PLATTE RIVER MANAGEMENT JOINT STUDY

BIOLOGY WORKGROUP

Final Report

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Denver, Colorado

CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

1. Background on Establishment of the Joint Study and the Workgroups.

On March 25, 1983, the Regional Directors of the Fish and Wildlife Service (Service) and Bureau of Reclamation (Bureau) agreed to establish the Platte River Management Joint Study (PRMJS). Working groups of the PRMJS are made up of Service, Bureau, and Corps of Engineers representatives, water development interests, representatives of Colorado, Nebraska, and Wyoming, and environmental groups (Table 1). The Workgroups are charged with developing a wildlife management plan for the Platte River ecosystem in central Nebraska. Objectives of the management plan will be developed in two phases. Phase 1 involves alternatives to remove the jeopardy opinion for the proposed Narrows Unit in Colorado, pursuant to the Endangered Species Act. Phase 2 of the study addresses the habitat needs of nonlisted migratory birds and resident species which use Platte River habitats. This report addresses issues associated with Phase 1 of the Joint Study.

The Secretary of the Interior was petitioned by water development interests in Colorado, Nebraska, and Wyoming in November 1984 to establish a joint State/Federal Platte River Coordinating Committee. The Committee was ultimately made up of the Regional Directors of the U.S. Fish and Wildlife Service and Bureau of Reclamation; Director, Nebraska Department of Water Resources; Executive Director, Colorado Department of Natural Resources; and an appointee of the Governor of Wyoming.

The Coordinating Committee adopted the following statement of purpose for Phase 1 of the Joint Study:

"The purpose of the parties involved in Phase 1 of the Platte River Management Joint Study is to cooperate in discussions seeking ways to develop and implement recovery plans and programs which will enable Federal agency actions associated with water project development and depletions in the Platte River basin to proceed in compliance with the Endangered Species Act while avoiding conflicts between the Endangered Species Act and state water rights systems and the use of water apportioned to a state pursuant to the compact and decrees concerning the waters of the Platte River and its tributaries."

The Coordinating Committee established a Steering Committee and three workgroups -- biology, hydrology, and management alternatives. Along with the State and Federal agencies, the water development interests and environmental groups were represented on the Steering Committee and the workgroups. The Coordinating Committee abolished the Steering Committee in February 1988.

Table 1. Organizations and agencies represented on the workgroups of the Platte River Management Joint Study

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FEDERAL

U.S. Fish and Wildlife Service (Biology, Hydrology, Alternatives)
U.S. Bureau of Reclamation (Biology, Hydrology, Alternatives)
U.S. Army Corps of Engineers (Biology, Hydrology, Alternatives)

STATE

Nebraska Game and Parks Commission (Biology)
Nebraska Department of Water Resources (Hydrology, Alternatives)
Nebraska Natural Resources Commission (Alternatives)

Wyoming Water Development Commission (Biology, Hydrology, Alternatives)
Wyoming State Engineer's Office (Alternatives)

Colorado Department of Natural Resources (Alternatives)
Colorado Division of Wildlife (Biology)
Colorado Water Conservation Board (Hydrology)

PRIVATE

Nebraska Water Resources Association (Biology, Hydrology, Alternatives)
Wyoming Water Development Association (Biology, Hydrology, Alternatives)
Colorado Water Congress (Biology, Hydrology, Alternatives)
Interstate Task Force on Endangered Species (Biology, Hydrology, Alternatives)
National Audubon Society (Biology, Hydrology, Alternatives)
National Wildlife Federation (Alternatives)
Platte River Conservation Caucus (Biology)
Platte River Whooping Crane Trust (Biology, Hydrology, Alternatives)

The Biology Workgroup first met in September 1985 and adopted the following statement of purpose:

> "Identify the conditions in the Platte River basin necessary for maintenance and recovery of the four endangered species, and the role of the Platte River Basin in the maintenance and recovery of the four species."

The four threatened (t), and endangered (e) species considered in the statement of purpose were the whooping crane (e), (Grus americanus), bald eagle (e), (Haliaeetus leucocephalus), interior least tern (e), (Sterna antillarum), and piping plover (t), (Charadrius melodus). Although the Eskimo curlew (Numenius borealis) and peregrine falcon (Falco peregrinus) are occasional migrants in the Platte River Valley, those two species are not being considered in the development of the Joint Study management plan. If additional information suggests that management plans are needed for the Eskimo curlew or peregrine falcon, those plans will be developed when appropriate. Species subsequently listed as endangered or threatened will also be included in the management plan.

The Biology Workgroup was originally assigned eight tasks to accomplish. The present report is the culmination of the efforts of the Biology Workgroup. Specific objectives of the Workgroup report are described later in the introduction.

2. Background on Habitat Use Among Threatened and Endangered Species on the Platte River.

The historic and current ranges of the whooping crane, interior least tern, bald eagle, and piping plover in Nebraska suggest that some portion of their populations use habitats on and adjacent to the Platte River during some stage of their life cycle. The whooping crane, least tern, and piping plover use broad expanses of largely unvegetated Platte River sandbars for roosting, nesting, or feeding. The whooping crane uses adjacent wet meadows as foraging sites. The least tern, piping plover, and bald eagle use various reaches of the river or its banks for roosting and foraging. Habitat needs of the forage fishes consumed by bald eagles and least terns, as well as the wet meadows used by whooping cranes, are also considered in the Joint Study management plan.

3. Need to Develop an Integrated Habitat Management Plan for Threatened and Endangered Species on the Platte River.

Endangered species using habitats in the Big Bend reach of the Platte River occur there throughout the year (Table 2). Each

Table 2. Occurrence periods for endangered and threatened species in the Platte River between Overton and Grand Island, Nebraska. Data from Johnsgard (1980).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bald eagle	XXXX	XXXX	XXXX	XXXX						XXXX	XXXX	XXXX
Whooping crane			XXXX	XXXX	XXXX	XXXX				XXXX	XXXX	
Piping plover					XXXX	XXXX	XXXX	XXXX				
Least tern					XXXX	XXXX	XXXX	XXXX				

species has its own habitat requirements. Habitat management designed to satisfy the needs of one of the endangered or threatened species could ultimately prove detrimental to another species. Development of an integrated habitat management plan for the Platte River will allow for the assessment of species' needs throughout the year as well as determining the most appropriate actions to take to satisfy those needs. This report will be part of the Joint Study's integrated management plan for federally listed species.

4. <u>Introductory Remarks on Species Modeling</u>.

Implementation of Habitat Suitability Index (HSI) models provide species habitat information useful in impact assessment and habitat management (Bovee 1982). Species models available when the Biology Workgroup was formed were generally inadequate to describe habitats occupied by endangered and threatened species on the Platte River. The principal inadequacy of each model examined was the lack of specificity in addressing habitat issues related to endangered species in alluvial systems such as the Platte River.

Another important inadequacy was the lack of consensus on those existing models that addressed alluvial systems.

A series of workshops was organized by the Grand Island Field Office of the Fish and Wildlife Service during 1986 - 1988 to develop habitat suitability criteria for endangered species and forage fishes that could be incorporated into HSI models. Results of the modeling efforts were used in the development of the habitat management options described in this report.

5. <u>Objectives of the Biology Report</u>.

