1992

CHARACTERISTICS OF WHOOPING CRANE ROOST SITES IN THE PLATTE RIVER

Craig A. Faanes
U.S. Fish and Wildlife Service

Douglas H. Johnson
Northern Prairie Wildlife Research Center

Gary R. Lingle
Platte River Whooping Crane Maintenance Trust

CHARACTERISTICS OF WHOOPING CRANE ROOST SITES IN THE PLATTE RIVER

CRAIG A. FAANES, U.S. Fish and Wildlife Service, 203 West Second Street, Grand Island, NE 68801
DOUGLAS H. JOHNSON, Northern Prairie Wildlife Research Center, Jamestown, ND 58401
GARY R. LINGLE, Platte River Whooping Crane Maintenance Trust, Suite H, 2550 North Diers Avenue, Grand Island, NE 68803

Abstract: The Big Bend of the Platte River in central Nebraska provides important migration habitat for whooping cranes (*Grus americana*). River profiles were obtained at 23 confirmed nocturnal roost sites occupied by whooping cranes during 1983–90. Whooping cranes selected roost sites that had shallower water depths than at unused sites. All but 4 roosts were located in channels wider than 150 m; roost sites were an average of 27.8% of the channel width from the nearer shore. Nearly 90% of the roost sites had a trench of deeper water on both sides. Proper management of the Platte River is necessary to provide whooping crane stopover habitat.

Key Words: *Grus americana*, physical characteristics, river, roosts, whooping crane

PROC. NORTH AM. CRANE WORKSHOP 6:90-94

The Platte River, Nebraska, is a strategically located migration stop for whooping cranes in the Wood Buffalo-Aransas population (U.S. Fish and Wildlife Service 1981, 1986; Shenk and Armbruster 1986; Faanes and Bowman, in press). Recognizing the importance of the Platte River to whooping cranes, the U.S. Department of the Interior in 1976 designated an 83-km reach of the "Big Bend" of the river as critical habitat (*Federal Register* 43:20938-20942).

Despite the critical habitat designation, habitat conditions for whooping cranes and other avian species have become degraded in recent years. Currier et al. (1985) and Sidle et al. (1989) described losses of riverine channel and wet meadows resulting from water development projects in the Platte River system. The continued existence of suitable whooping crane roosting habitat is now dependent on the maintenance of adequate instream flows and active management and removal of wooded vegetation from the riverine channels.

Certain attributes of whooping crane roost sites have been described. Johnson and Temple (1980) and Johnson (1982) listed criteria as follows:

(1) channel width: ≥55 m, most >155 m;
(2) flow: slow, <6 km/hour at roost, with possibly faster waters elsewhere in channel;
(3) water depth: <20 cm (Johnson and Temple 1980) or <30 cm (Johnson 1982), optimally 5–15 cm;
(4) vegetation: absent, i.e., no submergent, floating, or emergent vegetation at roost;
(5) substrate: fine, usually sand;
(6) horizontal visibility: unobstructed view from bank to bank and several hundred meters upstream and downstream;
(7) overhead visibility: open, i.e., no tall trees, tall and dense shrubbery, or high banks near roost;
(8) feeding sites: relatively close, usually <1.6 km;
(9) isolation: usually >0.4 km from human developments and isolated from them by tall trees or high banks; and
(10) sandbars: nearby presence of gently sloping sandbars with sparse vegetation.

Lingle et al. (1984, 1986) described 2 roost sites on the Platte River (these are also included in our evaluation), which generally met the above criteria. Ward and Anderson (1987) described 5 roost sites used by 2 subadults in 1983 during fall migration from Saskatchewan to Texas. Their sites were in lacustrine or palustrine, as opposed to riverine, habitats, so their conclusions may not be directly applicable here. They noted, however, that whooping cranes used sites with muddy bottoms. Four of the roosting wetlands they described were shallow, so it was impossible to determine any preference by the birds for water depth. The remaining wetland ranged in depth from 0 to 52 cm; depth at the roost site was 18 cm.

