Mortality of Cranes (Gruidae) Associated with Powerlines over a Major Roost on the Platte River, Nebraska

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ABSTRACT Two 69-kilovolt powerlines spanning the Platte River in south central Nebraska are suspected to cause substantial mortality to sandhill cranes (*Grus canadensis*) and pose a threat to endangered whooping cranes *(G. americana*) that roost overnight on the river during spring and fall migrations. Most studies of crane collisions with powerlines in the region have focused on counts of carcasses away from night roosts on the river and none have accounted for potential biases in detecting carcasses. We found 61 carcasses of sandhill cranes below over-river segments of the two powerlines during 4 March to 7 April 2006 and 90 such carcasses between 5 March and 13 April 2007. In 2007 we estimated the number of carcasses undetected in our surveys due to removal by scavengers, loss to downstream flow, and observer oversight. We estimated between 165 and 219 sandhill cranes were killed by the two powerlines during spring 2007. These calculations exclude mortalities from individuals injured by powerline collisions and dying elsewhere, as well as those killed before or after our 5 March to 13 April survey period. We detected no evidence of mortality for whooping cranes during our surveys. Our results corroborate anecdotal evidence of signficant sandhill crane mortality each spring due to collisions with above-ground powerlines at this major night roost. Collisions by sandhill cranes will continue and collisions by whooping cranes seem likely unless an effective means of averting birds from powerlines is implemented at this site.

KEY WORDS detectability bias, *Grus americana*, *Grus canadensis*, migratory birds, mortality, Nebraska, Platte River, powerline collision, sandhill crane

Above-ground powerlines and associated structures cause mortality to many species of migratory birds via collision and electrocution (Scott et al. 1972, Morkill and Anderson 1991, Bevanger 1994, Lehman 2001), but the mortality rates often remain unquantified. Five high-voltage powerlines cross the Platte River in south central Nebraska between the towns of Lexington and Grand Island. The broad floodplain formed by this river provides the most important migration stop for sandhill cranes (*Grus canadensis*) in North America. About 500,000 sandhill cranes, three-fourths of the world's population, stage in the area each spring during their northward migration (Krapu et al. 1984, Sharpe et al. 2001). The area also is used annually as a stopover by migrating whooping cranes (*G. americana*), a species federally listed as endangered in the United States and Canada, with as many as 82% of migrating individuals passing through this 140-km corridor (Dunlap 1991, Stehn and Wassenich 2008). Both crane species regularly roost overnight among the river's shallow waters, sparsely vegetated islands, and sandbars.

Several studies have documented powerline collisions by cranes throughout North America during migratory movements and in their summer and winter ranges (Morkill and Anderson 1991, Stehn and Wassenich 2008). Powerline collisions represent the greatest source of mortality for whooping cranes of flying age (Brown and Drewien 1995, Stehn and Wassenich 2008). Conceivably, both species of cranes are equally vulnerable to powerline collision along the Platte River, in fact we (JTR and RRH) documented whooping cranes altering their flight to avoid striking powerlines near an overnight roost. Ward et al. (1987) discovered the remains of 130 sandhill cranes below a sample of nine 1.6-km segments of powerline over uplands near the Platte River during spring 1986 and 1987. Windingstad (1988) found the remains of 51 sandhill cranes below a segment of powerline near a night roost on the Platte River. Despite such high incidences of crane collisions, to date there are no published estimates of total crane mortality associated with above-ground powerlines that span roost sites used by cranes in North America's Great Plains. Our objective was to document direct

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evidence of crane mortality as well as estimate total numbers of cranes killed at a roost site on the Platte River spanned by two arrays of 69-kilovolt powerlines.

STUDY AREA

We conducted our study at the National Audubon Society's Lillian Rowe Sanctuary (hereafter, Rowe), which includes nearly 4 km of 250- to 500-m wide, sandy river channel and adjoining grassy meadows and cropfields in Buffalo and Kearney counties, Nebraska (40°40′12″ N; 98°53′12″ W). Open, unobstructed roost habitat is maintained for cranes and other birds in the river channel through heavy discing to control tall vegetation, especially woody plants such as willow (*Salix* spp.) and eastern cottonwood *(Populus deltoides)*. The channel is braided with sandbars and islands. Water flows vary daily on the river in spring; most water is less than 0.5 m deep. Sandhill cranes and whooping cranes roost in the area mainly during late February through mid-April and mid-March through late April, respectively. Typically, cranes leave night roosts on the river during the first 2 hours after sunrise to feed in surrounding wet meadows and farmlands and return to night roosts during the last hour of daylight.