The objectives of this report are to describe the methods and evaluation used to:

(1) select or develop species habitat models applicable to the Platte River system;

(2) define and apply habitat suitability criteria to species models;

(3) identify conflict among habitat needs and select seasonal criteria to be applied to models;

(4) establish habitat objectives and identify factors affecting habitat;

(5) identify and evaluate habitat management alternatives;

(6) select a preferred management plan which may include one or more alternatives, and;

(7) recommend a future research and monitoring program.

The Biology Workgroup and Hydrology Workgroup reports will be used by the Management Alternatives Workgroup in formulating a management plan for the Platte River system. The management plan will be submitted to the Coordinating Committee.

CHAPTER 2

BACKGROUND/HISTORY

1. Description of the Physical Setting of the Platte River.

The Platte River originates at the confluence of the North Platte and South Platte Rivers near the City of North Platte, Nebraska (Figure 1). From its source, the Platte River flows eastward and empties into the Missouri River near Omaha, Nebraska. Along this 500 km (310 mile) route, about 77,210 square km (29,800 sq. mi.) are drained by the Platte River and its major tributaries (USFWS 1981).

The South Platte River originates as snowmelt in central Colorado at about 3810 m (12,500 feet) above sea level (Fig. 1). From its source, the South Platte River flows southeastward, then northeastward, and, after crossing the Colorado-Nebraska border, flows almost due east to join the North Platte River near the City of North Platte, Nebraska. The South Platte River is about 730 km (450 miles) long and drains about 62,960 sq. km (24,300 sq. mi.) (USFWS 1981).

Also beginning as snowmelt, the North Platte River flows northward from northcentral Colorado into central Wyoming where it gradually bends to the southeast before joining the South Platte River (Fig. 1). From its source at about 3,350 m (11,000 feet) above sea level to its confluence with the South Platte River, the North Platte River traverses about 1,070 km (665 miles) and drains an area of 90,430 square km (34,900 square miles) (USFWS 1981).

2. Historic Use of Platte River by Endangered and Threatened Species.

Whooping Cranes

Whooping cranes in spring migration have been sighted in Nebraska during 15 March to 18 June (Swenk 1933, Faanes and Lingle 1988). Platte River sightings in spring extend from 15 March to 18 June (Table 3). Whooping cranes have been sighted in Nebraska during the fall migration from 22 September to 8 December (USFWS 1981; USFWS, unpubl. data). Platte River records in fall extended from 22 September to 5 November (Table 4). The Platte River data in Tables 3 & 4 are based on Allen (1952), USFWS 1986, the list of confirmed sightings maintained by USFWS, and NGPC, unpubl. data.

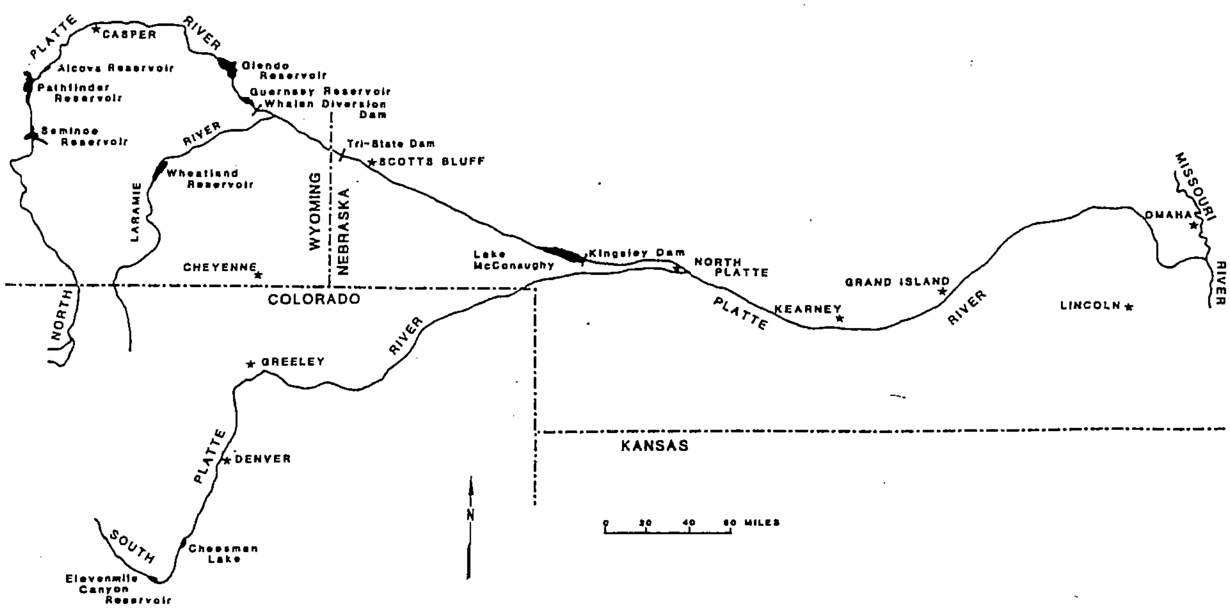


Figure 1. Geographic location of the Platte River ecosystem in Colorado, Nebraska, and Wyoming.

Table 3. Observations of whooping cranes on the Platte River in spring, 1912-1990.

Date	No. Birds	Location	County	Source
MARCH				
15/1918	6	Kearney	Buffalo	Swenk 1933
17-4/19/1987	1	Gibbon	Kearney	USFWS list
24/1988	2	Minden	Buffalo	USFWS list
24-4/2 1989	1	Wood River	Hall	USFWS list
26/1988	2	Odessa	Phelps	USFWS list
29/1919	1	Kearney	Buffalo	Swenk 1933
29/1977	1	Minden	Buffalo	USFWS list
APRIL				
1/1936	7	Cozad	Dawson	Brooking 1943
1/1948	5	North Platte	Lincoln	Allen 1952
1/1988	1	Wood River	Hall	USFWS list
2/1914	1	Newark	Kearney	
2/1944	3	Kearney	Buffalo	Brooking 1944
3/1930	8	Kearney	Buffalo	Swenk 1933
3/1930	3	Kearney	Buffalo	Swenk 1933
3/1931	3	Kearney	Buffalo	USFWS 1981
3/1934	3	Kearney	Buffalo	Brooking 1943
4/1926	2	Kearney	Buffalo	Swenk 1933
4/1943	1	Kearney	Buffalo	Brooking 1943
4/1988	1	Alda	Hall	USFWS
7/1925	3	Kearney	Buffalo	Swenk 1933
7/1926	6	Kearney	Buffalo	Allen 1952
7/1942	3	Lexington	Dawson	Brooking 1943
8/1926	5	Kearney	Buffalo	Swenk 1933
9/1942	3	Lexington	Dawson	
9/1985	2	N. Platte R.	Garden	USFWS
13/1924	11	Kearney	Buffalo	Allen 1952
14-15/1990	3	Minden	Buffalo	USFWS list
16-17/1989	1	Minden	Buffalo	USFWS list

Table 3 (continued).