Howe (1989) presented information on 86 stopover sites, mostly palustrine, used either by 15 whooping cranes that were radio-marked or by others in company with marked birds. Water depths averaged 14.1 cm (SD = 9.0 cm). He found no indication that whooping cranes selected sites based on substrate texture. Birds did not appear restricted to sites with unlimited visibility; 64% had maximum visibility <2 km. Feeding sites were usually nearby; 56% were within 1 km.

Armbruster (1990), summarizing a workshop involving authorities on whooping crane migration, developed a set of assumptions about whooping crane habitat selection, which can serve as testable hypotheses for future research. Migrational habitat was characterized as having (1) horizontal visibility, (2) water depth ≤30 cm, (3) little human disturbance, and (4) feeding areas nearby.

One deficiency noted by other investigators (Ward and Anderson 1987, Howe 1989, Armbruster 1990) was the lack of information on habitats available to the birds, in addition to information about sites actually used, so that preference for particular features could be ascertained. Our study is an attempt to remedy this situation. We have information not only for riverine roost sites used, but also on alternative sites available at the same reach of the river.

Field data were gathered by a number of employees of the Grand Island, Nebraska, office of the U.S. Fish and Wildlife Service, and by the Platte River Whooping Crane Trust, Nebraska Game and Parks Commission, and National Audubon Society; we are grateful to all. O. Bray, R. Khan-Malek, G. L. Krapu, D. L. Larson, and R. McCue provided helpful comments on earlier drafts of the manuscript.

FIELD METHODS

We recorded habitat characteristics at 23 nocturnal roost sites occupied by whooping cranes during 1983–90. All 23 roosts are used in the analyses of channel width; data from 19 transects are included in the analyses of channel topography and water depth. All sightings were on different days; of the 19 roosts, 15 were in spring and 4 were in fall. Transects were generally surveyed within 5 hours after whooping cranes departed. Three or 4 observers conducted bank-to-bank transects positioned over the roost site and perpendicular to the river current. Measurements in 1983 were taken at 1-m intervals; measurements in subsequent years were at 3-m intervals across the channel. The set of measurements along the transect represented a profile of the river at the roost site. All but 3 profiles included measurements taken at roost sites. For 3 profiles, the roost site was between 2 measured sites, and we interpolated values of depth linearly.

We measured total channel width and at each interval on each transect we recorded water depth and distance from shore. In addition to channel width, we considered several variables including (1) water depth, (2) distance to nearer shore, (3) distance to nearer shore as a percentage of total channel width, and (4) an indicator variable (0 or 1) for whether or not the site was surrounded by a trench of deeper water ($\geq$15 cm deeper).

We compared 1,400 sites along the 19 transects across the river, all of which were inundated (i.e., shore and sandbar measurements were excluded). Nineteen sites represented roost sites of whooping cranes, and 1,381 were considered unused sites. Channel widths at 23 roost sites were compared with values given in U.S. Fish and Wildlife Service (1981: Appendix I).

ANALYTIC METHODS

We examined variables one at a time to compare their distributions at roost sites versus unused sites. We compared not only means of the variables but also the entire distributions, to determine whether or not there was a certain range of values favorable to roosting. Continuous variables (water depth and distances) were compared between roost and unused sites with *t*-tests (either assuming equal variances or not, depending on the outcome of *F*-tests of equal variances). Tests of entire distributions were based on Kolomogorov-Smirnov statistics. Percentages of observations above versus below certain values were compared with a *G*-test for 2 $\times$ 2 contingency tables, as

