

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

North American Crane Workshop Proceedings

North American Crane Working Group

---

1992

# FACTORS INFLUENCING THE FUTURE OF WHOOPING CRANE HABITAT ON THE PLATTE RIVER IN NEBRASKA

Craig A. Faanes

*U.S. Fish and Wildlife Service*

Follow this and additional works at: <http://digitalcommons.unl.edu/nacwgproc>

 Part of the [Behavior and Ethology Commons](#), [Biodiversity Commons](#), [Ornithology Commons](#), [Population Biology Commons](#), and the [Terrestrial and Aquatic Ecology Commons](#)

---

Faanes, Craig A., "FACTORS INFLUENCING THE FUTURE OF WHOOPING CRANE HABITAT ON THE PLATTE RIVER IN NEBRASKA" (1992). *North American Crane Workshop Proceedings*. 302.

<http://digitalcommons.unl.edu/nacwgproc/302>

This Article is brought to you for free and open access by the North American Crane Working Group at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in North American Crane Workshop Proceedings by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

# FACTORS INFLUENCING THE FUTURE OF WHOOPING CRANE HABITAT ON THE PLATTE RIVER IN NEBRASKA

CRAIG A. FAANES, *U.S. Fish and Wildlife Service, 203 West 2nd Street, Grand Island, NE 68801*

**Abstract:** Lands along 86 km of the Platte River in Nebraska were designated by the U.S. Department of Interior as critical habitat for the endangered whooping crane (*Grus americana*) in 1978. The designation established the legal basis for the continued protection of lands critical to the survival and recovery of whooping cranes. Currently there are 14 federal, state, and local water projects planned for the Platte River system. If completed, total withdrawal would be about 80% of the remaining 30% of the original flow. In this paper I summarize those projects and discuss their potential impact on whooping crane habitat. Management activities by several conservation groups are summarized.

Proc. 1988 N. Am. Crane Workshop

The Platte River system provides important habitat for fish and wildlife resources of national and international significance. Over 80% of the world's sandhill cranes (*Grus canadensis*) stage annually during migration on the Platte and North Platte rivers to prepare for the continuation of their migration (U.S. Fish & Wildlife Service 1981). The Platte River supports nearly 100% of the mid-continent population of greater white-fronted geese (*Anser albifrons*) (Currier et al. 1985) and provides important wintering habitat for mallards (*Anas platyrhynchos*) (Jorde 1981).

The Platte River also provides wintering habitat for the bald eagle (*Haliaeetus leucocephalus*) (Lingle and Krapu 1986). Significant populations of the endangered interior least tern (*Sterna antillarum*) and the threatened piping plover (*Charadrius melodus*) nest annually on some of the remaining unvegetated sandbars in the river (Faanes 1983).

Among endangered species, however, the Platte River is probably best known as a migration stop-over area for whooping cranes (Allen 1952). Recognizing the importance of the river system in that regard in 1978, the U.S. Department of the Interior designated about 86 km of the river as critical habitat (43 Fed. Register 20938-20942).

About 70% of the historic annual flow in the Platte River system has been diverted upstream for consumptive uses in Colorado, western Nebraska, and Wyoming (Williams 1978; U.S. Fish & Wildlife Service 1981). As a result, channel widths have been reduced by 80 - 90% in some portions of the

Big Bend reach (Currier et al. 1985). Reductions in peak flows and reduced annual flows, and subsequent agricultural development caused by water impoundments and diversions, have resulted in significant losses of floodplain wet meadow crane feeding habitat. Reduced flows have allowed encroachment of woody vegetation that have rendered some reaches of the Platte unsuitable for crane roosting (Frith & Faanes 1982; Currier et al. 1985).

Historically, flows in the Platte River were estimated at about 2.6 million acre-feet annually. But, mean annual flows in the Platte River at Overton, Nebraska, are currently about 900,000 acre-feet (U.S. Bureau of Reclamation unpubl. data). In this paper, I report on the status of planned water diversion projects in the Platte River system that threaten to further reduce the annual flows. Additionally, activities regulated by the U.S. Corps of Engineers that are contributing to a reduction in the integrity of the riverine system are discussed. I also report on the activities of several private conservation organizations in preserving and managing whooping crane habitat on the Platte River.