Date	No. Birds	Location	County	Source
17/1939	5	Cozad	Dawson	Brooking 1943
17/1975	2	Kearney	Kearney	
17/1980	9	Platte River	Phelps	USFWS 1986
18/1926	1	Odessa	Buffalo	Swenk 1933
18/1975	7	Odessa	Buffalo	USFWS 1986
18/1980	2	Minden	Buffalo	USFWS
19/1947	5	North Platte	Lincoln	Ross Lock
19/1980	7	Platte River	Buffalo	USFWS
20/1975	5	Odessa	Phelps	USFWS list
MAY				
1/1922	7	Kearney	Buffalo	Swenk 1933
2/1934	2	Wood River	Hall	Brooking 1934
4/1950	1	Overton	Dawson	
22-24/1989	1	Oshkosh	Garden	USFWS list
"April" 1914 specimen (#13139)	1	Newark	Kearney	Hastings Museum
"May" 1934	2	Kearney	Buffalo	USFWS 1981
"May" 1936	1	Brady	Lincoln	Allen 1952
"Spring" 1912	1	Prosser	Hall	USFWS 1981

Total Occurrences = 43

Total Birds = 143

Table 4. Observations of whooping cranes on the Platte River in fall, 1907-1988.

Date	No. Birds	Location	County	Source
SEPTEMBER				
22/1928	1	Newark	Kearney	Swenk 1933
OCTOBER				
1/1933	1	Odessa	Buffalo	Black 1934
7/1920	2	Kearney	Buffalo	Allen 1952
10/1920	10	Kearney	Buffalo	Allen 1952
12/1929	1	Kearney	Buffalo	Swenk 1933
12/1985	4	Grand Island	Hall	USFWS
13/1929	1	Kearney	Buffalo	Swenk 1933
13/1949	2	North Platte R.	Garden	NGPC
13-14/1989	4	Wood River	Hall	USFWS list
15/1920	3	Kearney	Buffalo	Allen 1952
16/1924	4	Kearney	Buffalo	Allen 1952
18/1907	1	Grand Island	Hall	
19/1925	1	Kearney	Buffalo	Swenk 1933
20/1966	5	Phillips	Hamilton	USFWS 1986
21/1985	3	Minden	Buffalo	USFWS list
21/1987	2	Gibbon	Buffalo	USFWS list
22/1942	1	Odessa	Buffalo	Brooking 1943
24/1928	5	Newark	Kearney	Swenk 1933
25/1925	5	Overton	Dawson	Swenk 1933
25/1925	5	Odessa	Buffalo	Swenk 1933
25/1931	9	Elm Creek	Buffalo	Swenk 1933
27/1983	5	Shelton	Hall	USFWS list

Table 4. (Continued)

Date	No. Birds	Location	County	Source
31/1974	2	Platte River	Buffalo	USFWS 1986
<u>NOVEMBER</u>				
4/1989	2	Alda	Hall	USFWS list
5/1986	3	Kearney	Buffalo	USFWS list

Total Occurrences = 26

Total Birds = 84

The Whooping Crane Recovery Team established a list of confirmed sightings of whooping cranes that begins with observations in 1942 (USFWS 1986). Sightings which satisfy the necessary criteria are recorded on the confirmed sightings list which is updated by the USFWS at the end of each migration season. Sightings prior to 1940 cannot be confirmed according to the criteria described by USFWS (1986).

Allen (1952) reported occurrences of the whooping crane in North America including the Platte River from 1899 to 1949. The purpose of his work was to present known evidence of the geographical distribution of the species. Allen qualified his summary by indicating that:

> "no acceptable report has been consciously omitted. However, it is inevitable that some perfectly authentic records will not be found in the tabulations that follow. In addition to any that have been simply overlooked, many recent reports that are convincing in most respects have not been included because of lack of detail. This lack is chiefly in the description of the birds themselves, their manner of flight, etc. Reports that seemed weak on identification, or uncertain for other reasons, have been omitted, although some very old records are included on rather slim evidence, both because of their obvious historic value and because the presence of the species at the location in question appears logical with relation to time, place, and the general pattern of distribution."

Allen (1952) described 35 sightings of whooping cranes on or along the Platte River between 1912 and 1949. Some records by three observers were accepted and some records by those same observers were rejected by Allen. The distribution data may have been biased because of locations of field observers. Sightings prior to 1949 occurred from the South Platte River near North Platte, Nebraska, east to near Wood River. Sighting locations since 1949 have ranged from the North Platte River near Lewellen to just east of Grand Island. Sixteen specimens collected on or near the Platte River from 1884 - 1917 were also reported by Allen (1952). Specimens were collected from near Grand Island, Wood River, Prosser, Kearney, Overton, Newark, Elm Creek, Gothenburg, and Ogallala.

The number of whooping cranes in the Aransas-Wood Buffalo flock reached a low of 16 in 1941 (USFWS 1986). There has been a slow but steady increase in numbers in the last 47 years. By 1 January 1989, there were 150 whooping cranes known from the Aransas-Wood Buffalo flock (USFWS, unpubl. data).

Least Tern

Both the least tern and piping plover occupy similar habitat on the Platte River (Faanes 1983). The first recorded nesting of least terns on the Platte River system was in 1926 (Tout 1947). Least terns were found nesting in a colony on sandbars in the South Platte River near North Platte, Nebraska (Tout 1947). Observations made from 1926 through 1929 showed populations at this site were: 1926 - 34 adults (17 nests), 1928 - 36 adults (18 nests), and 1929 - 50 adults (22 nests). Least terns were also present in 1930, but a storm killed some adults and reduced the colony to about half its former size. No data are available from the Platte River from 1931 -1940.

The next recorded observation in the Platte River system was in 1941 when birds were found nesting on sandbars in the river near Columbus (Shoemaker 1941). Ten and possibly more nests suggest that the colony size was at minimum 20 adults. A single nest, and then young, was found at Merritt's Beach swimming lake, northwest of Plattsmouth in 1943 (Heineman 1944). Six pairs of least terns were found nesting on a sandbar in the South Platte River in 1948 two miles east of Brule, Keith County (Benckeser 1948). Nesting was recorded again on the South Platte River in the vicinity of North Platte in 1949 (**Aud Field Notes** 3:244).

The longest field study of least terns on the Platte River was conducted for 17 years (1944 - 1960) south of Lexington (Wycoff 1960). The nesting area was a low sandbar not over 75 feet wide and about 200 feet long. The highest number of nesting least terns reported by Wycoff (1960) from this location ranged from 2 individuals in 1952 to 35 individuals in 1949.

Downing (1980) conducted an aerial survey of least tern use of the Platte River in 1975. A population of 150 least terns was estimated from the 80 birds Downing observed (Table 5). Following Downing's initial survey in 1975, partial surveys were conducted along two different segments of the river in 1979 and 1981 (Table 5). Surveys of interior least terns on the Platte River have been conducted annually since 1982 by the Nebraska Game and Parks Commission (NGPC) and the Platte River Whooping Crane Trust.

Survey coverage and effort has varied annually. Both aerial and ground surveys were made along the Platte River from North Platte, Nebraska, downstream to Plattsmouth, Nebraska in 1982 and 1983. Because of the high flows in 1983, survey effort was expanded to include 21 sandpits adjacent to the Platte River; four sandpits were surveyed in 1982. Although the census effort varied between years during 1983 through 1988, area coverage remained relatively constant.

