<td>286.9</td>
<td>250.4</td>
</tr>
<tr>
<td>Distance to nearest shrub (m)</td>
<td>22.6</td>
<td>17.4</td>
</tr>
<tr>
<td>Distance to nearest tree (m)</td>
<td>162.4</td>
<td>84.1</td>
</tr>
<tr>
<td>Water depth when found (cm)</td>
<td>12.2</td>
<td>8.9</td>
</tr>
<tr>
<td>Water depth when analyzed (cm)</td>
<td>12.9</td>
<td>10.4</td>
</tr>
<tr>
<td>0-33 cm concealment score</td>
<td>59.3</td>
<td>29.4</td>
</tr>
<tr>
<td>33-66 cm concealment score</td>
<td>23.8</td>
<td>22.9</td>
</tr>
<tr>
<td>66-99 cm concealment score</td>
<td>8.2</td>
<td>14.6</td>
</tr>
<tr>
<td>Shrub clumps within 1.5 m</td>
<td>0.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Shrub stems within 1.5 m</td>
<td>4.2</td>
<td>15.9</td>
</tr>
<tr>
<td>Trees within 5 m</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Stems/0.25 m$^2$:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Typha spp</td>
<td>11.1</td>
<td>9.9</td>
</tr>
<tr>
<td>Carex spp</td>
<td>28.8</td>
<td>40.9</td>
</tr>
<tr>
<td>Phalaris arundinacea</td>
<td>2.3</td>
<td>6.6</td>
</tr>
<tr>
<td>Phragmites australis</td>
<td>1.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Scirpus sp</td>
<td>1.4</td>
<td>5.5</td>
</tr>
<tr>
<td>Cirsium arvense</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Scutellaria galericulata</td>
<td>0.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Acorus calamus</td>
<td>0.4</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Nest Success

Apparent hatching success on the study area in 1990 (69.2%) is similar to values documented elsewhere in the Great Lakes region. In Kittson and Marshall Counties of Minnesota, apparent hatching success was 75.0% and 41.0% in 1989 and 1990, respectively (S. J. Maxson, unpubl. data). In central Morrison County, Minnesota, apparent hatching success was 77.2% in 1973-75 (Johnson 1976b). Apparent hatching success among eastern greater sandhill cranes has been as high as 92% in Ontario in 1979 (Tebbel 1981).

The Mayfield corrected nest success estimate of 53.8% is more accurate than the apparent estimate. In Kittson and Marshall Counties of Minnesota, Maxson (unpubl. data) observed Mayfield corrected nest successes of 84.5% and 18.9% in 1989 and 1990, respectively.

LITERATURE CITED


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nesting success among eastern greater sandhill cranes has ranged as high as 100% in Ontario in 1978-79 (Tebbel 1981).


