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MANAGEMENT OF LANDS ALONG THE PLATTE RIVER FROM ELM CREEK TO LEXINGTON, NEBRASKA, AS CRANE HABITAT

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MANAGEMENT OF LANDS ALONG THE PLATTE RIVER FROM ELM CREEK TO LEXINGTON, NEBRASKA, AS CRANE HABITAT

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Abstract: To meet Federal Energy Regulatory Commission (FERC) license requirements for the operation of 5 hydroelectric power plants on the North Platte and Platte Rivers in Nebraska, the Nebraska Public Power District (NPPD) and The Central Nebraska Public Power and Irrigation District (Central) together have become the second largest owners and managers of lands for the conservation of endangered species and migratory waterbirds along the central reach of the Platte River. We describe here the management activities on the properties, success of the management in achieving objectives, and the response of sandhill (*Grus canadensis*) and whooping cranes (*G. americana*) to that management. The primary developments and enhancements for the Cottonwood Ranch Property are the removal of 200 ha of mature riparian cottonwood (*Populus deltoides*) and ash (*Fraxinus pennsylvanica*) forest on accretion lands, the conversion of 136 ha of farmland to grassland interspersed with linear wetlands, the construction of a 10-ha palustrine wetland within the restored grassland, and 8 ha of vegetation free sand island. Five miles upstream of the Cottonwood Ranch Property is Central's 1,800-ha Jeffrey Island Habitat Area. Similar to the Cottonwood Ranch Property, the primary development for the Jeffrey Island Habitat Area is the removal of >146 ha of riparian forest, the construction of >7 km of linear sloughs and wetlands, and the creation of >65 ha of barren sand adjacent to the river channel. Central also has a long-term conservation management easement on 200 ha located along the North Platte River in Lincoln County, which is owned and operated by The Nature Conservancy. Monitoring of cranes on these properties indicates an increase in use of the Cottonwood Ranch Property for night roosting by sandhill cranes and a decrease in the number of sandhill cranes using the Jeffrey Island Habitat Area as a night roost. Daytime use of all properties by sandhill cranes has been almost non-existent. There is 1 confirmed sighting of 2 whooping cranes for 2 days on the Cottonwood Ranch Property in the spring of 2006 and 1 probable sighting of a whooping crane on the Jeffrey Island Habitat Area in the spring of 2004.

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Key words: *Grus americana, Grus canadensis,* habitat management, Nebraska, Platte River, riparian forest, riverine, sandhill crane, whooping crane.

The central reach of the Platte River in Nebraska is well known for its spring concentration of migrating waterbirds including sandhill cranes (*Grus canadensis*), the largest concentration of cranes in the world. This reach also has more riverine roost sightings of whooping cranes (*Grus americana*) than any other river system in North America (Austin and Richert 2001) and was designated as critical habitat in 1978 (43 Code of Federal Regulations 20938, May 15, 1978). Researchers of both whooping cranes (Allen 1952) and sandhill cranes (Frith 1976, Tacha et al. 1994) along the Platte River supported the idea that a portion of this river should be a refuge for cranes. In 1974, the U.S. Fish and Wildlife Service (Service) announced plans to establish a 6,070-ha national wildlife refuge along the Platte River (Wallenstrom 1976). Although a national wildlife refuge has not been established due to widespread landowner opposition (Faanes 1992), the amount of land presently being managed as crane habitat along the Platte River far exceeds the originally envisioned refuge, with over 8,800 ha currently under management between Lexington and Chapman.

Prior to the 1990s, the only significant owners of Platte River property managed as crane habitat were traditional nongovernmental conservation organizations. The National Audubon Society (NAS) in 1974 obtained 315 ha of land along the central reach of the Platte River to establish the Lillian Annette Rowe Sanctuary, which now encompasses 503 ha along the river (Audubon Rowe Sanctuary web page, http://www.rowesanctuary.org/). In 1978, the Platte River Whooping Crane Habitat Maintenance Trust (WCHMT) was developed in an out-of-court settlement that permitted the construction of the Grayrocks Dam and reservoir on the Laramie River in Wyoming, a major tributary in the Platte River system. Grayrocks provides cooling water for Basin Electric's Laramie River Station coal-fired electric generating plant. Over the next 20 years, the WCHMT was able to obtain various pieces of property along the Platte River so that today they are the largest conservation landowners on the central Platte River with almost 4,000 ha divided into 9 separate properties (Platte River Whooping Crane Trust web page, http://www.whoopingcrane.org/html/about1.shtml). In addition to the NAS and WCHMT, other managed habitat lands along the central Platte River are those owned by The Nature Conservancy (1,231 ha) and the state of Wyoming (175 ha), both of which are managed, at least in part, for crane conservation.