One powerline array crosses the Platte River about 100 m west of the visitor center at Rowe and the other is 1.8 km east of the visitor center. Each powerline array consists of two nonelectrified "static" wires suspended about 15 m above the ground and three transmission "conductor" wires about 5 m below these (powerlines of 69 kilovolts and greater often are called transmission lines). Wires are supported by H-frame structures, each having two wooden vertical poles. The western powerline includes a support structure amid the river channel. The eastern powerline has a support structure on either river bank, but none in the river channel. Bank-to-bank spans of the western and eastern powerlines are 301 m and 283 m, respectively. Several years prior to our study, 0.2-m long spiral vibration dampers were placed about every 6 m on the static wires to decrease bird mortality (Brown and Drewien 1995).

METHODS

In 2006, we established a 100-m wide quadrat centered on each powerline array with ends bounded by the river banks. We extended width of the quadrats to 120 m in 2007 to better account for birds that may glide after contacting powerlines. Prior to conducting our initial surveys each year, we searched quadrats and removed all bird remains. To locate crane carcasses in a quadrat, one searcher (TJS or GDW in 2006, TJS in 2007) walked slowly (3–4 km/hr) in a zig-zag pattern down one-half of the quadrat then back on the other half. We searched the area beneath each powerline twice each week in 2006 and three times each week in 2007, except a severe snowstorm in 2006 postponed three consecutive searches for carcasses. Searches lasted 0.5–1.5 h per powerline. Upon discovery, legs and distal wings of each carcass were marked with orange paint to avoid recounting the carcass on subsequent surveys. We marked legs and wings because they generally persisted far longer than other body parts. We recorded the location of each carcass in geographic coordinates using a hand-held GPS receiver (Garmin eTrex, Garmin International, Olathe, Kansas, USA) to within 5 m accuracy in the North American Datum 1983.

In 2007, we estimated carcass detectability rates by attempting to account for carcasses removed by scavengers, overlooked by observers, or swept downstream by water (Table 1). We used a blind assessment approach in which GDW or RKM placed one to three complete, intact sandhill crane carcasses within each quadrat on randomly selected days. All searches were conducted by TJS. We placed carcasses 1.5–4 hrs after a search; placed carcasses were uniquely but inconspicuously marked by a combination of broken or removed remiges and broken phalanges or tarsi. We recorded the location of each placed carcass via GPS plus distance and direction from natural markers. Carcasses were placed subjectively to simulate a typical pattern of distribution based on observations in 2006, and the observer (TJS) had no knowledge of carcass placements. Within 1.5–4 hrs after each carcass search, GDW or RKM performed a verification visit to placed carcasses. If remains of a given carcass persisted, it was noted whether signs of scavenging were evident and whether it had been marked with paint (i.e., discovered by the observer that day). We assumed that no scavenging of carcasses occurred during the 1.5–4 hours between a carcass search and the verification visit to determine the rate of detection. This assumption seemed reasonable because we rarely observed scavengers on quadrats in midday.

To estimate the number of carcasses swept downstream prior to detection, we calculated the proportion of the channel width at each powerline array covered by deep water, i.e., the mean depth needed to float complete carcasses of sandhill cranes downstream (12.5 cm; $n = 5$ trials). We used a laser level and a GPS to determine widths of channel segments that equaled or exceeded this depth at the highest and lowest flow levels observed during our survey period. We multiplied the inverse of the proportion of channel covered by deep water by the number of estimated mortalities corrected for both carcass detection rates and scavenger removal rates (Table 1).

RESULTS

We detected no evidence of mortality for whooping cranes. During our 2006 survey (4 March to 7 April), we found three (7%) dead sandhill cranes below the western powerline and 37 (93%) beneath the eastern powerline. We also observed carcasses of three additional sandhill cranes about 20 m beyond our quadrats, on banks composing the high water mark of the channel.

Table 1. Assessment of detection bias and estimate of total mortality of sandhill cranes at two 69-kilovolt powerlines spanning the Platte River at the National Audubon Society's Rowe Sanctuary in south-central Nebraska, 5 March–13 April 2007.

Estimate or factor category	*n*	Source [a]
Assessment of detection bias on area of channel not covered by deep water [b]		
Crane carcasses placed without observer's knowledge	27	A
Removed by scavengers before observer's search	5	B
Present for observer's search but undetected by observer	3	C
subtotal: removed plus present but undetected (B + C)	8	D
Proportion detected ([A-D]/A)	0.70	E
Crane carcasses detected by observer, death attributed to collision	90	F
Estimated number of cranes killed but not falling into deep water (F/E)	129	G
Proportion of bank-to-bank channel covered by deep water [c]		
Minimum	0.22	H
Maximum	0.41	I
Estimated range of total mortality attributed to powerlines		
Minimum (G/[1.00-H])	165	
Maximum (G/[1.00-I])		219

[a]Used for subsequent calculations.
[b]Defined as water ≥12.5 cm deep; depth required to float crane carcasses downstream.
[c]Based on highest and lowest values observed between the two powerline spans.