I appreciate the helpful comments provided by J.B. Brabander, D.B. Bowman, J.G. Sidle, K.J. Strom, J.W. Ziewitz, and K.L. Ziewitz. The manuscript benefited from numerous earlier philosophical discussions with G.R. Lingle about whooping cranes and their habitats. J. Hanson typed several drafts of the manuscript.

## THE PLATTE RIVER

The Platte River originates at the confluence of the North Platte and South Platte rivers in Lincoln County, Nebraska, and flows generally eastward along a 500 km route to the Missouri River near Omaha, Nebraska. The South Platte River originates in the mountains of central Colorado and flows generally northeastward toward Nebraska. The South Platte drainage along its 730 km course is about 62,960 km<sup>2</sup>. The North Platte River also originates in central Colorado. From its source at about 3550 m above sea level to its confluence with the South Platte, the North Platte flows about 1070 km and drains an area of 90,430 km<sup>2</sup> (U.S. Fish & Wildlife Service 1981).

### WATER DEVELOPMENT PROJECTS

The first major water development in the Platte River system began in the late 1800's with direct diversions for gravity irrigation. In April 1909, Pathfinder Dam was completed in southcentral Wyoming to retain over 1.2 billion m<sup>3</sup> (1.0 million acre-feet) of water for later release to 3 major irrigation projects. Five additional major reservoirs were constructed on the North Platte River in the subsequent 50 years, including Guernsey Reservoir (1927), Alcova Reservoir (1938), Seminoe Reservoir (1939), Lake McConaughy (1941) and Glendo Reservoir (1957). By 1960, almost 8.0 billion m<sup>3</sup> (6.5 million acre-feet) of North Platte waters, and 1.2 billion m<sup>3</sup> (1.0 million acre-feet) of South Platte waters were stored in reservoirs (U.S. Fish & Wildlife Service 1981).

Currently 14 additional federal, state and private water development projects are planned in the Platte River system (Table 1). Upon completion total withdrawal from the system would be about 674,318 acre-feet annually, or 75% of the remaining mean-yearly flow. The greatest depletion will occur in Nebraska where about 441,200 acre-feet of flow would be removed annually. Each project is described below.

**Narrows** - This project on the South Platte near Fort Morgan, Colorado, is sponsored by the Lower South Platte and the Central Colorado Water Conservancy Districts. Authorized by Public Law 91-389, its purposes are irrigation, flood control, fish and wildlife conservation, public recreation and potential future municipal and industrial water supplies. The predominant project facility would be the Narrows Dam and Reservoir. The principal

environmental concerns with the Narrows Project are downstream flow reductions and loss of sediment input to the Platte River system in Nebraska. Ultimately, narrowed river channels and reduced habitat value for important fish and wildlife resources within the critical habitat reach could occur.

**South Platte-Frenchman** - This project would divert water from the South Platte River system to the Frenchman Creek drainage. The feasibility of the project and its potential impacts are currently being evaluated based on flow depletions of 50,000 and 150,000 acre-feet annually. Its principal objective is to augment depleted groundwater resources.

**Two Forks Dam and Reservoir** - This South Platte project is sponsored by the Denver Water Department. Two Forks would provide 1.1 million acre-feet of water storage for municipal use in the Denver Metropolitan area. Mean annual depletions from the South Platte would be about 14,800 acre-feet; the remainder of the water would enter the system by an interbasin transfer from the Colorado River system. The principal downstream conservation issue related to Two Forks is the depletion of water resources in the South Platte and Platte Rivers. Formal consultation under Section 7 of the Endangered Species Act of 1973 suggests concern for the whooping crane and adverse modification of its critical habitat. Greater concern is being expressed for impacts on nesting populations of least terns and piping plovers. The U.S. Environmental Protection Agency has recently recommended that Two Forks be vetoed and that less damaging alternatives to its construction be used to meet the water demands of metropolitan Denver.

**Wildcat Creek** - The Wildcat Reservoir is proposed for construction near Brush, Colorado, on Wildcat Creek, a tributary of the South Platte River. The dam and reservoir would provide the Riverside Irrigation District with greater flexibility in operating its irrigation system. The Fish and Wildlife Service (U.S. Fish & Wildlife Service 1982) determined that the main impact of the Wildcat Creek Project on the whooping crane would be increased encroachment of woody vegetation within the critical habitat reach of the Platte River in Nebraska.