Adding to the land owned and managed for the benefit of cranes are properties totaling nearly 2,900 ha owned and managed by 2 public power entities. In 1984, the Nebraska Public Power District (NPPD) and The Central Nebraska Public

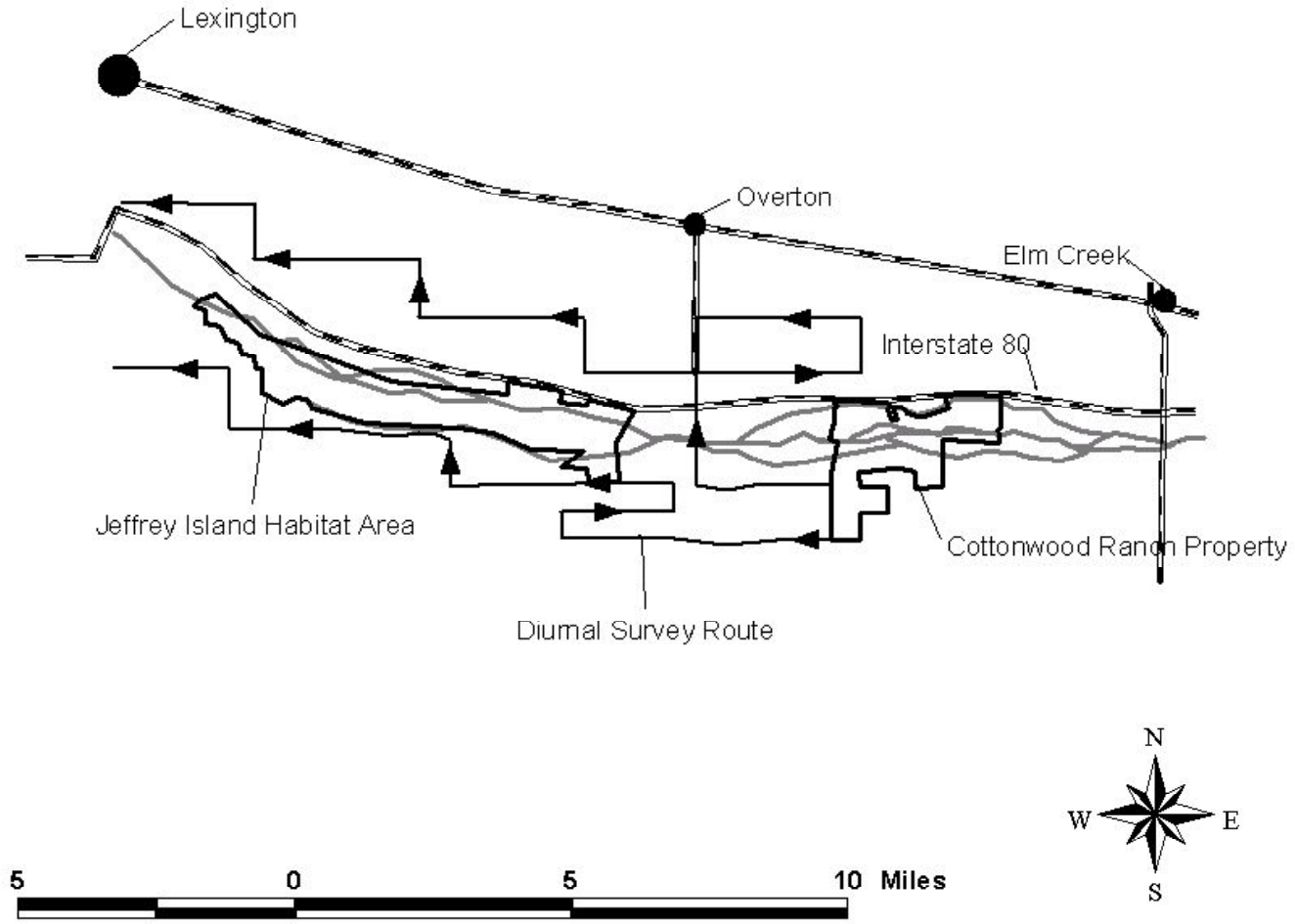

Figure 1. Location of the Cottonwood Ranch Property, Jeffrey Island Habitat Area, and the diurnal sandhill crane habitat use routes.

