631.115 FAA
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IN PRESS: PROC. 1988 CRANE WORKSHOP
in Woot, DA (Ed.). 1992. Proceedings: 1988 North American Crane Workshop
ref #7

RELATIONSHIP OF CHANNEL MAINTENANCE FLOWS TO WHOOPING CRANE USE OF THE PLATTE RIVER

CRAIG A. FAANES, U.S. Fish and Wildlife Service, 203 West Second Street, Grand Island, Nebraska 68801

DAVID B. BOWMAN, U.S. Fish and Wildlife Service, 203 West Second Street, Grand Island, Nebraska 68801

ABSTRACT: Periodic high flows in the Platte River are necessary to scour vegetation, and to redistribute sediment in the stream channel. Although peak and mean annual flows have been reduced by as much as 70% from pre-development times, channel maintenance flows still occur although at a much reduced frequency and magnitude of occurrence. Use of the Platte River by migrant whooping cranes (**Grus americana**) in recent years appears to be related to the recent occurrence of flows in excess of 8,000 cu.ft./sec for 5 or more days.

The Platte River in Nebraska is an important and strategically located migrational area for whooping cranes (Allen 1952, USFWS 1981, Currier et al. 1985). While on the Platte

River, whooping cranes roost nightly in shallow river channels (USFWS 1981, Lingle et al. 1984, 1986).

The historic record indicates that prior to 1940 whooping crane use of the Platte River was more frequent than currently. An important factor limiting contemporary use of the Platte River by migrant whooping cranes is degradation of the river channel and the subsequent encroachment of wooded vegetation. Currier et al. (1985) present data indicating that in two reaches of the Platte River about 97% of the suitable roost habitat has been altered or lost because of reduced flows in the river. Williams (1978) reported that flows in the Platte River were reduced by nearly 70% from pre-development times. Clearly, a relationship exists between instream flows and the existence of suitable roost habitat.

In this paper we present data on the magnitude of flows prior to observations of whooping cranes on the Platte River. We also argue the biological validity of providing adequate flows to maintain river channels in a condition suitable for supporting whooping cranes.

ROLE OF PLATTE RIVER HABITAT

The Platte River and its use by both whooping cranes and sandhill cranes (**Grus canadensis**) has been extensively described since the time of early settlement (Currier et al. 1985). The importance of habitat to migrating whooping cranes was recognized by the U.S. Department of the Interior in 1978 when critical habitat was designated that included Salt Plains National Wildlife Refuge, Oklahoma; Quivira National Wildlife Refuge and Cheyenne Bottoms State Wildlife Refuge, Kansas; and the Platte River Valley, Nebraska (USFWS 1978). The following factors were considered in making the critical habitat determination for the Platte River:

1. The Platte River bottoms provide a dependable source of food, water, and other nutritional or physiological needs of the whooping crane during spring and fall migrations. Insects, crayfish, frogs, small fish, and other small animals as well as some aquatic vegetation and some cereal crops in adjacent croplands appear to be major items taken during the migration period.

2. At proper flow regimes, the Platte River provides whooping cranes with the required open expanse for nightly roosting. Roosting areas, comprised of sand and gravel bars of very shallow water in rivers and lakes, appear to be one of the major factors in whooping crane habitat selection of nightly stopover sites. Cranes observed during migration are most often

found within short flight distances of wetland areas.

3. Whooping cranes do not readily tolerate human disturbances. A human on foot will flush whooping cranes at distances of over one-quarter of a mile. The Platte River provides the needed isolation.

The Aransas-Wood Buffalo flock commonly uses the Platte River during migration (Table 1). In spring, wet meadows provide whooping cranes with a food source essential for successful reproduction. Resting and foraging habitat ensures that the birds arrive on the breeding grounds in a healthy condition. The health and survival of whooping cranes is dependent on the condition and abundance of their habitat. The importance of maintaining traditional habitats such as the Platte River is especially critical given the impact of man's ongoing conversion of Great Plains habitats to other uses (USFWS 1986).

River channels that exhibit significant variation in depths are used most frequently for roosting by whooping cranes (Lingle et al. 1984, 1986). Whooping cranes select roosting sites on the basis of the security offered by the site(s) (Shenk and Armbruster 1986, USFWS 1987a). Prior to the initiation of extensive water development, the Platte River was used by whooping cranes more frequently than other habitats when flows were greater and the channel was less encroached by vegetation

(Swenk 1933, USFWS 1987b). Recent increases in use by whooping cranes indicate that the Platte River would probably receive more use if higher flows and habitat enhancement continues, and if suitable flow regimes can be provided and maintained (USFWS 1987b).