**Senac Reservoir** - This 332 ha reservoir is proposed for construction on a tributary to the South Platte in Arapahoe County, Colorado. Its main objective is the provision of an emergency water

supply for the City of Aurora, Colorado.

**Cache La Poudre River** - This project on a tributary of the South Platte near Fort Collins, Colorado, is proposed by the Northern Colorado Water Conservancy District. Plans currently call for a reservoir to store 250,000 to 400,000 acre-feet of water for use by local irrigators. At present, no firm plans are at hand to make a judgment about the impacts of the project on fish and wildlife resources.

**Groundwater Withdrawal for Local Irrigation** - Additional reductions in mean annual stream flows in the Platte River are predicted to occur in the future from groundwater irrigation development (Missouri River Basin Commission 1975). By the year 2020, an estimated 62 to 75% of the flows that occurred in 1970 will be lost. Concurrently, the number of no-flow months in Nebraska will increase to between 20 to 40 per 100 years (Missouri River Basin Commission 1975). The principal environmental concern from the continued development of groundwater resources is encroachment of woody vegetation on sandbars and in adjacent wet meadows, and shrinkage of the river channel.

**Prairie Bend** - This is primarily a revitalization of the former Mid-State Irrigation Project (Wallenstrom 1976a). The project includes Plum Creek Reservoir and is proposed by the Bureau of Reclamation to be in 4 south-central Nebraska counties. The 2 purposes of Prairie Bend are to (1) recharge and stabilize groundwater supplies in Buffalo and Hall counties and use that water for irrigation of surplus crops, and (2) to conserve and recover migratory bird and threatened and endangered species habitats on the central Platte River in Nebraska.

Prairie Bend is designed to maintain the current extent of irrigated land in the project area. Improvements in the quality of groundwater may also occur. Other project benefits include outdoor recreation and the enhancement of municipal water supplies. Construction of a floodway to protect the City of Grand Island would also be a project benefit.

The principal environmental concern is flow depletion in the Big Bend reach of the Platte River. Suitable open river channel and sandbars used by nesting least terns and piping plovers, and roosting cranes, may be affected by encroaching vegetation. Concern has also been expressed that the periodic peak flows needed to maintain the braided morphology of the Platte River channel may be

further reduced. As proposed, Prairie Bend would include water storage and flow augmentation specifically for wildlife, including habitat management on about 5,660 ha along the river. A final Fish and Wildlife Service position on the project will be established upon completion of Instream Flow Incremental Methodology (IFIM) (Bovee 1982) and Habitat Evaluation Procedure (HEP) (U.S. Fish & Wildlife Service 1986a) studies.

**Groundwater Recharge Projects** - The U.S. Bureau of Reclamation is conducting evaluations of the potential for demonstrating groundwater recharge techniques that can be used in the Central Platte River valley. An ancillary purpose is to demonstrate that high nitrate and nitrogen levels in groundwater can be lowered by recharging low nitrate water into the aquifer. One of 3 project sites in Nebraska is located near Wood River, Hall County, and will operate by diverting water from the Platte River and a sandpit adjacent to 2 nearby recharge basins and the channel of Wood River. The project would operate continuously from 15 March to 31 October annually during a 5-year project life. The Wood River project would involve removal of 1,400 acre-feet of water (2 cfs) during 7.5 months each year. The Central Platte Natural Resources District has received a water right for operating the proposed project. Although the water withdrawal from the Platte River is small, it represents still another in a long list of flow depletions.

**Corn Creek** - The Corn Creek Irrigation District in Goshen County, Wyoming, has proposed to develop their annual right to 22,500 acre-feet of water from Corn Creek, a tributary of the North Platte River to provide irrigation water to about 6,070 ha of cropland in the District. The major concerns for endangered wildlife include potential impacts on whooping cranes, least terns, piping plovers and bald eagles. Whooping cranes may be affected by reduced flows which encourage woody vegetation encroachment on sandbars and adjacent areas. The project proponents submitted a final environmental assessment on the project in December 1985; no additional action has been taken.