Power District (Central) (collectively the Districts) began the process of re-licensing their 5 hydroelectric power plants with the Federal Energy Regulatory Commission (FERC). These plants are located along canals and reservoirs fed by Platte River water. In 1997, the FERC issued new licenses to the Districts for the operation of the 5 hydroelectric power plants. As part of the relicensing, the Districts agreed to provide to the Service 10% of Central's annual water supply in an Environmental Account in Lake McConaughy, purchase, develop, and/or enhance as habitat for endangered species and migratory waterbirds, a total of 2,895 ha of land in 2 blocks located along the Platte River within the critical habitat reach, and to monitor species response to the habitat enhancements.

Management activities on the Platte River are primarily designed to provide and to increase habitat for sandhill cranes, whooping cranes and other migratory waterfowl. These activities have been on-going for over 30 years (Strom 1987) with an objective of being able to achieve the conditions outlined in models of sandhill crane habitat (Currier and Ziewitz 1987), whooping crane habitat (Ziewitz 1992), and the Platte River Joint Study habitat complex (Platte River Joint Study 1990). Initial management activities focused on clearing vegetation from small islands located in wide channels. These activities were successful in providing wider unobstructed views (Currier 1984, Pfeiffer and Currier 2005) and resulted in an increase in use of those areas by sandhill cranes (Davis 2003). The riparian forest that lined the banks of these wide channels was removed with the intent to develop them into riparian grasslands and enhance the roost areas even more (Pfeiffer and Currier 2005).

To comply with license conditions, the Districts had to develop management plans for the properties and file them with FERC. Based upon the initial success of previous efforts, the management plans for the District's properties were developed using the same concepts as previous management efforts on the Platte River. The plans had to have concurrence by the Service

and Nebraska Game and Parks Commission. The properties being managed by the Districts have much narrower channels, higher banks, more accretion lands relative to wetted channel width, broader and denser forested areas, and are located farther west (upstream) than any of the previously mentioned habitat management areas. We describe herein the Districts' properties, their management to date, success of management in achieving desired land cover types, and the response of cranes to that management.

STUDY AREA

Cottonwood Ranch Property

In 1992, NPPD purchased a 1,092-ha block of land between Elm Creek and Overton, Nebraska (Fig. 1) known as The Cottonwood Ranch Property; it includes the entire river channel for 3.2 km and the north half for an additional 1.6 km. There are 3 main channels with a total channel width of 150 m and an average channel width in the widest channel of approximately 70 m. The property included 67 ha of upland grasslands, 108 ha of riparian grassland, 22 ha of non-riverine wetlands, 50 ha of irrigated cropland, 134 ha of dryland cropland, 676 ha mature cottonwood/ash riparian forest, and approximately 35 ha of open channel or bare sand.

Management plans for the Cottonwood Ranch Property are based upon parameters outlined in the Platte River Joint Study (1990). They included the removal of mature riparian forest (clearing) along the channels to provide for unobstructed view widths equal to or exceeding 350 m. Within this cleared area, linear wetlands (sloughs) were dug in an attempt to replicate the conditions created in large backwaters and hydrologically connected sloughs. Portions of the cleared area were planted to native grassland plant species (grassland creation), and the rest remains in bare sand that can be transported by sufficient flows to offset modeled sediment deficiencies at higher flows and provide nesting habitat for least terns (*Sternula antillarum*) and piping plovers (*Charadrius melodus*).

In addition to the riverine enhancements, non-riverine landcover types on this property have been enhanced to improve their value as crane habitat. All row-crop areas were restored to native grasslands with sloughs interspersed to provide a wetland component throughout the area. A palustrine wetland that had accumulated sediment and had become encroached with cattail (*Typha latifolia*) and willows (*Salix amygdaloides*) was also restored.

Jeffrey Island Habitat Area

Central purchased the Jeffrey Island Habitat Area, a 1,694-ha block of land along and within the segment of the Platte River between Lexington and Overton, Nebraska (Fig. 1). In 2005, Central purchased an adjoining piece of property of approximately 143 ha (Cook Property) for a total of 1,837 ha. At the time of purchase, this area consisted of 484 ha of mature cottonwood/ash riparian forest, 1,130 ha of upland grasslands, and 403 ha of active channel. As with the Cottonwood Ranch Property, Central developed and implemented a management plan to enhance the area for cranes and other migratory waterbirds. The major management actions were the same as at Cottonwood Ranch Property and included clearing, slough development, and grassland restoration.