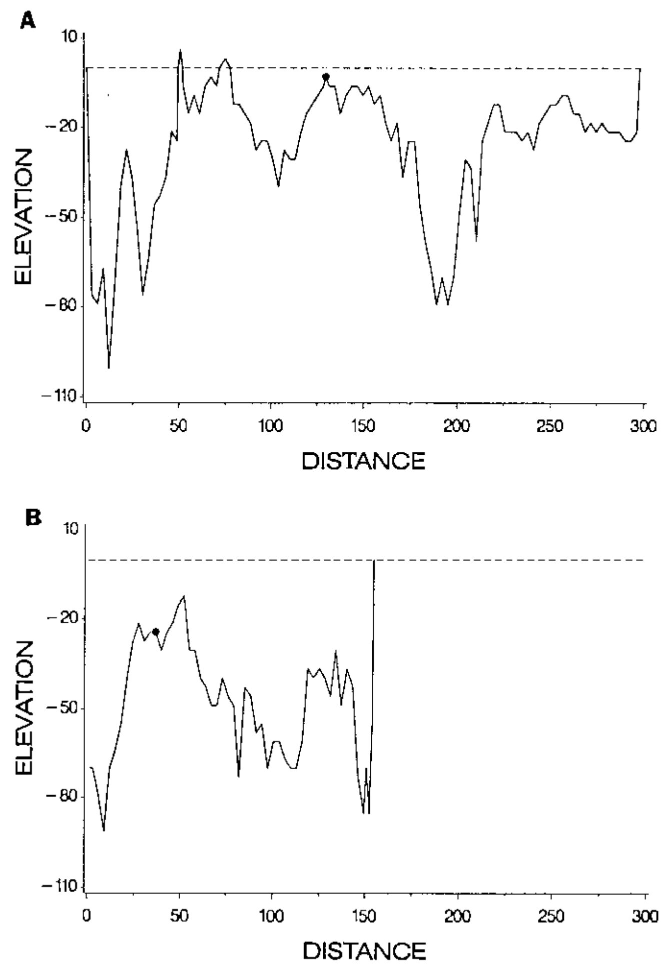

Fig. 1. Profiles of whooping crane roost sites (a) near the Minden, Nebraska, bridge on 10 April 1987 and (b) near the Gibbon, Nebraska, bridge on 6 April 1988. Elevations are in cm above water surface (indicated by dashed line) and distances from shore are in m. Dots denote roost sites.

Table 1. Summary statistics for variables at whooping crane migrational roost sites and unused sites along Big Bend of the Platte River, Nebraska, 1983 – 90.

Variable	Roost sites			Unused sites		
	$\bar{x}$	SD	Range	$\bar{x}$	SD	Range
Channel width (m)	217	79	52–366	187	67	31–402
Water depth (cm)	20.2	9.4	3–49	31.0	19.5	3–128
Distance to nearer shore (m)	66.2	44.1	15–179	65.5	47.8	0–189
Relative distance to nearer shore (%)	28	11	9–44	24	15	0–50

were indicators of whether or not sites were surrounded by deeper water. All analyses used procedures FREQ, NPAR1WAY, TTEST, and UNIVARIATE of the Statistical Analysis System (SAS Institute 1987, 1988).

RESULTS

Water Depth

Examples of typical bank-to-bank transects are shown in Fig. 1. Roost sites were shallower on average than unused sites (20.2 cm versus 31.1 cm; t = 4.85, P < 0.001; Table 1). Moreover, the range of water depths at roost sites was more restricted than at unused sites: the interquartile range (the values between which half of the observations lie) was only 10.1 cm for roost sites, as opposed to 21.4 cm for unused sites. The distributions differed according to the Kolomogorov-Smirnov test (P = 0.0038). Clearly, depths at roost sites were more concentrated than those at unused sites (Fig. 2).

Channel Width

Whooping cranes roosting in the Platte River have been noted to select sites with broad channels free of woody vegetation and with adequate horizontal and overhead visibility (U.S. Fish and Wildlife Service 1981). We found that inundated channel widths at roost sites ranged from 52 to 366 m (Table 1). Roost sites were at wider stretches of the river than average (t = 2.00, P = 0.047). Of 23 roost sites evaluated, 19 were in channels ≥150 m wide. More than 80% of the channel was inundated in all but 2 transects.

Distance to Nearer Shore

Roost sites and unused sites had similar average distances to the near shore (66.2 m and 65.5 m, respectively; t = 0.07, P = 0.94). Although the Kolomogorov-Smirnov test detected no overall differences in the distributions (P = 0.67), only 1 (5.3%) roost site was within 23 m of shore, whereas 304 unused sites (22%) were at least that close (G = 4.10, df = 1, P = 0.043; Fig. 3). The only exception was a roost in a channel only 52 m wide, which precluded the site from being far from the nearer shore.