**Seminole Reservoir** - Seminole Dam and Reservoir is on the North Platte River in Carbon County, Wyoming. Constructed in 1939 as part of the Kendrick Project, Seminole Reservoir provides water for irrigation and for power generation. A recent U.S. Bureau of Reclamation (1987) evaluation

predicted a potential shortage of municipal and industrial water to communities in the North Platte River Basin ranging from 428 to 21,412 acre-feet of water annually. Accordingly, the Wyoming Water Development Commission is studying several alternatives to upgrade Seminoe facilities and increase the water yield for downstream users. Among the alternatives being evaluated are: (1) enlargement of the existing dam, (2) water conservation, (3) purchase of existing water rights, (4) modification of river operation, (5) transbasin diversion, and (6) weather modification.

The main wildlife concerns derive from increased encroachment of woody vegetation on sandbars and adjacent wet meadows in the Big Bend reach of the Platte River resulting from reduced instream flows.

**Deer Creek** - The Deer Creek Project would be located on Deer Creek, a right bank tributary to the North Platte River in Converse and Natrona counties, Wyoming. Deer Creek would supply water to the City of Casper, Wyoming, in dry years when the city cannot obtain sufficient water from its surface or ground water rights. The main environmental concerns with Deer Creek are impacts on the bald eagle, whooping crane, least tern and piping plover. Project sponsors and the Corps of Engineers entered into formal consultation with the Fish and Wildlife Service under Section 7 of the Endangered Species Act. The biological opinion found that Deer Creek is not likely to jeopardize any endangered bird species or their critical habitat if conservation measures needed to offset the effect of the project on whooping crane habitat are implemented. Specifically, the Fish and Wildlife Service recommended the acquisition and management of about 10 ha of Platte River vegetated riverine islands and riparian habitat.

**Horse Creek** - The Horse Creek Project, on a tributary to the North Platte River, is sponsored by the Goshen Irrigation District in eastern Wyoming. Project plans call for dumping surplus water from the Fort Laramie Canal into Horse Creek Reservoir. The Wyoming Water Development Commission estimates that a reservoir with an estimated 5,000 to 10,000 acre-feet storage capacity will be needed. The main objective of Horse Creek would be to provide supplemental irrigation waters, especially during the late summer growing period.

**Kingsley Dam** - The reservoir behind Kingsley Dam, Lake McConaughy, is on the North Platte

River near Ogallala, Nebraska. Facilities associated with the dam, completed in 1938, include Sutherland Reservoir, Maloney Reservoir, Johnson Lake, and related feeder canals. Both the Central Nebraska Public Power and Irrigation District and the Nebraska Public Power District operate the dam and reservoir facilities. Current licenses issued by the Federal Energy Regulatory Commission (FERC) to operate the facilities expired in July 1987; relicensing efforts are now underway. The Kingsley Dam Project consists of about 1.8 million acre feet of water storage in Lake McConaughy, as well as several offstream reservoirs, 5 hydroelectric generation plants, 2 fossil fuel power generating plants, and about 193 km of main canals for irrigation and water delivery. Water from both the North Platte and South Platte rivers is used in the system. Power generation and irrigation are the major project purposes; recreation and flood control are secondary benefits.

Construction and operation of Kingsley Dam have resulted in significant impacts to wildlife habitat along the Platte River (Currier 1982; Currier et al. 1985; U.S. Fish & Wildlife Service 1981). Alteration in the flow regime since the 1930's and the subsequent encroachment of woody vegetation in the floodplain have been the 2 most profound impacts.

The Fish and Wildlife Service requested in 1987 that FERC and the project operators enter into formal consultation under Section 7 of the Endangered Species Act on the yearly operation of the dam. FERC denied the request. Consideration of possible changes in the normal operating plan, impacts on power generation, fishing and other reservoir recreation and other fish and wildlife resources will be evaluated during the relicensing process.