Table 5. Interior least tern breeding populations along the Platte River 1975-1988

		1975	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plattsmouth to Columbus (110 RM)	-R	UNK	NS	NS	65	40	0	0	107	214	305	365	353
	-P	UNK	NS	NS	NS	38	179	188-194	35	90	115	132	64
Columbus to Grand Island (70 RM)	-P	UNK	NS	NS	NS	22	0	0	0	0	0	0	0
	-P	UNK	NS	NS	NS	24	28	12	16	20	31	36	27
Grand Island to Lexington (80 RM)	-R	UNK	34	NS	NS	38	0	0 a/	40 b/	20	22	14	10
	-P	UNK	4	NS	NS	NS	39	26-30	58	78	118	73	116
Lexington to North Platte (60 RM)	-R	UNK	NS	NS	NS	NS	0	0	0	0	0	0	0
	-P	UNK	NS	NS	NS	NS	0	0	0	16	7	15	19
Total		80/150	38		65	162	246	226-236	256	438	598	635	589
No. Birds Observed (% total)--River		UNK	34 (89%)	NS	65	100 (62%)	0 (0%)	0 (0%)	147 (57%)	234 (53%)	327 (55%)	379 (60%)	363 (62%)
No. Birds Observed (38%) (% total)--Sandpits		UNK	4 (11%)	NS	NS	62 (38%)	246 (100%)	226-236 (100%)	109 (43%)	204 (47%)	271 (45%)	256 (40%)	226 (38%)

No. Colonies-All Habitat	UNK	4		4	13	a/ 18	b/ 12	25	24	53	53	63
No. Colonies-River	UNK	2 (50%)	NS	4	9 (69%)	0 (0%)	0 (0%)	15 (60%)	9 (38%)	31 (58%)	30 (57%)	42 (67%)
No. Colonies-Sandpits	UNK	2 (50%)	NS	NS	4 (31%)	18 (100%)	12 (100%)	10 (40%)	15 (62%)	22 (42%)	23 (43%)	21 (33%)
Mean Adult Terns/Colony-All Habitat	UNK	9.5	NS	16.3	12.5	13.7	18.8-19.7	10.2	18.3	11.3	12.0	9.3
Adult Terns/Colony-River	UNK	17.0		16.3	11.1	0	0	9.8	26.0	10.5	12.6	8.6
Adult Terns/Colony-Sandpits	UNK	2.0		NS	15.5	13.7	18.8-19.7	10.9	13.6	12.3	11.1	10.8

Notes: RM = river miles
R = river
P = sandpits
UNK = not surveyed

a/ One colony of 6 birds was observed on the river in late summer of 1984 and may have been a renesting effort. This colony and the birds associated with it were not included in totals to avoid possible duplication.

b/ Two additional colonies of 14 and 8 birds, respectively, were observed on the river in late summer of 1985 and may have been renesting efforts. These colonies and the birds associated with them were not included in totals to avoid possible duplication.

Piping Plover

Data on the number of piping plovers nesting on the Platte River prior to 1947 is scant. Tout (1947) reported piping plovers in the North Platte and South Platte Rivers in Lincoln County during 7 April (1929) to 16 September (1936). Piping plover was found at the time of Tout "on sandbars in the bed of the Platte and its north and south forks where it nests with the least tern." Tout (1947) provided anecdotal inferences of nesting but had little actual data. He found several dead piping plovers on sandbars in the South Platte River on 17 June 1933, but no nests or young were mentioned.

Census results for piping plovers from 1979 through 1988 are shown in Table 6. Only portions of the Platte River were surveyed in 1979-1983 (Faanes 1983, NGPC unpubl data, Platte River Trust, unpubl. data). From 1984 through 1988, the number of colonies surveyed remained about the same (NGPC, unpubl data; PRWCT, unpubl. data). The number of individual piping plovers observed on and adjacent to the Platte River ranged from 46 in 1981 to 164 in 1986.

A recent analysis of Nebraska Game and Parks Commission data (EA Associates 1988) suggests that populations of least terns and piping plovers are increasing in the Platte River system. In the Central Platte River area, Lingle (1988) reported that return rates among color-marked young of the year for both species are below those for other areas indicating poor survival. Lingle (1988) also stated that the Central Platte River population of least tern and piping plover is characterized by a low return rate among breeding individuals.

Bald Eagle

In Nebraska, bald eagles once bred regularly (1870's and 1880's) along the Missouri River and along Indian Creek in Gage County, on the eastern edge of the State (Rapp et al. 1958, Johnsgard 1980). Townsend (1839) recorded a nest on the North Platte River near Ash Hollow on May 25, 1834. Although the bald eagle is not known to nest regularly in the State today, it is a common migrant and winter resident. Nests were constructed and tended at Lewis and Clark Lake on the Missouri River in the 1970's, and near Oshkosh, Garden County, in 1987 and 1988. No eggs were laid at either site. Between Lewellen and North Platte on the North Platte River, and between North Platte and Gibbon on the Platte River, about 150 to 250 bald eagles winter each year (USFWS 1981). Lingle and Krapu (1986) recorded 136 bald eagles on January 21, 1980 within a 5-mile stretch of the Platte River near Overton. The area was adjacent to Jeffrey's Island, just downstream of the Johnson power plant river return of the Tri-County Canal.

Table 6. Summary of piping plover breeding populations on the Platte River, 1979-1989.

		1979	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plattsmouth to Columbus (110 RM)	-R	NS	46	NC	NC	0	0	44	84	131	161
	-P	NS	NS	NC	NC	48	24	26	33	30	24
Columbus to Grand Island (70 RM)	-R	NS	NS	NC	NC	0	0	0	0	0	0
	-P	NS	NS	NC	NC	6	5	4	7	12	7
Grand Island to Lexington (80 RM)	-R	80	NS	NS	NC	0	24	38	2	3	32
	-P	0	NS	NC	NC	8	4	48	78	41	58
Lexington to North Platte (60 RM)	-R	NS	NS	NS	NC	0	0	0	0	2	0
	-P	NS	NS	NS	NC	0	0	6	0	0	0
Total		80	46			62	68	164	204	219	282
No. Birds (% total) - River		80 (100%)	46			0	33 (49%)	82 (50%)	86 (42%)	136 (62%)	193 (68%)
No. Birds (% total) - Sandpits		0 (0%)	NS			62 (100%)	35 (51%)	82 (50%)	118 (58%)	83 (38%)	89 (32%)
No. Colonies Located-All Habitat		4	4	4	9	12	13	28	48	55	64
No. Colonies - River		4 (100%)	4	2 (50%)	0	0	7 (54%)	11 (39%)	26 (54%)	30 (55%)	44 (69%)
No. Colonies - Sandpits		0	NS	2 (50%)	9 (100%)	12 (100%)	6 (46%)	17 (46%)	22 (46%)	25 (45%)	20 (31%)

Mean Adult Plovers/ Colony - All Habitat	20	11.5	--	--	5.2	5.2	5.8	4.3	4.0	4.4
Adult Plovers/ Colony - River	20	11.5	--	--	--	4.7	7.5	3.3	4.5	4.4
Adult Plovers/ Colony - Sandbars	--	NS	--	--	5.2	5.8	4.8	5.4	3.3	4.5

<u>Notes:</u> RM = river miles; R = river; P = sandpits; NS = not surveyed; NC = not censused, piping plover adults and/or nests were noted in association with least tern colonies, but population size was not reported.