Examination of the relative distance to the nearer shore showed similar patterns. Averages were 28% of the channel width for roost sites and 24% for unused sites (t = 1.10, P = 0.27; Table 1). Roost sites were somewhat more closely concentrated about the average (SD = 0.11) than were unused sites (SD = 0.15), but the difference did not attain significance (F = 1.81, df = 1,380, 18, P = 0.13). The Kolomogorov-Smirnov test showed no overall differences in the distributions (P = 0.23), but again only 1 roost site (5.3%) was within the nearest 10% of the

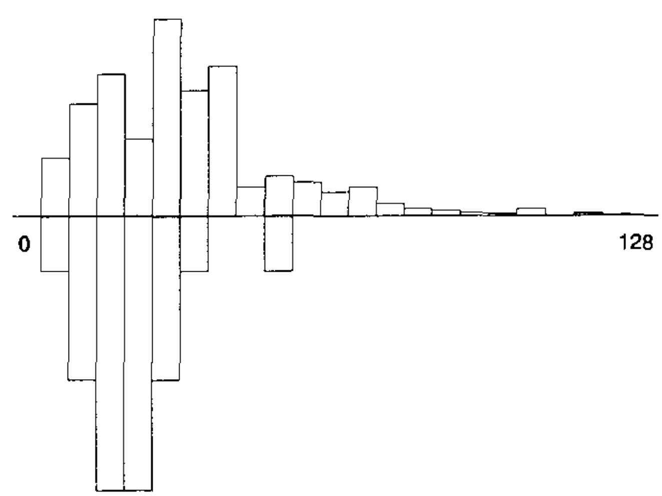

Fig. 2. Frequency distribution of water depths (in cm) at whooping crane roost sites (bottom) and unused sites (top) in the Platte River, 1983 – 90, illustrating that roost sites are more closely concentrated about depths <30 cm than are unused sites.

shore, as opposed to 316 (23%) unused sites (Fig. 4). The exception was a roost site that was 9.2% of the channel width from the nearer shore; because the channel was so wide, however, this percentage still represented a distance of 23 m.

Surrounded by Deeper Trench

Of 19 roost sites, 17 (89.5%) had a trench of deeper water on both sides; only 70% of the unused sites were so surrounded (G = 4.10, df = 1, P = 0.043). Roost sites without deep water on both sides had a shallow trench on 1 side and a deep trench on the other.

DISCUSSION

Whooping cranes generally select nocturnal roost sites in the Platte River based on the security offered by the site and proximity to feeding areas. Ample foods were available close to the river throughout our study area, so food probably did not strongly influence the selection of roost sites.

Cranes favored shallow water for roost sites. Water depths there were tightly clustered about the mean of 20.1 cm, a depth somewhat greater than those reported by Ward and Anderson (1987) and Howe (1989). Only 1 of 19 sites, at 49 cm, was deeper than 30.5 cm. Other than that exception, our results are in accord with the findings of Johnson (1982) and the model described by Armbruster (1990), characterizing water depth as not exceeding 30 cm.

We found whooping crane roost sites in channels ranging in width from 52 to 366 m. Johnson and Temple (1980) proposed a minimum width of 55 m. The narrowest roost site in our sample was 52 m, consistent with their recommendation; most were >150 m, similar to those reported by Johnson (1982). Lingle et al. (1986) suggested

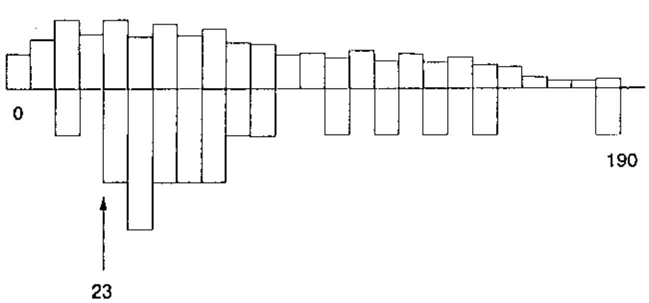

Fig. 3. Frequency distribution of distances (m) to shore of whooping crane roost sites (bottom) and unused sites (top) in the Platte River, 1983–90, showing that roost sites occur less often within 23 m of shore than do unused sites.