METHODS

Land Management

The Districts cleared riparian forest and shrub land using heavy equipment. Methods used include cutting the trees and treating the stumps for regrowth or removing the tree, stump, and all, by pushing the entire tree over with large equipment. The initial step in either method was to mow or scrape away the woody undergrowth of shrubs and small trees. Once the undergrowth was removed the larger trees were cut or pushed over. To remove large trees, the Districts used either an equipment mounted tree shear or chain saws. Other large standing trees were pushed over with tracked loaders and/or excavators. Workers piled and burned all the trees and woody undergrowth; then buried any remaining stumps or other debris.

Depending upon the specific site, the restoration plan called for leaving the cleared areas to erode as part of the river channel, treating the area with herbicides to create bare sand, or seeding for grassland restoration. Areas slated for grassland restoration were further modified by the addition of sloughs. Within the cleared areas and on cropland areas, restoration activities created sloughs to provide a wetland component. The Districts created sloughs by excavating the soil to a depth at, or near, groundwater level. Methods of excavation included the use of bulldozers, excavators, tracked loaders and scrapers. Methods used were determined by the contractor hired. The goal of the slough restoration was to have at least 10% of the slough below the groundwater level at the time of excavation. The Districts built check dams in the sloughs approximately every 400 m to create backwaters in the slough, thereby increasing the wetted area and resulting in each slough having a range of water regimes from small areas (~10% of slough area) that are permanent wetlands to the entire slough being temporarily filled with water during spring snow melt and large rain events.

The Districts designed the sloughs with a minimum bottom width of 12 m and a maximum bottom width of 50 m; all constructed sloughs have 4:1 slopes on the sides so that top width varies along with depth. Excavation crews spoiled

(placed) the material removed from the slough in nearby uplands and spread it so that it did not raise the soil surface by more than 30 cm. Workers then seeded all the spoils material with a grassland restoration seed mixture.

Restoration of the palustrine wetland utilized excavators, scrapers, and bulldozers. First, excavators dug drainage ditches to allow the water level to drop and the sediment to dry. Once it was sufficiently dry, scrapers removed the built up sediment and deposited it on adjacent uplands. In areas that remained too wet for scrapers, bulldozers pushed the material to where scrapers could be used. The wetland was configured to offer a continuum of depths from 0 to 1 m at full capacity, with a gentle slope from the shoreline and deepest points in the center. All material removed was deposited in adjacent upland areas not to exceed a depth of 50 cm and seeded with a high diversity grassland seed mixture.

Grassland creation involved seeding previously cropped areas and in areas where forest was removed spraying woody growth. Seeds of plants found in native grasslands were spread using either straight drop or broadcast fertilizer spreaders in the deforested areas. Workers seeded disturbed areas from late winter through early spring using either commercially available seed mixes with at least 17 species of plants or locally obtained high diversity seed mixes that contained over 100 species of plants. These seeded areas were excluded from grazing for at least 2 years and spot sprayed for noxious weeds.

Crane Response

Monitoring of sandhill crane use on these properties consisted of 3 types of surveys. The first type was a spring diurnal survey of the properties conducted on a weekly basis by biologists driving routes that included the properties as well as areas between the 2 properties (Fig. 1) and recording where cranes were observed. Surveys were started at least 2 hours after sunrise and completed at least 2 hours before sunset with an effort made to vary survey times. For each observation flock size, habitat type and time was recorded and the location was plotted on a map. A flock was defined as $\geq$ 2 cranes separated by > 100 m from other cranes (Iverson et al. 1987). If a flock was in > 1 habitat type it was considered 2 flocks and individuals in each habitat type were counted. The presence or absence of cranes was documented by the recording number of cranes and flocks of cranes. This survey was not conducted in the fall.

The second survey type focused on counting cranes on roosts in the early morning and evening, At the Cottonwood Ranch Property, biologists made morning observations of birds leaving the roost on either a section of river or the palustrine wetland. After sunrise, researchers surveyed sandbars throughout the entire length of the property and the shoreline of the wetland for evidence of cranes (e.g., tracks, feathers). If they found evidence of cranes, the observers returned to that area the next morning to conduct the count. The number of visits each year to the Cottonwood Ranch Property was dependent on weather, access limitations due to high water, and the presence of evidence that cranes were utilizing the property. This survey at the Cottonwood Ranch Property was conducted mainly in the spring but was also done in the fall if cranes were sighted on the property while conducting other activities. At the Jeffrey Island Habitat Area, there is a known roost that receives consistent use annually, and a minimum of 2 visits each spring were made to this site. The observer estimated the number of birds in both the evening and morning. The observer arrived well before sundown, stayed all night, and waited for the birds to leave the roost in the morning to minimize disturbance during these surveys.