Midwinter survey efforts have demonstrated recent use of the Platte River by bald eagles (Table 7). Wintering bald eagles are found in the largest numbers near Lewellen and Overton along the Platte and North Platte Rivers (USFWS 1981, NGPC unpubl. data). Ice cover on the Platte River begins to decline with warming temperatures in late February and early March. Additional migrant bald eagles begin to arrive on the river during the spring thaw, and then disburse according to the distribution of open-water areas on the river. The bulk of the wintering population has departed by mid-April; the latest date is 12 May (Johnsgard 1980). The earliest arrival date in fall is 16 September (Johnsgard 1980). Eleven bald eagle nocturnal roost sites were located on the central Platte River in 1978 - 1979 (USFWS 1981). Although the roosts were scattered throughout the stretch of the river from Lewellen to Kearney, three major roosts occurred in the immediate vicinity of Overton. Censuses of bald eagle use have been made annually at 12 roosts since 1980 (NGPC, unpubl. data).

Ground and aerial surveys of bald eagles were conducted during January - April 1988 between Lake McConaughy and Overton, Nebraska. The surveys included the Platte and North Platte Rivers as well as associated supply canals and storage reservoirs. Areas supporting the highest number of bald eagles included the reach from Johnson Lake to 4 miles below the J-2 river return including the supply canal and 2 power plants (105 on 1 March), and near Sutherland Reservoir (154 on 15 February).

Along the Platte River, nocturnal roosts consist primarily of large eastern cottonwoods which offer protection from the wind and other weather factors. The same nocturnal roosts are apparently used yearly, as was the case with 11 roosts monitored during the winters of 1978-79 and 1979-80. Roost site tenacity, however, diminishes as ice on the river thaws in early spring and additional migrating eagles begin to arrive on the Platte River (Lingle and Krapu 1986, NGPC, unpubl. data).

3. Changes Over Time in Platte River Conditions.

Changes in the areal extent of Platte River system habitats since pre-settlement times (pre 1840's) are quantified in Table 8. The two habitat components that have been reduced the most are 1) open, unvegetated river channel, and 2) the grassland complex (Currier et al. 1985).

A. Aquatic Habitat

On the average, 67% of the water-carrying channel area has been lost in the Big Bend reach (Currier et al. 1985). The abandoned channel area has been converted to brushland and forest in many areas. Channel losses along the Platte River range from 58% near

Table 7. Midwinter bald eagle counts by river segment, 1982-1988 (January counts of adults and immatures).

	1982	1983	1984	1985	1986	1987	1988
North Platte River							
Wyoming Line-Bayard*	5	10	19	7	30	16	8
Bayard-Lisco	3	2	6	3	10	7	4
Lisco-Lewellen	27	12	11	35	35	32	26
Lewellen-Keystone (Lake McConaughy)	48	25	6	40	28	52	25
Keystone-Sutherland	3	8	19	32	14	16	5
Sutherland-North Platte	0	0	0	0	0	5	0
South Platte River							
Colorado Line-North Platte	2	3	2	3	1	30	3
Platte River							
North Platte-Gothenburg	5	9	13	31	50	33	18
Gothenburg-Darr	2	12	5	10	15	8	5
Darr-Elm Creek (Johnson & Elwood Lakes)	24	83	64	71	46	85	104
Elm Creek-Kearney	4	3	8	11	15	23	13
Kearney-Grand Island	7	4	34	12	17	20	11
Grand Island-Silver Creek	0	0	6	5	2	15	14
Silver Creek-Columbus	0	1	5	2	0	1	4
Columbus-Ashland	16	9	23	12	20	33	29
Ashland-Plattsmouth	--	2	2	5	4	1	4
Total	145	183	223	279	287	377	273

Table 8. Percentage of acres in open channel, riverine grassland, and cropland habitat in 14 bridge segments. The change in the availability of open channel and grassland since pre-settlement times is indicated in the columns labeled % loss. Averages for the Big Bend (segments 1-11) and the North Platte (segments 12-14) are shown below each column.

			% CHANNEL				% UPLAND			
			Channel loss = % woody / % total x 100; channel beach/bar herbaceous				Grassland loss = % cropland + % development divided by % total + $ development x 100			
							Grassland complex		Upland Woods shrubs open water	
Segment	Acres	% Development	Total	Open	Woody	Loss	Total	Grass	Crop	Loss
1	58,374	7.8	10.2	3.9	6.3	61.7	82.0	22.4	59.6	75.0
2	36,215	11.0	7.1	2.8	4.3	60.6	83.3	18.4	64.9	80.0
3	35,926	12.2	6.7	2.8	3.9	58.2	81.2	27.4	53.8	70.6
4	25,454	4.8	7.4	3.0	4.4	59.5	87.7	27.1	60.6	70.7
5	41,872	4.6	7.8	2.5	5.3	67.9	87.5	18.6	68.9	79.8
6	28,180	5.1	8.4	2.9	5.5	65.5	86.4	17.9	68.5	80.4
7	29,700	4.6	9.0	2.7	6.3	70.0	86.4	27.9	58.5	69.3
8	35,005	11.4	9.3	2.9	6.4	68.8	79.5	20.4	59.1	77.6
9	42,407	8.7	10.3	2.6	7.7	74.8	81.1	39.2	41.9	56.3
10	29,928	5.1	12.3	2.4	9.9	80.5	82.6	33.2	49.4	62.1
11	54,637	5.6	12.6	3.4	9.2	73.0	81.9	27.8	54.1	68.2
Mean	417,698	7.4	9.2	2.9	6.3	67.3	83.6	25.5	58.1	71.8
12	75,892	14.0	6.8	1.5	5.3	77.9	79.1	58.8	20.3	36.8
13	38,967	3.6	6.0	1.9	4.1	68.3	90.3	63.7	26.6	32.2
14	63,910	2.5	4.9	2.2	2.7	55.1	92.5	71.5	21.0	24.7
Mean	178,769	6.7	5.9	1.9	4.1	67.1	87.3	64.7	22.0	31.2

Mormon Island to 80% near Elm Creek. Losses have been greater in some individual segments of the river. In a 2-mile segment near Odessa, 87% of the channel area has been converted to woody vegetation. Along the North Platte River, channel losses have not been as extensive as on the Platte River. On the North Platte River, losses range from 55% near Lewellen to 78% near North Platte.

The areal extent of river channel loss is substantial. Within the 80.5 miles of the Big Bend of the Platte River, 26,000 acres of river channel have been converted to other uses; an additional 8,000 acres of river channel on 28 miles of the North Platte River have been converted to other uses. The average loss is 285 to 320 acres per mile of river channel in the Big Bend reach.

B. The Grassland Complex

The vegetative community referred to as the Grassland Complex historically extended beyond the current high bank of the river channel. The Platte River Whooping Crane Trust analyzed the probable changes in the areal extent of the grassland complex vegetation based on the present area of cover types and the assumption that cropland and most trees did not exist in pre-settlement times within the river channel.