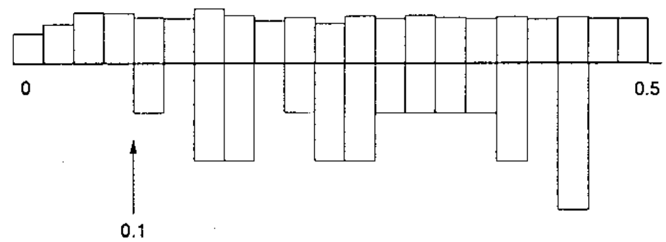

Fig. 4. Distribution of relative distances to nearer shore of whooping crane roost sites (bottom) and unused sites (top) in the Platte River, 1983–90, showing that the distance from roost sites to the nearer shore is rarely less than 10% of the channel width.

that whooping cranes might choose widest available sites.

Channels of the Platte River that normally carry water (active channels) are bounded by woody perennial vegetation. The banks and vegetation form visual obstructions for whooping cranes standing in the river and enhance their security, as long as the banks and vegetation are not close to the cranes. Use of channels wider than 150 m is substantiated by observations at other riverine roost sites not necessarily on the Platte River (R. Lock, pers. commun.). Similarly, an expanse of water at the roost apparently provides whooping cranes with a sense of isolation and security (Shenk and Armbruster 1986, U.S. Fish and Wildlife Service 1987). All but 2 of the measured channels in this study were ≥80% wet, which suggests that whooping cranes may select channels with sufficient water to afford them security. Also, greater width indicates higher flows, which facilitate the development of trenches of deeper water surrounding roost sites.

Our analysis indicated that whooping cranes generally roost some distance from shore. Only 5.3% of the roost sites were within 23 m, as opposed to 22% of the unused sites. Johnson and Temple (1980) thought that whooping cranes needed to be at least 6.1–9.1 m away from shore or emergent vegetation. Some findings of Johnson and Temple (1980) should be viewed with caution because their analysis was based on only 2 measurements taken at the roost sites, and some of their roost sites were examined 16 years after occupancy. Armbruster (1990) suggested a 20-m overwater distance to visual obstructions as the approximate tolerance limit for whooping cranes at nontraditional sites, which is consistent with our findings.

We found that deeper water surrounding a roost site may be an important selection factor (17 of 19 roosts were so surrounded). No other studies have examined this habitat feature in detail. The presence or absence of trenches of deeper water is dependent on the current flow rate and channel morphology. Changes in the bed of alluvial streams that result in short-term changes in hydrologic variables are often related to the preceding flow regime (Milhous et al. 1984).

During aerial surveys, we have observed that deeper trenches of water surrounding a sandbar may draw attention to a potentially suitable roost site. Once cranes are on the sandbar, deeper trenches may serve as barriers to potential mammalian predators (Biology Workgroup 1990), providing additional security.

Water flows during our surveys ranged from 16 to 108 m^3/second ($\bar{x}$ = 59 m^3/sec) or 576 to 3,800 cubic feet per second ($\bar{x}$ = 2,080 cfs). We suggest that flows in the 59 m^3/second (2,000 cfs) range are necessary in the Platte River during spring and fall migration periods to provide an adequate distribution of deeper water trenches to aid whooping cranes in selecting nocturnal roost sites. U.S. Fish and Wildlife Service (1987) and Faanes and Bowman (in press) made similar recommendations based on other data sets. Flows of 227 m^3/second (8,000 cfs) at intervals have been recommended to scour vegetation from the channel (U.S. Fish and Wildlife Service 1987).

To provide more meaningful analyses, future riverine roost transects should involve profiles at a variety of unused sites for comparison on a larger scale. We recommend that future profiles be made not only through a roost site but also, at a minimum, 100 m upstream and 100 m downstream of the site. With additional data we could develop a multivariate analysis incorporating the relevant variables in combination. We believe this approach would significantly increase the validity of various habitat models developed for whooping crane habitat in the Platte River system. The resulting models, of course, should be tested against fresh data sets.