The third type of crane monitoring, initiated in 2001, was a daily flight of the river between 21 March to 29 April and 9 October to 10 November each year. These flights were made primarily to document whooping crane use of the river (Platte River Recovery Implementation Program 2006), but were to also document any sandhill crane use on the Cottonwood Ranch Property.

RESULTS

Land Management

Management of these properties began in the year 2000 and continues to date. Approximately 254 ha along 10.0 km of river channel have been cleared of vegetation. Both the tree cutting and tree pushing methods of removing trees were viable. Cost of removing, burning, and burying trees ranged from $1,215/ha to $1,800/ha and was more dependent on the number and size of trees per acre than the method utilized. Clearing has resulted in an area without woody vegetation for a width of at least 350 m along this 10-km stretch. The clearing has not resulted in an increase in active channel area, but has improved unobstructed view in areas where banks are low enough to not be a visual obstruction. Within this cleared area, the Districts constructed 13.5 km of sloughs. Under groundwater conditions, similar to those at the time of construction, these sloughs create approximately 4.8 ha of surface water. The areas provide an additional 50 ha of area that has a mesic to xeric gradient. Providing that additional habitat should permit colonization of those areas by plants and invertebrates not currently found in abundance in those reaches of the river. The cost for creating the sloughs ranged from $6.00 to $7.75/m of slough. Cost for seeding slough spoil areas is incorporated in to seeding costs for the entire area.

The restoration plans provided for the creation of 38 ha of grassland on cleared areas. The Districts used a high diversity seed mixture obtained from local sources on a 12-ha area and

Table 1. Number of flocks of sandhill cranes observed in each habitat type on diurnal drive route surveys, 1999-2006.

Year	Corn	Alfalfa	Grasslands	Cottonwood Ranch Pond	Other (soybeans, disked, feedlots, etc)
1999	47	14	18		7
2000	37	12	8		7
2001	46	2	10		3
2002	18	8	4	3	4
2003	25	13	11		2
2004	70	51	4		14
2005	26	11	7		1
2006	70	30	6		15
Totals	339	141	68	3	53
	56.1%	23.3%	11.3%	0.5%	8.8%

seeded the remaining areas with a commercially available seed mixture of 17 species. The cost of seeding the cleared areas ranged from $245/ha in the low diversity sites to $625/ha in the high diversity seeding areas. The low organic content of soil in these cleared areas has resulted in sparse grassland and large populations of non-native first successional invaders such as musk thistle (*Carduus nutans*) and leafy spurge (*Euphorbia esula*). The control of noxious weeds and woody regrowth in these cleared areas has cost from $30 to $275 per hectare annually and in some areas over a 5 year period has nearly doubled the cost of the original clearing.

Areas cleared but not seeded for grassland creation are kept bare or minimally vegetated as potential least tern and piping plover nesting habitat or as potential sediment source. Soils on these sand areas are more friable than on vegetated areas and thus provide a sediment source to offset clean water returns to the river during higher flow periods. Control of invasive plants on these areas, while equally expensive as the grassland restoration areas, is more effective because different methods, such as disking or using pre-emergent herbicides, can be used without concern over the effects on desirable plant species. The Districts have created and maintain 74 ha of barren sand and 142 ha of minimally vegetated sand substrate. While least terns and piping plovers have been observed occasionally on these areas, no nesting has occurred. The Districts have physically placed approximately 27,000 m^3 of sediment in to active channel areas and estimated that approximately an additional 39,000 m^3 have eroded naturally from the banks after clearing the vegetation.

In addition to the riverine areas cleared of woodlands on the 2 properties, there were 136 ha of cropland on the Cottonwood Ranch Property that was seeded in May 2002 with 2,700 kg of a high diversity mixture of locally obtained seeds at a cost of $90.00/ha; this price does not include the cost of seed bed preparation. There was little germination and the area became infested with Canada thistle (*Cirsium arvense*) within 3 years. The failure of this seeding is likely due to the late seeding date and the drought conditions that started in 2001 and continued to plague central Nebraska through the 2005 growing season. Within this grassland restoration area, 8.5 km of sloughs were constructed which contain approximately 7 ha of surface water area at normal groundwater levels. The entire area including the sloughs was reseeded in fall 2007 with a commercially available seed mixture.