## CUMULATIVE IMPACTS OF BANK STABILIZATION ON THE PLATTE RIVER

In all probability, the action of filling a wetland or altering a short reach of a streambank will not cause major harm to wetland resources. Problems arise when each project is initiated without considering the inevitability of subsequent projects. With that in mind, the Omaha District, U.S. Army Corps of Engineers, in conjunction with the Fish and Wildlife Service, has initiated an evaluation of cumulative impacts of fill activities on the Platte and North Platte rivers. The U.S. Army Corps of Engi-

neers has regulatory authority over fill activities in wetlands in the United States, primarily through Section 404 of the Clean Water Act (PL 95- 217).

Localized and cumulative impacts associated with bank stabilization and fill activities will be assessed. Five approaches will be used to accomplish the objective of the assessment, including (1) establishment of study limitations and guidelines, (2) data collection, including inventory of existing permitted and unpermitted projects, (3) data synthesis and modelling riverine hydraulics, (4) evaluation and analysis of environmental impacts, and (5) development of management plans.

The Fish and Wildlife Service has identified several environmental issues of considerable concern related to fill activities. Bank stabilization may adversely influence sediment transport characteristics, adjacent wetland habitats, rates of vegetation encroachment, flow regimes, sandbar habitat and channel morphology, as well as affecting water quality, natural drainage characteristics, adjoining land use and encouragement of streambed degradation.

The Fish and Wildlife Service has also expressed concern over several aspects of the streambank stabilization activities the Corps regulates. Principal among these are the cumulative effects of PL 95-217 and other permitted and unpermitted bank stabilization activities on the Platte River and its tributaries. Likewise, currently pending and future Section 404 permit applications for bank stabilization actions are of concern.

The Fish and Wildlife Service has expressed willingness to coordinate activities with the Corps in the cumulative assessment planning, and in data collection. To successfully complete the process, the Service has suggested that the Platte River system be divided into 6 priority reaches for the assessment. An analysis will be made of alternative bank stabilization techniques.

## HABITAT PRESERVATION AND MANAGEMENT ACTIVITIES

At the conclusion of his analysis of whooping crane ecology in the Great Plains region, Allen (1952) recommended the establishment of a refuge for cranes on the Platte River. Frith (1976) substantiated that proposition, stating that the sandhill crane in North America depended on the preservation of habitat and suggested that because of the strategic location of the Platte River, preservation of habitats there would contribute positively to

crane management. Accordingly, in 1974, the Fish and Wildlife Service announced plans to acquire and establish a 6,070 ha National Wildlife Refuge on the river near Grand Island, Nebraska (Wallenstrom 1976b). With the principal goal of protecting vital whooping crane and sandhill crane habitat, the refuge proposal was endorsed by the Governor of Nebraska, the Nebraska Game and Parks Commission, and by conservationists. But widespread landowner opposition to the proposal developed, which halted attempts to establish the refuge.

About the same time, the National Audubon Society began acquisition of a crane preserve on the Platte River, later to be known as the Lillian Annette Rowe Bird Sanctuary (Logan et al. 1976). Establishment of that sanctuary marked the first time that Platte River lands had been protected specifically for the conservation of cranes and other migratory bird species. The sanctuary encompasses about 810 ha of lands, including 324 ha protected in fee title ownership (Strom 1987).

The original objectives of the sanctuary were to (1) clear encroaching vegetation from riverine sandbars, (2) restore native tallgrass prairie vegetation to the floodplain, and (3) conduct research to enhance knowledge of crane needs and to develop a monitoring plan. Results of the first 10 years of management demonstrate remarkable success in rejuvenating grasslands that previously had been overgrazed, and in the clearing of vegetation from riverine sandbars (Strom 1987).

Recognizing the changing habitat conditions in the Platte River system, the sanctuary recently updated its management plan, calling for a more active role in management and preservation of sanctuary lands. The new plan includes additional habitat manipulation and monitoring, additional scientific research, public education and attempts to maintain Platte River instream flows.

Concentrating on wet meadow habitats, sanctuary lands will be subjected to a rotational burning program designed to enhance warm-season grasses and the production of soil invertebrates. Haying will be used as needed to produce foraging habitat and curtail encroachment of woody vegetation in wet meadows. Based on the findings of whooping crane habitat use research at Aransas National Wildlife Refuge (Slack & Hunt 1987), that periodic burning is a positive technique for maintaining crane habitat, the sanctuary is avoiding the use of grazing by ungulates as a grassland management technique.