LOSS OF PLATTE RIVER HABITATS

The cumulative decrease in total area of sandbars and open water in the Platte River coincides with decreased stream flows (Currier et al. 1985). An estimated 70% of the pre-1930 mean annual flow has been lost (USFWS 1981). In the reach just above the critical habitat (e.g., Cozad and Brady), the stream flows have been reduced by 65 to 85%; this area is now unsuitable for roosting by both whooping and sandhill cranes. Although potentially suitable feeding areas still exist in the farmlands next to this reach of the Platte River, crane use is nonexistent because the continued loss of roosting habitat reduces the use of available feeding habitat as well.

River channel habitat in the Overton area, a key sandhill crane staging site (Frith and Faanes 1982) and an area used by whooping cranes has deteriorated and several reaches have been abandoned by sandhill cranes (Currier et al. 1985). In 1938, about 24,700 acres of open channel and barren sandbars existed between the Johnson 2 (J-2) power plant return (near Overton) and

Chapman. In 1969, only about 11,100 acres remained, a loss of about 55% during 31 years (Currier et al. 1985). Riparian vegetation has replaced these habitats.

The present channel from the confluence of the North and South Platte Rivers to just above Overton is only about 200 to 600 feet wide, a 90% reduction in area since the 1930's. The width of the downstream reach from Overton to Grand Island increases to about 1,200 feet, probably as a result of the J-2 return flow which enters the river about 7 miles upstream from Overton. Nonetheless, if losses in open channel and barren sandbars continue, further reductions in the available roosting habitat will occur also.

The river channel has been reduced in width due to reduction in peak flows (USFWS 1987b). Vegetation has not been scoured by peak flows, and has gained a foothold in that part of the former channel which no longer carries scouring flows. The banks and islands of the Platte River in the mid- to late 1800's, at least upstream from the vicinity of Grand Island, had little or no vegetation. Because of flow reductions, a great deal of vegetative encroachment has occurred in recent decades. Some of this vegetation, such as willows (Salix spp.) becomes established in 2-3 years (Currier 1982).

ROOSTING HABITAT FLOWS

USFWS (1981) suggested that a hiatus in the use of the Platte River and adjacent wetlands by whooping cranes occurred during the previous 30 years. Table 1 indicates no whooping cranes were observed on the Platte River between 1945 and 1965, and only 5 sightings occurred between 1966 and 1980. Even though the population of whooping cranes was lowest in 1941, we believe that use of the Platte River by whooping cranes is related more to availability of suitable habitat than to the number of individuals in the population.

During the period 1945 to 1965 when no whooping cranes were observed on the Platte, there were only 2 years (1947 and 1949) in which flows reached 8,000 cfs for 5 or more consecutive days at Grand Island. Since 1970, however, whooping crane use of the Platte has been more common (11 sightings in 8 years), and flows have been higher and more frequent (Table 2).

Empirical data suggest that reduced whooping crane use of the Platte River channel habitat may have resulted from reduced channel width, growth of wooded vegetation on islands and channel banks, and increased human activity. The concept that use of the Platte River by whooping cranes is related to deterioration of habitat conditions is crucial to understanding the potential effects of water depletion on the condition of Platte River habitats.

Since 1966, 16 confirmed sightings of 34 whooping cranes have occurred on the Platte River downstream from Overton; 11 of these confirmed sightings (16 whooping cranes) have occurred since 1 January 1980 (Table 1). One confirmed sighting on 19 April 1975, involving seven whooping cranes was the result of hazing nine whooping cranes from a Rainwater Basin area where there was a cholera threat: this sighting was not used in the following analysis. The sighting of five whooping cranes roosting on the Platte River on 20 April 1975, is a separate sighting unrelated to the hazing. For the purpose of this analysis, the standard of measure was the flow in the Platte River on the date that whooping cranes arrived on the river to roost. For example, two whooping cranes roosted in the river the night of 31 October 1974, and left the river on 1 November 1974. The best estimate of the flow at the time and place the whooping cranes selected their roosting site is 838 cfs which occurred on 31 October 1974 (Table 1) (USFWS 1987b).

The migrational use period by whooping cranes in spring is 25 March to 10 May, and the fall use period is 16 September to 15 November. Flows between 838 cfs and 5,150 cfs were present in the Platte River on the dates whooping cranes rested on the river (Table 1). If 90 percent is used as a threshold, (90 percent of the sightings occurred at flows no lower than 1,200 cfs), 1,200 cfs appears to be the minimum flow conducive to availability of

suitable roosting habitat. This figure is considered to be applicable to both the spring and fall migration period. However, the mean flow during all confirmed sightings was 2,683 cfs, fully 55% higher than the 1,200 cfs.