In addition to the created sloughs within this restored grassland, a natural wetland was restored by removing accumulated sediment to a maximum depth of 1 m, creating an emergent wetland that is 70% open water and 30% emergent vegetation. This is a permanent wetland with a base water level maintained by groundwater. The size of this wetland at base level is approximately 4 ha and at maximum elevation it is 10 ha with a maximum water depth of 1 m. A total of 60,000 m^3 of sediment was removed from the wetland at cost of $101,000. Seeding cost of the spoil is included in the cropland seeding listed above.

Crane Response

Weekly survey routes conducted since 1999 show that crane use of these properties was never high. Diurnal use of the properties basically ceased when the cropland at the Cottonwood Ranch Property was removed (Table 1). Of the 604 flocks of sandhill cranes identified since 1999 through the Districts' diurnal sandhill crane monitoring only 11 have been on the 2 properties. Our diurnal surveys show that an average of 56.1% of all crane flocks identified were in corn fields (Table 1), a habitat type that no longer exists on either of the managed properties.

Results of ground-based river roost surveys indicated that numbers of sandhill cranes roosting at the Jeffrey Island Habitat Area is declining and that some sandhill cranes are starting to roost on the Cottonwood Ranch Property (Table 2). The use of the Cottonwood Ranch Property by cranes started in the same year as the trees were removed near the river banks, and crane numbers have slowly been building since. The palustrine wetland on the Cottonwood Ranch Property also is used as a roost in the years when vegetation in the immediate uplands is kept short. Much of the use of this wetland is late in the spring migration period and in the fall.

Table 2. Results of ground-based surveys for sandhill crane use of District properties, 1999-2005.

Survey type and area	Year	No. days surveyed	No. days with cranes on properties	Peak counts
River roost surveys at the Cottonwood Ranch Property	1999	8	0	0
	2000	12	5	400
	2001	6	2	400
	2002	6	1	100
	2003	13	4	1,500
	2004	13	2	2,000
	2005	20	2	5,000
River roost surveys Jeffrey Island Property	1999	2	2	7,000
	2000	2	2	8,000
	2001	1	1	7,000
	2002	2	2	7,000
	2003	2	2	6,500
	2004	2	2	5,500
	2005	2	2	3,500
Palustrine wetland surveys at the Cottonwood Ranch Property	1999	Not Restored		
	2000	Not Restored		
	2001	Not Restored		
	2002	25	11	2,800
	2003	15	0	0
	2004	12	2	5,000
	2005	21	3	1,000
Diurnal Habitat Use Surveys	1999	5	2	1,000
	2000	3	2	75
	2001	2	1	66
	2002	5	1	700
	2003	3	0	0
	2004	5	0	0
	2005	5	0	0

Aerial flights of the river have not found any sandhill cranes roosting on the Cottonwood Ranch Property. However, on several occasions, observers reported sandhill cranes roosting on the river during ground observations and that the sandhill cranes left the river before the plane arrived. The aerial flights have resulted in 1 probable sighting of a whooping crane on the Jeffrey Island Habitat Area in the spring of 2004 and 2 whooping cranes verified as roosting on the Cottonwood Ranch Property in the spring of 2006. The 2 whooping cranes on the Cottonwood Ranch Property roosted there for 2 nights and foraged briefly in the river in the early morning before they flew to cornfields located approximately 1.6 km south of the river, where they spent both days.

DISCUSSION

Over the past 7 years, NPPD and Central have managed lands along 10 km of the Platte River in Central Nebraska in an attempt to improve the area as both whooping crane and sandhill crane habitat. While other studies (Currier 1984, Davis 2003) show an immediate response of sandhill cranes to management activities such as clearing, we have observed little or negative response by sandhill cranes. Unlike the Districts' properties described here, most other areas managed for cranes are areas that already had a large number of sandhill cranes utilizing the immediate area or nearby areas. In contrast, the areas being managed by the Districts have only 1 known historical sandhill crane roost site (USFWS 1981, Pucherelli 1988, Sidle et al 1993). The numbers of sandhill cranes has always been low in this area (Faanes and LeValley 1993), and continues to be low today (Kinzel et al. 2006). Our findings corroborate an earlier assessment by Faanes and LeValley (1993), who found no significant change in the number of birds between 1957 and 1989 despite large increases in numbers of cranes in other areas. Previous habitat management efforts focused on wide channels, showed small vegetated islands in wide channel (200-300 m) could be converted to mobilized islands; however, there was little success with the same efforts on "accretion ground" (Pfeiffer and Currier 2005). All the areas cleared by the Districts are "accretion ground". As flows in the Platte River decreased and/or stabilized, cottonwood trees were able to establish on the bare mineral soils of the exposed river bed (Williams 1978, Johnson 1994). Sidle et al. (1989) estimates that up to 73% of the active channel area from the J-2 Return to Chapman has been converted to wooded floodplain. The area that used to be channel and is now wooded floodplain is accretion ground. Differentiating between river bed and accretion ground as practiced by licensed surveyors is based upon vegetative characteristics, with the river bed being defined as that area absent permanent vegetation and accretion ground having the presence of permanent vegetation such as large trees or native grasses (Brown 1991).