Maintenance of unvegetated sandbars in the

river channel is perhaps the greatest management challenge facing the Sanctuary (Strom 1987). After initial clearing of woody vegetation (generally accomplished by volunteer labor) from sandbars, the next challenge is to retard growth of tall vegetation. Scarification by mechanical discing is used to retain the unvegetated character of most managed sandbars. Burning appears to be a viable option that is less hazardous than using herbicides. The low density of herbaceous material in the ground layer frequently precludes fire as a management tool on river channel islands.

### THE PLATTE RIVER WHOOPING CRANE HABITAT MAINTENANCE TRUST

Established in an out-of-court settlement over the Grayrocks Dam in Wyoming, the Platte River Whooping Crane Critical Habitat Maintenance Trust (the Trust) has a major environmental presence in the Platte River system (VanDerwalker 1982). Operating under 7 specific objectives, the Trust is actively engaged in the protection and management of habitats occupied by whooping cranes and other endangered species. Perhaps the most important of those objectives is to "foster the continued existence of that amount of habitat required to meet the needs of whooping cranes stopping in the Big Bend of the Platte River on their spring and fall migrations".

Ellis and Shoemaker (1982) developed the first habitat management plan for the Trust, providing managers with a base from which to expand. The Trust's first major acquisition was the 810 ha Mormon Island Crane Meadows near Grand Island, Nebraska (Lingle 1982). From that initial acquisition, the Trust has expanded its objectives to include the preservation of a minimum of over 1,000 ha within each of the 10 highway bridge segments in the Big Bend reach of the Platte River (Currier et al. 1985).

The principal land management objective of the Trust is the maintenance of habitat diversity by managing for a mixture of surface cover types. Of particular interest is the inclusion of riverine forest, open river channel, wet meadows, upland grasslands and agricultural lands. To aid management efforts, Currier and Ziewitz (1987) developed a geographic information system model to assess the distribution and extent of suitable crane habitat along the Platte River. The Trust manages its lands primarily with burning and grazing of grasslands, and removal of woody vegetation from river

channel islands. Currier (1984) has demonstrated that degraded reaches of Platte River crane habitats can be successfully rehabilitated.

### DISCUSSION

Two recent publications have raised doubts about the importance of the Platte River to whooping cranes (Johnson 1982; EA Engineering 1985), centering on the number of cranes reported yearly, the availability of habitat throughout the flyway and the suggestion that whooping cranes are non-traditional in their use of habitats and specific locations while on migration. The basis for much of the argument is contained in the interpretation of results of the radio-tracking study conducted in 1981-1984 and summarized by Howe (1987).

But the importance of Platte River habitats in the migration ecology of whooping cranes and sandhill cranes has been extensively reported (Lewis 1974; U.S. Fish & Wildlife Service 1981; Krapu et al. 1982; Lingle 1987). In the past, the Platte River was used by whooping cranes more frequently than adjacent areas when flows were greater and the channel less encroached by vegetation (Allen 1952). The recent increase in Platte River use suggests that the species will use the river more regularly if the higher stream flows of recent years continue, along with intensified management of riverine habitats. Other Nebraska rivers are not used by whooping cranes as often as the Platte River and do not provide the extent of roosting and foraging area that are available on the Platte (Lingle 1987). The Rainwater Basin is used by whooping cranes with a comparable frequency, but the prevalence of disease outbreaks makes Rainwater Basin wetlands an unsafe alternative for whooping crane roosting and foraging habitat (Krapu & Pearson 1982; Lingle 1987; Snyder et al. 1987). In fact, the risk for whooping cranes to contract disease in the Rainwater Basin has necessitated the development of a hazing program there. Moreover, increased use of the Rainwater Basin for roosting could occur as Platte River habitats are further degraded, increasing the likelihood of whooping crane mortality from disease.