Losses of wet meadows (grasslands in the historic high banks of the river), sandhills prairie, alfalfa and emergent wetlands on lands within 3.5 miles of the river channel have been substantial. In the Big Bend of the Platte River grassland losses have ranged from 56% near Odessa to about 80% near Grand Island and Shelton. The average loss of the grassland complex in the Big Bend reach within 3.5 miles of the river channel has been estimated at 72% (Currier et al. 1985).

Losses of the wet meadow complex along the North Platte River have been considerably less than on the Platte River, ranging from 25% near Lewellen to 37% near North Platte. An average of 31% of the grassland have been converted to other uses along the North Platte River (Table 8).

Much of the remaining native grasslands are of marginal value to endangered species and other migratory birds because they are located in small, disjunct tracts within the Platte and North Platte River valleys. In the Big Bend region over 80% of the grassland complex (about 2000 tracts) are less than 50 acres in size (Currier et al. 1985). Small tracts of grassland make up 22% of the grassland area in the Big Bend, but their mean size is 9 acres. About 40% of the grassland area in the Big Bend is concentrated in a few relatively large tracts of 300 acres or more (mean = 546 acres). For many bird species the smallest grassland tracts (0-50 acres) do not provide suitable habitat no matter how many are available. Human disturbance in the form of roads, utility lines and other development makes the perimeter of grassland marginal habitat although the vegetation appears suitable (Currier et al. 1985). In smaller tracts of grassland, a larger amount of the habitat is lost to the disturbance buffer than in larger tracts. The impact of these habitat changes on the endangered species and their habitats is described elsewhere in this report.

In summary, the Platte River has undergone the following major changes since pre-settlement times (from Currier et al. 1985):

(1) 65 to 79% reduction in channel width in the Big Bend reach of the Platte River and a corresponding increase in encroachment of the channel by wooded vegetation;

(2) 58 to 87% reduction in the areal extent of the Platte River channel as a result of woody vegetation encroachment;

(3) 73% loss of the grassland complex within 3.5 miles of the Platte River;

(4) Extensive irrigation, ditching, and drainage of lands adjacent to the Platte River channel.

C. Current influences in and adjacent to the Platte River.

1. Least Tern and Piping Plover

Water Fluctuations - During 1975-1988, flows that caused nests to be inundated were observed on the Platte River during 7 of the 10 years that least tern and piping plover nesting surveys were conducted (1975, 1979, 1981-88). Inundation after nest establishment accounted for 74% of the eggs lost at sandbar nesting colonies in 1986 (Table 9). Drowning of chicks and nest destruction were observed or suspected at 7 of the 9 sandbar sites used for nesting (NGPC 1986). Based on survey efforts in the Grand Island to Lexington reach in 1979, Faanes (1983) reported that all known least tern and piping plover nests in the river channel were inundated by rising water. Flow data recorded at the Grand Island gage indicate that mean daily flow increased from 1810 cfs on 20 June 1979 to 3,000 cfs on 21 June 1979, the date when all nests in the central Platte River reach were inundated (Faanes 1983). Flows on 21 May 1979 when the first nests were observed was 911 cfs at Grand Island (Faanes 1983).

Nesting by least terns and piping plovers during 1988 was initiated on sandpits in the Big Bend reach during late May when

Table 9. Causes of egg loss at least tern colonies along the Platte River, 1984 and 1986.

	1984	1986	
	12 Sandpit Colonies	10 Sandpit Colonies	6 Sandbar Colonies
# Eggs laid	319	282	392
# Eggs with known outcome	275 (86%)	18 (66%)	317 (81%)
# Eggs hatched	109 (34%)	68 (24%)	187 (48%)
# Eggs lost	166 (52%)	119 (42%)	130 (33%)
Causes of Egg Loss			
Lost to predation	17 (10%)	14 (12%)	11 (8%)
Lost to human disturbance	28 (17%)	8 (7%)	0 (0%)
Lost to abandonment for undetermined reasons	96 (58%)	11 (9%)	18 (14%)
Lost to flooding	0 (0%)	9 (7%)	96 (74%)
Lost to other factors (weather, unknown causes, etc.)	25 (15%)	77 (65%)	5 (4%)
Total Eggs Lost	166	119	130

the river stage precluded emergence of suitable sandbars for nesting. By late June, river stage was lowered causing sandbars to be exposed and least terns initiated nesting. Heavy rains fell on 30 June and in concert with irrigation flows placed back in the channel caused the river stage to rise dramatically (Table 10). Flows during late June and early July at Overton, Nebraska, ranged from 111 cfs on 27 June to 3,881 cfs on 1 July. Flows at Odessa, Nebraska, ranged from 11 cfs on 29 June to 2,600 cfs on 2 July. Flows at Grand Island ranged from 99 cfs on 28 June to 2,510 cfs on 4 July (USGS, unpubl. data). All known nests in the Big Bend reach of the river channel were inundated from rising water by 4 July.

Downing (1980) similarly reported that the Platte River breeding population was affected by high flows during a survey conducted in late June 1975. The minimum flow for any day during the summer prior to Downing's survey was 280 cfs at Overton, 388 cfs at Grand Island and 482 cfs at Duncan (USFWS 1987a). U.S Geological Survey records indicate a flow of 323 cfs at Grand Island in 1984 at the time human disturbance of a colony near Alda occurred. Recreational disturbance of a nesting colony near Alda on 6 or 7 July and 20 or 21 July 1985 resulted in direct mortality of young. Grand Island gage records of flows on those dates were 633, 564, 636 and 715 cfs respectively (USFWS 1987a). All-terrain vehicle use of the Platte River channel at Grand Island was also observed by USFWS and Bureau personnel on 25 July 1986; U.S. Geological Survey data indicate a flow of 601 cfs at the Grand Island gauge on that day.

Downing's (1980) observations appear to be consistent with USGS gaging records which reflect a sudden rise in flows at that time (950 cfs on 16 June 1975; 5300 cfs on 23 June 1975). Low flows are known to allow increased access to the river channel by recreationists (NGPC unpubl. data). Low flows and high water temperatures can result in the death of forage fish consumed by least terns as occurred in June 1988 (USFWS, unpubl. data).

<u>Human Disturbance</u> - Human activities near least tern and piping plover nesting areas can pose a regular threat to breeding success (Sidle et. al. 1988). Human disturbance may prevent use of an otherwise suitable site, or cause nest abandonment or direct mortality of eggs and young. NGPC (1982) reported that open riverine sandbars are used for summer recreational activities such as picnicking, sunbathing, fireworks displays, driftwood collection and other activities. Downing (1980) observed vehicle tracks on most emerged sandbars in the Platte River in 1975. Ducey (1981) similarly reported human activities near most riverine colonies surveyed, including swimming, campfires, wading, hiking on sandbars, as well as vehicular use. Heavy vehicular use at one site apparently caused adult least terns to abandon their nests.

Table 10. Flow changes (in cfs) at three stream gaging stations in the Big Bend reach of the Platte River during late June and early July 1988. U.S. Geol. Surv., unpubl. data.