Sandhill cranes will roost in channels much narrower than exist on the properties (Folk and Tacha 1990); however, most channels on the properties do have a wetted width <150 m, which Davis (2001) showed that sandhill cranes on the central Platte select against. The avoidance of narrow channels on the central Platte River could indicate that water depth, and not width, is the factor limiting crane use. The use of much narrower channels on the North Platte River (Folk and Tacha 1990) is possible because of much lower flows in that area.

From 1975 to 1998, average March daily flow on the North Platte River at North Platte was 15.6 m^3/sec while the Platte River at Overton during the same time frame the average March daily flow was 66.4 m^3/sec (Stroup et al. 2006). In an attempt to address water depth issues, our management is shifting from just improving unobstructed views by removing vegetation to incorporating the sediment from these cleared areas into the channel to increase the wetted width of the channel and decrease water depth.

From 2000 to 2004, the average area of channel utilized for roosting by sandhill cranes was 80.3 ha (Kinzel et al. 2006). Two analyses of available habitat based on flows over a 48-year time period from 1947 to 1995, but using different methods to define suitable conditions for habitat, indicate that there is somewhere between 280 ha (Farmer et al. 2005) and 1375 ha (DOI 2006) of habitat. Based on these models, it appears that in an average year cranes do not utilize all available habitat for roosting. However, ranges for all these parameters are quite large with varying flows and since our management began the Platte River has been in a drought with flows well below average. Distribution of cranes may also be affected by habitat shortages. Analysis of sandhill crane use in one of the most heavily utilized sections of river showed that at the flows analyzed, there was more water area of suitable depth and width then was used by the cranes (DOI 2006). If sufficient roosting habitat exists and > 95 % (DOI 2006) of the population of mid-continental sandhill cranes already stop on the North Platte or central Platte River, interpretation of crane response to management becomes complicated. Two possible scenarios exist: 1) cranes that currently do not stop on the Platte River will be attracted to the management areas and stop; or 2) more likely, birds that already utilize the river will shift from current use areas to the newly managed areas. Faanes and LeValley (1993) documented such a shift in usage patterns along the central Platte River and attributed that shift to the encroachment of trees in the western sections coupled with clearing efforts of the WCHMT in the eastern sections. Movement between managed areas is already occurring, Kinzel et al. (2006) showed significant decline in birds in the section of river between the Highway 10 and Gibbon bridges, and a corresponding increase in number of birds further downstream. Between Highway 10 and Gibbon is the Audubon Rowe Sanctuary, a section of river that has been extensively managed for over 30 years (Strom 1987), areas where the birds moved to have been more recently managed by the WCHMT (Davis 2003). The shift in cranes from one managed area to another, needs to be evaluated in terms of actual benefit or detriment to the cranes before sandhill crane use is the measure of management success.

The juxtaposition of diurnal and nocturnal habitat has been speculated to be of importance to habitat selection by sandhill cranes (Folk and Tacha 1990). Therefore, use of apparently suitable roosting habitat may fall short of expectation due to lack of appropriate diurnal habitats nearby. Past efforts have shown that sandhill crane use is highest in areas with the most wet meadow area (Faanes and LeValley 1993, Sidle et al. 1993). Wet meadows provide sandhill cranes with invertebrates (Davis and Vohs 1993), water, and a place for loafing and social interactions (Tacha et al. 1992). The Districts converted all row crops to grassland interspersed with wetlands at a ratio of about 1 ha of wetland to 10 ha of grassland. They also converted 38 ha of woodland to grassland. Crane use of these grassland areas to date has been nonexistent. For several years these grasslands were not managed with the low vegetative stature of typically utilized by cranes; therefore, lack of use should be looked at with caution. However, these properties contain large tracks of native grassland (1,297 ha) which also do not receive crane use even when managed for a low vegetative stature.