LITERATURE CITED

ARMBRUSTER, M. J. 1990. Characterization of habitat used by whooping cranes during migration. U.S. Fish Wildl. Serv. Biol. Rep. 90(4). 16pp.

BIOLOGY WORKGROUP. 1990. Final report to the Platte River Management Joint Study. Unpubl. Rep., U.S. Fish Wildl. Serv., Denver, Colo. 130pp.

CURRIER, P. J., G. R. LINGLE, and J. G. VANDERWALKER. 1985. Migratory bird habitat on the Platte and North Platte Rivers in Nebraska. Platte River Whooping Crane Maintenance Trust, Grand Island, Nebr. 177pp.

FAANES, C. A., and D. B. BOWMAN. In Press. Relationship of channel maintenance flows to whooping crane use of the Platte River. *In* D. A. Wood, ed. Proc. 1988 crane workshop. Fla. Game and Fresh Water Fish Comm., Tallahassee.

HOWE, M. A. 1989. Migration of radio-marked whooping cranes from the Aransas-Wood Buffalo population: patterns of habitat use, behavior, and survival. U.S. Fish Wildl. Serv., Fish Wildl. Tech. Rep. 21. 33pp.

JOHNSON, K. A. 1982. Whooping crane use of the Platte River, Nebraska—history, status, and management recommendations. Pages 33-43 *in* J. C. Lewis, ed. Proc. 1981 crane workshop. Natl. Audubon Society, Tavernier, Fla.

______, and S. A. TEMPLE. 1980. The migratory ecology of the whooping crane. Unpubl. Rep., Off. of Endangered Species, U.S. Fish Wildl. Serv., Washington, D.C. 120pp.

LINGLE, G. R., P. J. CURRIER, and K. L. LINGLE. 1984. Physical characteristics of a whooping crane roost site on the Platte River, Hall County, Nebraska. Prairie Nat. 16:39-44.

______, K. J. STROM, and J. W. ZIEWITZ. 1986. Whooping crane roost site characteristics on the Platte River, Buffalo County, Nebraska. Nebr. Bird Rev. 54:36-39.

MILHOUS, R. T., D. L. WEGNER, and T. WADDLE. 1984. User's guide to the physical habitat simulation system. Instream Flow Inf. Pap. 11, U.S. Fish Wildl. Serv. FWS/OBS -81/43 Rev. 475pp.

SAS INSTITUTE INC. 1987. SAS/STAT for personal computers, version 6 edition. SAS Institute Inc., Cary, N.C. 1028pp.

______. 1988. SAS procedures guide, release 6.03 edition. SAS Institute Inc., Cary, N.C. 441pp.

SHENK, T. M., and M. J. ARMBRUSTER. 1986. Whooping crane habitat criteria for the Big Bend of the Platte River. Unpubl. Rep., Natl. Ecol. Res. Cent., U.S. Fish Wildl. Serv., Fort Collins, Colo. 34pp.

SIDLE, J. G., E. D. MILLER, and P. J. CURRIER. 1989. Changing habitats in the Platte River valley of Nebraska. Prairie Nat. 21:91-104.

U.S. FISH AND WILDLIFE SERVICE. 1981. The Platte River ecology study. Spec. Res. Rep., Northern Prairie Wildl. Res. Cent., Jamestown, N.D. 187pp.

______. 1986. Whooping crane recovery plan. U.S. Fish Wildl. Serv., Albuquerque, N.M. 283pp.

______. 1987. Biological opinion on the Platte River off-site effects of the Denver Water Department's Two Forks Dam project. Memo. from U.S. Fish Wildl. Serv., Denver, Colo., to U.S. Army Corps of Eng., Omaha, Nebr., 14 October 1987.

WARD, J. P., and S. H. ANDERSON. 1987. Roost site use versus preference by two migrating whooping cranes. Pages 283-288 *in* J.C. Lewis, ed. Proc. 1985 crane workshop. Platte River Whooping Crane Maintenance Trust, Grand Island, Nebr.