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Distributions of Roosting Sandhill Cranes as Identified by Aerial Thermography

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ABSTRACT -- We used aerial thermography to determine the location of sandhill crane (*Grus canadensis*) roosting sites during a single night over a 142-km reach of the Platte River, Nebraska. We assessed the influences of human disturbance features, screening of disturbance features by woody vegetation, distance to surrounding cropland of various types and channel width on distribution patterns of sandhill crane roosting sites with the aid of a geographic information system (GIS). We found that roosting sites were farther from bridges and paved roads than random points along the river channel; a visual woody screen mitigated the effect of bridges on locations of roosting sites; and roosting sites were in wider river channels than were observed at random points.

Key words: aerial thermography, *Grus canadensis*, Nebraska, Platte River, roosting sites, sandhill cranes.

In March and early April, the Big Bend Reach of the Platte River in Nebraska is a staging area for most of the mid-continent population of the sandhill crane (*Grus canadensis*). The Platte River is a critical part of the migration route to the breeding grounds because of the high quality feeding and roosting sites (Krapu et al. 1985, Iverson et al. 1987, Tacha et al. 1987, Tacha 1988). Corn (*Zea mays*) remaining in floodplain fields and invertebrates in wetlands provide energy and nutrients for sandhill cranes during this stage of migration (Krapu et al. 1985, Tacha et al. 1987). Sandhill cranes roost on unvegetated and shallowly submerged sandbars in the Platte River at night (Norling et al. 1991). Roosting sites are generally near feeding sites, away from human disturbance, and where channels are widest (Krapu et al. 1984, Pucherelli 1988, Sidle et al. 1993).

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Aerial photography has been used to determine where sandhill cranes roost, but photographs must be taken at dawn when the birds are getting ready to depart (some already might have flown off) and only a small portion of the river can be photographed. Nighttime aerial thermography (thermal infrared imaging) is an alternative remote sensing technique for defining sandhill crane roosting sites over long reaches of river. Thermography involves a scanner that detects thermal energy emanating from the ground and converts it to an electrical signal that varies with the amount of thermal energy (Pucherelli 1988, Sidle et al. 1993). Resulting images are recorded on photographic film. Thermography is sufficiently sensitive to identify individual sandhill cranes as they stand on nighttime roosting sites (Sidle et al. 1993).

We used aerial thermography and a geographic information system (GIS) to describe the distribution of sandhill crane roosting sites over a 142-km reach of the Platte River. Additionally, we investigated the effects of human disturbance features, the screening of disturbance features by woody vegetation, and distance to surrounding cropland on the distribution pattern of sandhill crane roosting sites.

STUDY AREA

The Platte River originates at the confluence of the North and South Platte rivers near North Platte, Nebraska and flows east to the Missouri River. Major sandhill crane roosting sites occur between Lexington, Nebraska and Highway 34, east of Grand Island, Nebraska. Most of the land along the river is privately owned and managed for corn and cattle (*Bos taurus*) production (Krapu et al. 1984). Woody vegetation has developed across much of the floodplain and historic river channel probably as a result of reduced spring discharge due to upstream reservoir construction. Riparian woodlands contain cottonwood (*Populus deltoides*), red cedar (*Juniperus virginiana*), and rough-leafed dogwood (*Cornus drummondii;* Currier 1982). Peachleaf willow (*Salix amygdaloides*), coyote willow (*Salix exigua*), and false indigo (*Amorpha fruticosa*) dominate low islands and vegetated sandbars (Currier 1982). Mean monthly air temperatures range from - 4.9° C in January to 25.7° C in July and total annual precipitation ranges from 48 to 60 cm (Stevens 1978).

METHODS

We used aerial thermography to describe the distribution patterns of roosting sandhill cranes near the end of their staging period over a 142-km reach of the North Platte River from Lexington, Nebraska downstream to the Interstate 80 bridge near Chapman, Nebraska. We used a small, propeller-driven plane flown at about 100 km/h to sample on the night of April 8 - 9, 1985. To orient the plane and aid in mapping, strobe lights were placed on ten bridge and road segments. The flight was between 2300 and 0400 hours at 600 m above the river. At the time of the flight, the sky was clear; visibility was 33 to 42 km; air temperature was - 1° C; dew point was -8°C; relative humidity was 43 to 61%; and wind was from the south at 10 to 20 km/h.