Date	Gaging Station		
	Overton	Odessa	Grand Island
27 June	111	15	111
28 June	118	15	99
29 June	120	11	161
30 June	939	65	376
1 July	3881	918	447
2 July	2858	2600	414
3 July	2355	2191	1936
4 July	1502	1610	2510
5 July	999	834	2256
6 July	613	549	1652

Although human disturbance at a nesting colony may be a problem one year and not the next, the frequency of disturbance at riverine sandbars may be greater at locations where bridge crossings or nearby roads provide access to the river channel. Least terns nested successfully at river sandbars near the Two Rivers State Recreation Area in 1982 but not in 1981 (Ducey 1982). Human use such as wading, hiking, and vehicular disturbance were apparent at this site in 1981. Least tern colonies at sandpits adjacent to the Platte River are also subject to human disturbance (NGPC 1982-1988) (Table 9).

Predation - Least tern and piping plover nesting colonies in the Platte River are subject to predation. (NGPC 1982, 1983; Ducey 1982). Sandpit colonies are not typically surrounded by water and thus allow easier access for terrestrial predators. Recent data suggest similar levels of known loss to predation at sandpit and sandbar nesting colonies (Table 9). Water barriers do not always protect nesting colonies from predators. Observed or suspected predators of least tern and piping plover eggs and young include snakes, turtles, great blue heron (**Ardea herodias**), great horned owls (**Bubo virginianus**), red-winged blackbird (Agelaius phoenicus), American kestrel (**Falco sparvarius**), raccoon (Procyon lotor), skunks (**Mephitis sp.**), dogs, and coyotes (Canis latrans) (NGPC 1982 - 1988).

2. Whooping Crane

Water Fluctuations - Whooping cranes have been recorded in the Platte River at discharges ranging from 700 - 4000 cfs. Suitable sandbars are present in the river at varying discharges allowing whooping cranes to use the river for roosting. During flows of 6,240 to 7,920 cfs (X=7,051 cfs) in March 1984 (USGS 1984), some sandhill cranes in the Big Bend reach were observed roosting in flooded fields adjacent to the river as well as in the river channel. Some speculation exists as to whether there was increased availability of roosting habitat provided by flooded fields or whether portions of the river channel became unusable because of physical flow parameters. We do not know if whooping cranes would respond similarly.

Human Disturbance - Most of the water-based recreational activities that pose disturbance problems for nesting least terns and piping plovers are not present during the period of whooping crane migration. Residential and commercial development, roads, bridges, and railroads are potential disturbance factors near roosting habitat (USFWS 1981, Johnson 1981, Currier et al. 1985). The presence of houses can also increase opportunities for human activity and domestic animal disturbance near roosting areas.

Overhead lines and fences are known sources of mortality among migrating whooping cranes (Lingle 1987, USFWS 1986, Faanes and Johnson, in press). Thirteen instances of known whooping crane mortality through 1985 resulted from collisions with power lines (USFWS 1986). Five of the 13 collisions involved birds in the Aransas-Wood Buffalo flock. None of the mortality occurred on the Platte River. Power lines located near whooping crane roost sites and those bisecting the flight lanes between roosts and feeding areas are of major concern (Faanes 1987, Faanes and Johnson, in press). In the Big Bend reach of the Platte River, there are numerous power lines and telephone lines crossing the river and adjacent to the channel.

update

Shooting is a known source of whooping crane mortality. Lingle (1987) reported that one of six known instances of mortality among whooping cranes in the Aransas-Wood Buffalo flock during 1965-1984 was the result of gunshot wounds. This mortality occurred on the winter grounds. Various State and Federal resource agencies have developed a cooperative contingency plan that provides for the protection of whooping cranes including area closures during the waterfowl hunting season (USFWS 1986). In Nebraska, the Service and Nebraska Game and Parks Commission provide further protection through nearly continuous surveillance of whooping cranes during the day.

Disease - Waterfowl mortality from avian cholera in the Rainwater Basin and Platte River has occurred almost annually since 1975, and has resulted in the death of an estimated 200,000 ducks and geese (NGPC, unpubl data) based on 83,344 dead birds actually recovered in the field. The most severe outbreak occurred in 1980 when an estimated 90,000 dead birds were recorded (NGPC, unpubl. data). Estimations are based on the professional judgment of current conditions at each affected wetland including the difficulty in recovering dead birds (R. Gersib, pers. comm.). USFWS (1981) reported that avian cholera is now established in the waterfowl and American crow (Corvus brachyrhynchos) populations which use the Platte River and Rainwater Basin. Experience with avian cholera in waterfowl elsewhere (Jensen and Williams 1964, Korschgen et al. 1978, Locke et al. 1970) indicates that after a pattern of outbreaks has been established, the disease can be expected to recur.

Kauffeld (1987) and others have established the susceptibility of sandhill cranes to avian cholera. Two instances (1977 and 1981) of mortality among sandhill cranes from avian cholera were reported from the Platte River by Windingstad (1988); a third instance was confirmed during March 1988 (C.A. Faanes, unpubl. data). Snyder et al. (1987) reported the first confirmed mortality from avian cholera infection among whooping cranes. This mortality occurred in the San Luis Valley of Colorado. There have been no known instances of mortality among whooping cranes from avian cholera in the Aransas-Wood Buffalo flock. The presence of the disease among waterfowl suggests indicates that the risk to whooping cranes may increase substantially because they use much the same habitat in southcentral Nebraska.

A single case of avian tuberculosis was diagnosed with the isolation of Mycobacterium avium from the liver of a sandhill crane found on the Platte River near Overton, Nebraska, in April 1978 (Windingstad 1988). A secondary pneumonic fungal infection by Aspergillus fumigatus was also present in this sandhill crane. Avian tuberculosis was diagnosed in one whooping crane in the experimental Grays Lake flock (J.C. Lewis, pers. comm). There have been no known instances of avian tuberculosis in the Aransas-Wood Buffalo flock.

Predators - There are no known instances of whooping crane loss to terrestrial predators (USFWS 1986) while on migration. Timber wolves (Canis lupus) are known to prey on whooping cranes on the breeding grounds in the Canadian Northwest Territories (USFWS 1986).

3. Bald Eagle

High water flows, human disturbance, and predation have not been reported as a problem for bald eagles in the Platte River system. Among these three factors, human disturbance poses the largest potential threat to bald eagles. Potential problems include private and commercial developments, and activities near winter roost sites, gunshot wounds, and contact with overhead wires (either collisions or electrocution). Bald eagles tend to concentrate around areas of open water (USFWS 1981). Ice formation on the Platte River influences the distribution of wintering bald eagles (NGPC, unpubl. data). The presence of ice can influence the abundance and distribution of potential prey items (USFWS 1981).

4. Forage Fish

Habitat suitability index curves for forage fish in the Platte River show the river's contemporary suitability for sand shiners. These curves do not address whether the current conditions in the river are optimal for sand shiners, but rather which habitats the fish find most suitable today. The curves are useful in addressing how habitat suitability in terms of depth, velocity, substrate, and cover could change.

Potential effects of temperature and water quality on forage fish in the Platte River have not been investigated for present conditions, past conditions, or potential future conditions. Chemicals used by agriculture have increased over time to the point that concerns have been raised about contamination of municipal groundwater wells along the Platte River (Snow and

Spalding 1987). Although information on toxicity of these chemicals to Platte River forage fish (or closely related species) is available, these data have not been investigated for biological significance to the Platte River ecosystem.