Whooping cranes did not become endangered because of catastrophic events at one or two locations, but rather from the cumulative impacts of habitat loss throughout the species' range. The loss of Platte River habitats may not solely be responsible for reduced population levels of whooping cranes. However, the continued reduction in the integrity of Platte River habitats, coupled with additional losses throughout the remainder of the

species range, may contribute to further population suppression. Protection of habitats and instream flows on the Platte River and elsewhere on the migration route may be one way to ensure the continued viability of the whooping crane population

### LITERATURE CITED

- Allen, R.P. 1952. The whooping crane. Natl. Audubon Soc. Rept. 3, 246p.
- Bovee, K.D. 1982. A guide to stream habitat analysis using the instream flow incremental methodology. Instream Flow Info Pap. 12, U.S. Fish & Wildl. Serv. FWS/OBS - 82/26.
- Currier, P.J. 1982. The floodplain vegetation of the Platte River, phytosociology, forest development, and seedling establishment. Ph.D. Thesis, Iowa State Univ., 332p.
- Currier, P.J. 1984. Woody vegetation clearing on the Platte River aids restoration of sandhill crane roosting habitat. Restoration Manage. Notes 2:38.
- Currier, P.J. & J.W. Ziewitz. 1987. Application of a sandhill crane model to the management of habitat along the Platte River. Pp. 315-325 in J. C. Lewis & J.W. Ziewitz (eds.), Proc. 1985 Crane Workshop, Platte River Whooping Crane Maint. Trust, Grand Island, Neb.
- Currier, P.J., G.R. Lingle & J.G. VanDerwalker. 1985. Migratory bird habitat on the Platte and North Platte rivers in Nebraska. Platte River Whooping Crane Habitat Maint. Trust, Grand Island, Neb.
- EA Engineering, Science & Technology. 1985. Migration dynamics of the whooping crane with emphasis on the Platte River in Nebraska. Lincoln, Neb.
- Ellis, S.L. & T.G. Shoemaker. 1982. Draft habitat monitoring plan for the Platte River Whooping Crane Habitat Maintenance Trust. Pp. 144-150 in J.C. Lewis (ed.), Proc. 1981 Crane Workshop, Natl. Audubon Soc. Tavernier, Fla.
- Faanes, C.A. 1983. Aspects of the nesting ecology of least terns and piping plovers in central Nebraska. *Prairie Nat* 15:145-154.
- Frith, C.R. 1976. Crane habitat of the Platte River. Pp. 151-156 in J.C. Lewis (ed.), Proc. Int. Crane Workshop. Okla. State Univ.
- Frith, C.R. & C.A. Faanes. 1982. Inventory of sandhill crane roosting habitat on the Platte and North Platte Rivers, Nebraska. Pp. 13-16 in J.C. Lewis (ed.), Proc. 1981 Crane Workshop, Natl. Audubon Soc., Tavernier, Fla.
- Howe, M.A. 1987. Habitat use by migrating whooping cranes in the Aransas - Wood Buffalo corridor. Pp. 303-311 in J.C. Lewis & J.W. Ziewitz(eds.), Proc. 1985 Crane Workshop, Platte River Whooping Crane Habitat Maint. Trust, Grand Island, Neb.
- Johnson, K.A. 1982. Whooping crane use of the Platte River, Nebraska — history, status and management recommendations. Pp. 33-43 in J.C. Lewis (ed. ), Proc. 1981 Crane Workshop, Natl. Audubon Soc., Tavernier, Fla.
- Jorde, D . G. 1981 . Winter and spring staging ecology of mallards in south-central Nebraska. M.S. Thesis, Univ. N. Dak., 131p.
- Krapu, G . L . & G. L . Pearson. 1982 . Susceptibility of the midcontinent population of sandhill cranes to avian cholera in Nebraska — a preliminary report . Pp . 7-12 in J. C . Lewis (ed. ), Proc. 1981 Crane Workshop, Natl. Audubon Soc., Tavernier, Fla.
- Krapu, G. L., K. J. Reinecke & C . R. Frith. 1982 . Sandhill cranes and the Platte River. *Trans. N. Am. Wildl. Nat. Resour. Conf .* 47: 542-552.
- Lewis, J. C . 1974 . Ecology of the sandhill crane in the southeastern Central Flyway. Ph.D. Thesis, Okla. State Univ., 204p.
- Lingle, G.R. 1982. Mormon Island Crane Meadows — protecting habitat for cranes along the Platte River, Nebraska. Pp. 17-21 in J.C. Lewis (ed.) 1981, Proc. Int. Crane Workshop, Natl. Audubon Soc., Tavernier, Fla.
- Lingle, G.R. 1987. Status of whooping crane migration habitat within the Great Plains of North America. Pp. 331-340 in Proc. 1985 Crane Workshop Platte River Whooping Crane Habitat Maint. Trust, Grand Island, Neb.
- Lingle, G. R. & G.L. Krapu. 1986. Winter ecology of bald eagles in south-central Nebraska. *Prairie Nat.* 18:65-78.
- Logan, T.H., R.D. Klataske & R.J. Wicht. 1976. Preliminary report on the National Audubon Society's management efforts in the Platte River valley of Nebraska. Pp. 144-150 in J.C. Lewis (ed.), Proc. Int. Crane Workshop, Okla. State Univ.
- Missouri River Basin Commission. 1975. Platte River Basin, Nebraska flood damage and control technical paper. Omaha, Neb., 167p.
- Slack, R.D. & H.E. Hunt. 1987. The effects of various burning and grazing treatments on upland habitat use by whooping cranes and sandhill cranes on the Aransas National Wildlife Refuge, Texas. U.S. Fish & Wildl. Serv. Unpubl. Rept. Albuquerque, N. Mex., 146p.
- Snyder, S., M. Richard, R. Drewein & J. Lewis.