Flocks of sandhill crane were distinguished easily on thermography prints illuminated by a light table. Individual birds appeared as dark spots on a light background. Mylar overlays were fitted over enlargements of the aerial thermography prints and the locations of roosting flocks were outlined. Thermography prints showed

the channel shape and the flocks, but no other distinguishing land features were shown. We compared the thermography channel shapes with color infrared aerial photographs of the Platte River and floodplain to locate where the sandhill cranes were roosting and digitized these data to a GIS coverage by using ArcInfo (ESRI, Redlands, California). We also used the GIS and the SYSTAT statistical program to generate 138 random points within the river channel or on unvegetated sandbars within the river channel over the study reach. We made interactive measurements of distances from both flocks and random points, as well as to the nearest of each of 10 different types of human disturbance features and five types of croplands. Human disturbance features were: (1) bridges over the Platte River, (2) commercial buildings within the floodplain, (3) gravel roads (publicly maintained), (4) paved road (publicly maintained), (5) powerlines (major transmission lines), (6) private roads serving as primary access to residences, farms or businesses, (7) railroad tracks, (8) sand and gravel pits or quarries, (9) single dwellings (residences) occupied by humans, and (10) urban development (multiple clustered residences) occupied by humans. Cropland types were: (1) alfalfa (*Medicago sativa*) or clover (*Trifolium* spp.), (2) corn or sorghum (*Sorghum bicolor*), (3) grassland composed primarily of native species outside the floodplain, (4) wet meadows in the floodplain with herbaceous plants and woody seedlings less than 1 m high, and (5) other crops (crops not specifically categorized within the above classes including small grains and fallow land). We measured the closest distance from the nearest edge of roosting flocks and random points to each variable within a 1600 m radius. We also noted if there was a screen of woody vegetation at least 1 m high between the flocks or random points and human disturbance features. Additionally, we compared channel widths for roost sites versus random points.

Because we had a category of 1600 m or greater, our data became categorical. For this reason we used a nonparametric procedure (Mann-Whitney *U*-test) to determine if there were differences in distributions of measured distances between flocks and random points. Computations were made by using Statistix 4.0 (Analytical Software, Tallahassee, Florida).

RESULTS

We identified 139 clusters of roosting sandhill cranes over the 142-km study reach. We found three significant variables when comparing distances to human disturbance and land use features between 139 roosting sites and 138 random points. Roosting sites significantly were farther from bridges ($U = 1{,}337$, $n_1 = 55$, $n_2 = 34$, $P = 0.0007$) and paved roads ($U = 7{,}401$, $n_1 = 115$, $n_2 = 97$, $P < 0.0001$) than random points (Figs. 1 and 2), but closer to cornfields ($U = 11{,}300$, $n_1 = 138$, $n_2 = 134$, $P = 0.0014$) than random points (Fig. 3). No other significant differences were observed for human disturbance or cropland features.

When we examined the influence of woody vegetation as a screen on roosting site distributions, we found that the screening effect was significant only for distance to bridges ($U = 632$, $n_1 = 31$, $n_2 = 24$, $P < 0.0001$). Without the screen, roosting sites were farther from bridges.

There was a significant difference ($U = 58{,}000$, $n_1 = 570$, $n_2 = 138$, $P < 0.0001$) in channel width use between roost sites and random points (Fig. 4). Roosting sites tended to be in wider channels than random points.

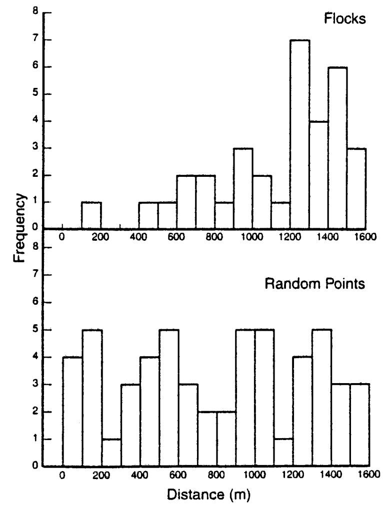

Figure 1. Frequency histograms of distances between bridges and roosting flocks of sandhill cranes observed on the 142-km study reach of the Platte River on the night of April 8 - 9, 1985 and distances between bridges and random points in the river channel over the study reach.

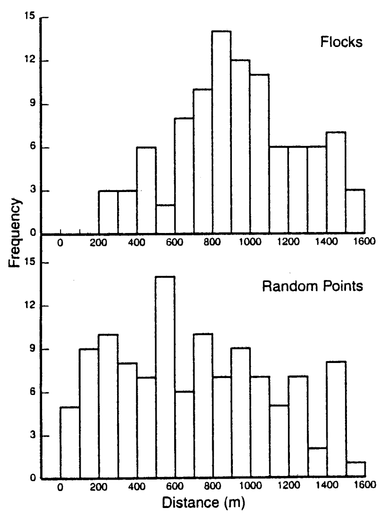

Figure 2. Frequency histograms of distances between paved roads and roosting flocks of sandhill cranes observed on the 142-km study reach of the Platte River on the night of April 8 - 9, 1985 and distances between bridges and random points in the river channel over the study reach.

