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Abstract: Periodic high flows in the Platte River are necessary to scour vegetation and redistribute sediment in the stream channel. Peak and mean annual flows have been reduced by as much as 70% from pre-development times, but 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 cfs for 5 or more consecutive days.

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The Platte River in Nebraska is an important and strategically located migrational area for whooping cranes where they roost nightly in shallow river channels (Allen 1952; U.S. Fish & Wildlife Service 1981; Lingle et al. 1984, 1986; Currier et al. 1985). Historic records suggest that prior to 1940 whooping crane use of the Platte River was no more frequent than currently. An important factor limiting contemporary use is degradation of the river channel and the subsequent encroachment of wooded vegetation. Currier et al. (1985) indicated that in 2 reaches of the Platte River about 97% of the suitable roost habitat has been altered or lost because of reduced flows in the river, and Williams (1978) reported that flows in the Platte were reduced by nearly 70% from pre-development times. A relationship clearly 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 Aransas-Wood Buffalo flock of whooping cranes commonly uses the Platte River during migration (Table 1). In spring, wet meadows provide whooping cranes with a food source essential for successful reproduction and resting and foraging habitat ensures that the birds arrive on the breeding grounds in a healthy condition. 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 (U.S. Fish & Wildlife Service 1986).

River channels that exhibit significant variation in depths are used most frequently for roosting (Lingle et al. 1984, 1986), selected on the basis of the security offered by the site(s) (Shenk & Armbruster 1986; U.S. Fish & Wildlife Service 1987a). Prior to 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 less encroached by vegetation (Swenk 1933; U.S. Fish & Wildlife Service 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 (U.S. Fish & Wildlife Service 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 (U.S. Fish & Wildlife Service 1981). In the reach just upstream from the critical habitat (e.g. Cozad to Brady), the stream flows have been reduced by 65 to 85%; this area is now unsuitable for roosting by both whooping cranes and sandhill cranes (*Grus canadensis*). Although potentially suitable feeding areas still exist in areas adjacent to this reach, crane use is nonexistent because the continued loss of roosting habitat re-

duces the use of available feeding habitat as well. River channel habitat in the Overton area, a key sandhill staging site (Frith & Faanes 1982) and an area also used by whooping cranes, has deteriorated and several reaches have been altogether abandoned by sandhill cranes (Currier et al. 1985). In 1938, about 10,000 ha of open channel and barren sandbars existed between the Johnson 2 (J-2) power plant return (near Overton) and Chapman. In 1969, only about 4,490 ha remained, a loss of about 55% over 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 61 to 183 m wide, a 90% reduction in area since the 1930's. The width of the downstream reach from Overton to Grand Island increases to about 365 m, probably as a result of the J-2 return flow which enters the river about 11 km 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 (U.S. Fish & Wildlife Service 1987b). Vegetation has therefore not been scoured by peak flows, gaining footholds 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. But because of flow reductions, a great deal of vegetative encroachment has occurred In recent decades. Some, such as willows (Salix spp.), can become well established in 2-3 years (Currier 1982).

ROOSTING HABITAT FLOWS

An apparent hiatus in the use of the Platte River and adjacent wetlands by whooping cranes occurred over the previous 30 years (Table 1) (U.S. Fish & Wildlife Service 1981). Although the whooping crane population was low during much of that period, we believe that use of the Platte River was 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). 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 (involving 34 whooping cranes) have occurred on the Platte River downstream from Overton 11 (16 total cranes) of which occurred since 1 January 1980 (Table 1). One, on 19 April 1975, involved 7 cranes which had been hazed from a Rainwater Basin area where there was a cholera threat. That sighting was therefore not included in our analysis.

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, 2 whooping cranes roosted in the river the night of 31 October 1974, and left 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 (Table 1) (U.S. Fish & Wildlife Service 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 occurred in the Platte River on the dates whooping cranes rested on the river (Table 1). If 90% is used as a threshold, (90% of the sightings occurred during flows no lower than 1,200 cfs), 1,200 cfs appears to be the minimum flow conducive to providing suitable roosting habitat and is considered to be applicable to both the spring and fall migration periods.

However, the mean flow during all confirmed sightings was 2,683 cfs, 55% higher than the 1,200 cfs. Therefore, we believe that 2,000 cfs should be regarded as the minimum roosting habitat flow. That conclusion is 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 modeling effort (U.S. Fish & Wildlife Service 1987b) suggests that 2,000 cfs may provide the optimum flow under existing conditions.

DISCUSSION

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, and the encroachment is sometimes permanent. Three to 5 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

Table 1. ***Continued***

Date	Approximate Location	Number of birds	Approximate flow (cubic feet/sec)
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 iver. Flow data from the Grand Island gage.

Year	# Consecutive days flows >5,000 cfs	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	(spring) 54 (fall) 41	(spring) 34 (fall) 6	17,700 9,800	0 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