Sandhill cranes stop on the Platte or North Platte River during the spring migration to accumulate fat and proteins to continue migration and initiate breeding (Krapu et al. 1984, Iverson et al. 1987). Waste corn has become the principal food resource for sandhill cranes (Reinecke and Krapu 1986). In our diurnal surveys, 55% of all cranes seen were in cornfields, which is consistent with other studies (Iverson et al. 1987, Folk and Tacha 1991, Davis 2001). Recent studies indicate that sandhill cranes are storing less fat in Nebraska (Krapu et al. 2005*a*), potentially the result of limited corn supplies because of changing cropping practices (Krapu et al. 2004) and competition with waterfowl (Krapu et al. 2005*b*). The Districts feel there is more than sufficient corn in close proximity to our managed properties and thus have eliminated corn production on these properties. However, because this line of thought relies on the assumption that corn will remain economically profitable for farmers in the immediate area, it needs to be continually re-evaluated as agricultural practices change.

Whooping cranes utilize many of the same habitat types as sandhill cranes. However, because of behavioral differences, such as being less traditional than sandhill cranes in their use of roost sites (Howe 1989, Johnson and Temple 1980), more temporally compacted migrations, and smaller group size (Austin and Richert 2005), whooping cranes likely have a different process of habitat selection. Evaluating responses of whooping cranes to habitat management is difficult and needs to be viewed with caution due to their scarcity. The National Research Council (2005) reported that over the past 20 years, the number of individual whooping cranes stopping on the Platte River in any given year ranged from 0 to 17. Without overstating its importance, the 1 probable and 1 confirmed sighting of whooping cranes on these properties is promising and indicates the management activities have been improving habitat conditions for whooping cranes. The only previous sighting on the properties was 3 adult birds on what is now

the western end of the Jeffery Island Habitat Area in the spring of 1942 (Austin and Richert 2001).

MANAGEMENT IMPLICATIONS

Removing riparian forest and creating wet meadow to improve crane habitat on the Platte River does not appear to result in increased numbers of sandhill cranes in all instances. While increased use by sandhill cranes is a measure of management success, it also likely indicates a redistribution of birds from other managed areas and the benefit of such shifts to the cranes themselves needs to be evaluated. There are indications (National Research Council 2005) that management has increased use of the Platter River by whooping cranes. The almost immediate use by whooping cranes of the properties managed by the Districts further supports this idea.

The clearing of cottonwood forest to restore channel area has been successful in the past (Pfeiffer and Currier 2005) and in this study even though crane response to that restored channel was not similar. Creation of grassland by removing forest and planting to grassland species has met with limited success in both our efforts and those of past managers (Pfeiffer and Currier 2005) and needs to be evaluated for what benefit it provides to cranes. Clearing riparian forests to create habitat for cranes removes the rarest land cover type in Nebraska (CALMIT 2005). Currently land management along the Platte River follows 2 basic models: 1) management should maintain existing floral and faunal assemblage and where feasible improve conditions for priority species such as cranes, least terns and piping plovers, or 2) management should strive for historic conditions defined as a wide, braided, treeless river surrounded by grass, which provided habitat for priority species like cranes, least terns and piping plovers. These different models are the result of discriminating views on what historic conditions on the river were (National Research Council 2005), interpretation of the importance of species use of new food sources such as corn (Krapu et al. 2004) and land cover such as riparian forest (Sharf 2006), and the feasibility of achieving and maintaining management objectives. The feasibility, success and other associated issues related to both of those models will be evaluated in the currently formed Platte River Recovery Implementation Program (PRRIP).

Likewise, past and future management efforts by the Districts will become part of the PRRIP and be subjected to intensive scientific scrutiny as to the benefits. The PRRIP brings several other important components to habitat management on the Platte River. First, it has both land and water management components that will allow an integration of management actions that has not occurred to date. Secondly, the PRRIP will have a strong scientific component driven by adaptive management concepts that will constantly review management actions in terms of actual benefit to species. The PRRIP is governed by a committee of stakeholders that has an independent science advisory committee to provide guidance on the science. The first increment of 13 years has a budget of $317,330,000. Additional information on the Platte River Recovery Implementation Program can be found at http://www.platteriver.org/.

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Ray Buller, U. S. Fish and Wildlife Service – Central Flyway Representative with a lesser and a greater sandhill crane taken at Laguna de los Mexicanos, Chihuahua, Mexico, November 1970. Photo by Roderick C. Drewien.