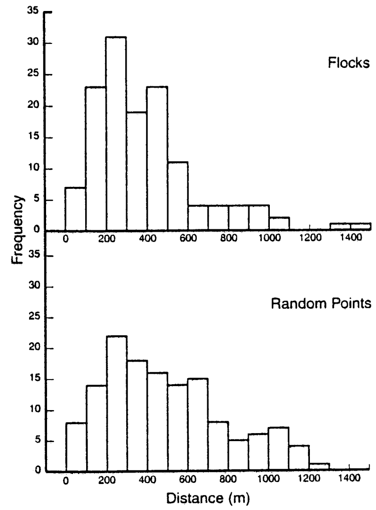

Figure 3. Frequency histograms of distances between cornfields and roosting flocks of sandhill cranes observed on the 142-km study reach of the Platte River on the night of April 8 - 9, 1985 and distances between bridges and random points in the river channel over the study reach.

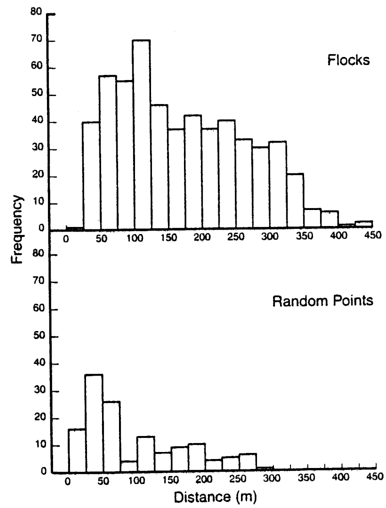

Figure 4. Frequency histograms of channel widths at the locations of roosting flocks of sandhill cranes observed on the 142-km study reach of the Platte River on the night of April 8 - 9, 1985 and channel widths at random points in the river channel over the study reach.

DISCUSSION

Nighttime aerial thermography can be used to identify locations of sandhill crane roosting sites (Sidle et al. 1993), which enables long reaches of the river to be observed during the time when birds are roosting. For example, during one night we were able to sample 142 km of river channel. In comparison, Norling (1990), using photography near dawn, was able to sample only 6.4 km within a 36 km study reach on one morning.

By coupling aerial thermography with a GIS, we were able to identify factors influencing nocturnal distributions of sandhill crane roosting sites. The GIS allowed precise measurements of distances to features affecting roost sites used by sandhill cranes. Tracking changes in distributions of human disturbances (bridges and paved roads), woody vegetation that provides visual screens from bridges, and cornfields with a GIS might enable identification of the causes for changes in distributions of roosting sites over time.

Our results were similar to other studies that have examined the effects of human disturbance on distributions of sandhill crane roosting sites in that bridges and paved roads appeared to influence roosting site selection. Krapu et al. (1984) observed that bridges or roads immediately adjacent to the Platte Rivers had a negative effect on sandhill crane use. Norling et al. (1992) found that sandhill cranes avoided areas less than 400 m from a bridge and less than 500 m from a paved road. However, Folk (1989) found human disturbances had little or no effect on sandhill crane roosting sites on the North Platte River with roosting sites as close as 80 m to a bridge.

We found that a visual screen of woody vegetation affected sandhill crane roosting site selection near bridges, but not paved roads. However, almost all paved roads were screened from the Platte River by woody vegetation so the effect of screening on paved roads might not have been apparent. Norling et al. (1992) found visual obstructions reduced overall disturbance of paved roads on roosting sandhill cranes. Littlefield (1986) observed visual barriers of vegetation mitigated the disturbance of highways and human residences.

Proximity to food sources in cornfields appeared to be critical to sandhill cranes when selecting roosting sites. Similarly, Sidle et al. (1993) found that roosting site selection was dependent on availability and distance to wetland meadows.

The sandhill crane is thought to prefer wider channels to narrow channels. In our study, half of all roosting sites were in channels less than 150 m wide with the greatest proportion in channels 51 to 150 m wide. Krapu et al. (1984) observed about 70% of roosting sandhill cranes in channels at least 150 m wide and over 99% in channels greater than 50 m wide. Folk and Tacha (1990) found 82% of roosting sites were in channels 48 m or wider and 18% in channels 16 to 47 m wide on the North Platte River.

Optimal habitat for sandhill crane roosting sites no longer might exist along the Platte River due to encroachment of woody vegetation into the channel and various human uses of the floodplain. Managers must determine the factors that are most critical to the sandhill cranes and try to protect these features of the landscape. Aerial thermography coupled with a GIS appears to have potential as management tools for monitoring both the locations of sandhill crane roosting sites and landscape features that affect selection of roosting sites.

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