During our 2007 survey (7 March to 13 April), we found 90 dead sandhill cranes. Fifteen (17%) were beneath the western powerline and 75 (83%) were beneath the eastern powerline. We also observed six crippled cranes below the eastern powerline, three of which were immobile. We excluded the crippled birds from carcass counts because they were not yet dead upon detection. Gross, external evidence of blunt-trauma injury, especially fractured legs and wings, was obvious on most carcasses.

Based on corrections for biases due to carcass removal by scavengers, observer oversight, and loss of carcasses to downstream flows, we estimated approximately twice as many sandhill cranes were killed by powerline collisions at Rowe in 2007 than suggested by the number of detected carcasses (Table 1). Moreover, we suspect that total sandhill crane mortality due to collisions with powerlines in 2006 was roughly similar to that in 2007, mainly because our survey quadrats in 2006 covered 20% less area and were visited two-thirds as often. Loss to downstream flow represents most significant potential bias; 22% to 41% of crane carcasses may have floated downstream prior to detection (based on difference between estimates of total mortality and of numbers of carcasses that did not fall into deep water; Table 1). Scavenger removal and observer oversight accounted for only 6% to 11% of all detection bias. Based on visual observation and tracks, scavenger

species included bald eagle (*Haliaeetus leucocephalus*), American crow (*Corvus brachyrhynchos*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and coyote (*Canis latrans*); raccoon tracks were particularly abundant.

DISCUSSION

We detected mortality of sandhill cranes at both powerlines at Rowe during spring migration in 2006 and 2007. In both years, most (93% and 83%) dead cranes were observed under the eastern powerline. We attributed this uneven distribution of mortality mainly to the extensive roosting sites on open sandbars around the eastern powerline, although we did not assess numbers of cranes roosting near each powerline. Moreover, fewer cranes may have been killed at the western line because they readily saw and avoided wooden support poles in the middle of the river channel, or perhaps individuals were avoiding the nearby visitor center.

Most powerline collisions by sandhill cranes occur when birds travel between roosting and feeding sites or when vegetation or topographical funnels divert birds towards powerline arrays (Bevanger 1994, Faanes 1987, Savereno et al. 1996). Willows and cottonwoods on banks of the Platte River likely confine crane movements to and from the roost and exacerbate mortality caused by powerline collisions. Tall shrubs and trees expanded along the river during the past century, coinciding with decreased river flows resulting from construction of dams and diversion canals (Johnson 1994). Other factors reducing visibility, especially strong winds and precipitation, can increase the likelihood of collision by cranes with powerlines (Stehn and Wassenich 2008).

We tried to account for biases that would cause us to overlook carcasses and underestimate the number of cranes killed by powerlines at Rowe. Large carcass size, level topography, and sparse vegetation likely enhanced our detection rate. However, not all collisions with powerlines result in immediate mortalities. Crippled birds move locally or continue to migrate (Faanes 1987, Morkill and Anderson 1991, Stehn and Wassenich 2008). We observed crippled cranes within our quadrats, but likely many other cranes struck the powerlines and glided, walked, or otherwise moved away from our quadrats, eluding detection. Studies documenting the proportion of strikes resulting in immediate fatalities versus crippling injuries, such as that by Savereno et al. (1996), would help account for this source of additional mortality.

Based on our findings, crane collisions with powerlines in the Platte River valley require immediate mitigation, particularly near major roost sites. Collisions may be less likely if diverter devices are installed, although mortality for sandhill cranes that we documented at Rowe was extensive despite presence of spiral vibration dampers on powerlines to divert birds. Brown and Drewien (1995) documented reduced crane mortality in Colorado at powerlines equipped with plate diverters or spiral vibration dampers, but dampers were longer and spaced more closely than those placed on static wires at Rowe before our study (1.2 m long and 3.3 m apart, versus 0.2 m long and about 6 m apart at Rowe). Morkill and Anderson (1991) observed that 30-cm diameter aviation balls reduced collisions by cranes in the Platte River valley, although the improvement was not substantial, and other investigators have observed birds colliding with powerlines fitted with aviation balls (Savereno et al. 1996). A new diverter that combines motion, light reflection, and luminescence (FireFly™, Firefly Diverters, LLC, Grantsville Utah, USA) may more effectively reduce avian mortality at powerlines.

MANAGEMENT IMPLICATIONS

Our study suggests nearly 90% of mortality among sandhill cranes due to collisions with powerlines at Rowe could be eliminated if the eastern powerline was somehow rerouted or reconfigured, e.g., by housing it within a pipeline beneath or just over the river channel. Rowe is not the only location bisected by powerlines along the Platte River in south central Nebraska, thus we suspect several hundred cranes are killed annually by colliding with powerlines throughout the area. More critically, perhaps, is that the extent of mortality we observed among sandhill cranes suggests whooping cranes are likely to be killed by colliding with powerlines over the Platte River. Further monitoring along the river, combined with location records of roost sites used by whooping cranes, will help indicate high priority sites for powerline modifications at this significant migration area.

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