1987. *Pasturella multocida* infection in a whooping crane associated with an avian cholera outbreak. Pp. 149-155 in J.C. Lewis & J.W. Ziewitz (eds.), Proc. 1985 Crane Workshop, Platte River Whooping Crane Habitat Maint. Trust, Grand Island, Neb.
- Strom, K.J. 1987. Lillian Annette Rowe Sanctuary — managing migratory crane habitat on the Platte River, Nebraska. Pp. 326-330 in J.C. Lewis & J.W. Ziewitz (eds.), Proc. 1985 Crane Workshop, Platte River Whooping Crane Habitat Maint. Trust, Grand Island, Neb.
- U.S. Bureau of Reclamation. 1987. Seminoe Dam modification preliminary findings memorandum. Unpubl. Rept., Billings, Mont., 7 p.
- U.S. Fish & Wildlife Service. 1981. The Platte River Ecology Study. N. Prairie Wildl. Res. Cent. Spec. Res. Rept.
- U.S. Fish & Wildlife Service. 1982. Biological Opinion—Wildcat Creek Project. Unpubl. Rept., Denver, Colo., 16p.
- U.S. Fish & Wildlife Service. 1986a. Habitat evaluation procedures (HEP) ESM 102. U.S. Fish Wildl. Serv., Washington, DC.
- VanDerwalker, J.G. 1982. The Platte River Whooping Crane Critical Habitat Maintenance Trust. Pp. 4-6 in J.C. Lewis (ed.) Proc. 1981 Crane Workshop, Natl. Audubon Soc., Tavernier, Fla.
- Wallenstrom, R.L. 1976a. The history and present status of the Mid-State Project, Pp. 139-140 in J. Lewis (ed.), Proc. Int. Crane Workshop Okla. State Univ.
- Wallenstrom, R.L. 1976b. The Platte River National Wildlife Refuge. Pp. 141-143 in J.C. Lewis (ed.) Proc. Int. Crane Workshop, Okla. State Univ.
- Williams, G.P. 1978. The case of the shrinking channels —North Platte and Platte rivers in Nebraska. U.S. Geol. Surv. Circ. 781.

**Table 1. Mean annual flow depletions from proposed water development projects in the Platte River system, Colorado, Nebraska, and Wyoming. Depletions are in acre-feet of water.**

PROJECT	DEPLETION
<b>COLORADO</b>	
Narrows	89,000
South Platte-Frenchman	50,000
Two Forks	14,800
Wildcat Creek	14,000
Senac Reservoir	18
Cache LaPoudre	Unknown
Subtotal:	167,818
<b>NEBRASKA</b>	
Groundwater withdrawal (local irrigation)	341,000
Prairie Bend	90,000
Plum Creek	8,800
Groundwater recharge projects	1,400
Subtotal:	441,200
<b>WYOMING</b>	
Corn Creek	32,500
Seminole Dam	15,800
Deer Creek	11,000
Horse Creek	6,000
Subtotal:	65,300
Total Depletions	674,318
% Total Flow	75.0