We believe that 2,000 cfs is the minimum roosting habitat flow based on: (1) existing conditions on the Platte, (2) the present population level of the species, (3) our knowledge of the species' requirements for migrational habitat, (4) our understanding of the past, present, and future importance of the Platte River to the whooping crane, and (5) our knowledge of the effects of flows and changes in flows on suitability and availability of whooping crane roosting habitat. A recent modelling effort (USFWS 1987b) suggests that 2,000 cfs may provide the optimum flow under existing conditions.

Active channel width is a function of annual peak flows which keep the alluvial bed mobile and scoured free of stabilizing vegetation. Permanent reductions in the annual peak flows of alluvial streams result in a reduction of width, particularly in wide, shallow, braided rivers such as the Platte River system. Reductions in active channel width allow vegetation to grow in the former channel zone. The encroachment is sometimes permanent. Three to five years of reduced flow levels apparently are sufficient to permit encroaching vegetation to become permanent (Currier 1982).

The present mean peak flow of about 8,000 cfs in the critical habitat area has been a key factor in the maintenance of the existing channel. Based on the historic duration of the peak flows, we recommend a minimum of 5 consecutive days over 8,000 cfs to maintain the channel configuration. Streambed degradation begins when peak flows decrease from 8,000 cfs to 5,000 cfs, although the concomitant bank degradation and rapid channel narrowing appears to be reduced.

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Table 1. Confirmed sightings of whooping cranes on the Platte River, the number of birds present, and the approximate in-stream flow during the sightings, 1912-1987.

Date	Approximate Location	Number of birds	Approximate flow (cubic feet/sec)
Spring 1912	Prosser	2	> 1,460
29 Mar 1919	Kearney	small flock	2,950
7 Oct 1920	Kearney	2	2,000
10 Oct 1920	Kearney	10	2,000
15 Oct 1970	Kearney	3	3,300
1-5 May 1922	Kearney	7	4,040-5,540
13 Apr 1924	Kearney	11	9,407
16 Oct 1924	Kearney	4	4,030
7 Apr 1925	Kearney	3	3,540

25 Oct 1925	Odessa	5	3,500
4 Apr 1926	Kearney	2	2,620
7 Apr 1926	Kearney	6	2,630
8 Apr 1926	Kearney	5	2,620
18 Apr 1926	Odessa	1	2,430
22 Sep 1928	Newark	?	500
24 Oct 1928	Newark	5	2,710
13 Oct 1929	Kearney	1	3,200
3 Apr 1930	Kearney	3	2,565
3 Apr 1930	Kearney	8	2,565
25 Oct 1931	Elm Creek	9	986
3 Apr 1931	Kearney	3	5,970
Apr 1934	Wood River	2	2,170

17 Apr 1939	Cozad	5	4,060
22 Oct 1942	Odessa	1	711
4 Apr 1943	Kearney	1	1,400
2 Apr 1944	Kearney	3	730
20-21 Oct 1966	Grand Island	5	1,200
31 Oct-1 Nov 1974	Gibbon	2	838
18 Apr 1975	Odessa	7	1,240
20 Apr 1975	Odessa	5	1,240
29 Mar 1977	Gibbon	1	1,560
17-18 Apr 1980	Gibbon	2	5,150-5,030
27-28 Oct 1983	Shelton	5	1,210
21 Oct 1985	Gibbon	3	1,700
5 Nov 1986	Kearney	3	2,750

21 Mar 1987	Gibbon	1*	3,870
7 Apr 1987	Gibbon	1*	3,670
8 Apr 1987	Gibbon	1*	3,280
9 Apr 1987	Gibbon	1*	3,070
10 Apr 1987	Gibbon	1*	2,840
11 Apr 1987	Gibbon	1*	2,500
22 Oct 1987	Gibbon	2	1,670

* same bird

Table 2. Relationship of scouring flows to whooping crane occurrence on the Platte River. Flow data from the Grand Island gage.

Year	# consecutive days flows >5,000 cfs	# consecutive days flows > 8,000 cfs	Peak daily flow	# Whooping cranes next year
1970	6	0	6,820	0
1971	57	38	11,500	0
1972	0	0	4,600	0
1973	54 (spring)	34 (spring)	17,700	0
	41 (fall)	6 (fall)	9,800	0
1974	49	0	7,640	2

1975	1	0	5,300	12
1976	0	0	3,940	0
1977	0	0	3,940	1
1978	8	5	10,500	0
1979	5	0	5,950	0
1980	41	27	12,600	2
1981	0	0	3,510	0
1982	0	0	3,400	0
1983	79	52	23,500	5

1984	159	44	15,000	0
1985	19	1	8,000	3
1986	- unavailable -			3
1987	- unavailable -			3