High water temperatures decrease solubility of dissolved oxygen and decrease its availability to forage fish. Elevated temperatures act directly on the fish, increasing metabolism, respiration, and oxygen consumption. There is a maximum temperature which a fish species can tolerate, regardless of the other effects of increased temperature in the stream. Information on lethal temperatures of Platte River forage fish species (Carlander 1969) suggests that several of the species found have thermal tolerances less than temperatures measured in the Platte River.

The phenomena which cause elevated summer temperatures in the Platte River are air temperature and solar radiation, and probably the stage of the river and cross-sectional profile. Certain flows and cross-sectional profiles expose large expanses of shallow (3 to 6 cm [1 to 2 inches] deep) water on flats and bars in the river. High ambient air temperatures and high solar radiation can heat the water to temperatures fatal to forage fish. In laboratory studies, species found in the Platte River (common carp, golden shiner, emerald shiner, common shiner, flathead minnow, white sucker, and channel catfish) and acclimated to high water temperatures (25-26°C [77-79°F] die at temperatures less than those measured in the river during some summers. Time series analyses of temperatures in the Platte River are being conducted (K. Dinan, pers. comm.) but have not yet been applied to analyzing effects on forage fish.

4. <u>Effects of changes in Platte River habitat conditions on endangered and threatened species. Are the changes influencing species recovery?</u>

Endangerment occurs for a variety of reasons. Section 4(a)(1) of the Endangered Species Act (16 USC 1531 et seq.) states that determination of whether any species or population is endangered or threatened must be based on one or more of the five factors listed in that Section. Those factors include: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, or (5) other natural or manmade factors affecting its continued existence.

Some endangered species, such as the desert pupfish (Cyprinodon macularius) or the San Bruno elfin butterfly (Callophrys mossii bayensis), are largely sedentary. Accordingly, those species can be quickly and adversely affected by minute changes in their immediate environment. Migratory endangered species, such as those occupying the Platte River, may be affected more by the cumulative effects of habitat change over their entire range. Habitat loss can also be incremental (occurring over time) making it difficult to evaluate the effect of small quantities of habitat loss on the species.

The bald eagle was listed endangered or threatened over most of its range in 1978 (43 Fed. Register: 6230-6233). A primary cause of endangerment was habitat modification and the accumulation of pesticides derived from their food items. Populations of bald eagles were reduced seriously in many states in the 19th century. Land development and increased human activity were considered the key factors adversely affecting the suitability of both breeding and wintering areas (USFWS 1983). The Great Plains population of piping plovers was determined to be threatened in 1986 (50 Fed. Register 50726-50734). Reservoirs, river channelization, and modification of river flows that eliminated sandbar nesting habitat along hundreds of kilometers of the Missouri and Platte rivers in the Dakotas, Iowa, and Nebraska, were identified as causes for threatened status (USFWS 1984,1988). The interior least tern was listed as endangered throughout its range because the species' riverine habitats had been and were continuing to be modified through sandbar elimination and vegetation encroachment (USFWS 1985). The whooping crane was listed as endangered in response to severely reduced population levels. An important factor contributing to their endangerment was habitat loss (USFWS 1986). In none of the instances listed above was environmental change or habitat loss at any one location considered the only reason for listing. Rather, the cumulative effects of change over the species' ranges was identified.

Recovery plans for the piping plover (USFWS 1988) and interior least tern (USFWS, in press) call for increases in breeding populations to remove each species from endangered or threatened status. Actions to accomplish that objective will include restoration of nesting habitat, improving nesting success where nesting still occurs, and protection of nesting habitat to ensure that the birds have a safe place to nest. The Piping Plover Recovery Plan (USFWS 1988) specifically states that one of the actions necessary to delist the piping plover in the northern Great Plains is to "eliminate current or potential threats to breeding habitat." The Recovery Plan also specifies that essential habitat including the Platte River from Lexington, Nebraska, downstream to the confluence with the Missouri River must be protected and enhanced to provide for species recovery. The Recovery Team described essential habitat to include unvegetated riverine sandbars in the Platte River.

The Aransas-Wood Buffalo population of whooping cranes declined from a level of 700 - 1300 individuals in the late 1800's (Banks 1978, Allen 1952) to 16 individuals in 1941 (USFWS 1986). Habitat modification throughout its range was identified as one of the factors contributing to endangerment of the whooping crane (USFWS 1986). Conversely, the identification, management, and enhancement of whooping crane habitat along the migration route was identified as one of the factors necessary to affect species recovery (USFWS 1986).

Recognizing the importance of migrational habitat to species recovery, four migration stopover areas regularly used by whooping cranes were designated as critical habitat in 1978 (43 Fed. Register: 20938-20942). The designated areas included Salt Plains NWR, Oklahoma; Cheyenne Bottoms State Waterfowl Management Area and Quivira NWR, Kansas; and the Platte River between Lexington and Denman, Nebraska. In making its designation, the Department of the Interior stated that loss of the critical habitat areas "would appreciably decrease the likelihood of the survival and recovery of these cranes."

Bald eagle roost habitat on and adjacent to the Platte River has been enhanced in many areas by the establishment of wooded vegetation. The operation of electric power generating plants provides ice-free foraging habitat in downstream areas adjacent to the power plants. Although localized, habitat changes on the Platte River are contributing incrementally to recovery of the bald eagle.

The discussion above suggests that habitat changes which have occurred on the Platte River have not singularly caused the least tern, piping plover or whooping crane to become threatened or endangered. Changes on the Platte River may have increased the availability of winter habitat for bald eagles. Platte River habitat alterations have been an increment of the changes that have occurred through the ranges of those species. Ultimately those changes may influence species recovery. The chapters that follow describe the habitat needs of endangered and threatened species occupying Platte River habitats, and lay out suggested strategies for managing those habitats to enhance species recovery.

CHAPTER 3

HABITAT USE BY ENDANGERED AND THREATENED SPECIES ON THE PLATTE RIVER

The discussion in this section provides the reader with an introduction to the habitats used by whooping cranes, least terns, piping plovers and bald eagles while those species are on the Platte River. Also provided is a brief description of how the habitats contribute to satisfying the life requisites of the species. A discussion of forage fish habitat is presented to differentiate warm season and cold season requirements.

1. WHOOPING CRANE

A. Roosting

Whooping crane biologists generally agree that whooping cranes select roost sites based on the security offered by the site(s) which is demonstrated by the following characteristics from Shenk and Armbruster (1986) and USFWS (1987b):

(1) Unobstructed channel width (Table 11): whooping cranes select roost sites free of visual obstructions or with an unobstructed view, presumably to allow them to see approaching terrestrial predators.

(2) Presence of water: Whooping cranes roost in water. The availability of water is an inherent requirement of whooping crane behavior (USFWS 1987a).

(3) Depth of water: Whooping cranes generally roost in water less than 18 inches deep. Deeper water was present adjacent to the roost sites measured in the Platte River. Biologists have hypothesized that deep water surrounding riverine roost sites forms a deterrent to terrestrial predators.

(4) Water Width: In addition to simply being present and having adequate depths, the expanse of water surrounding the roost site must be sufficiently wide to provide a sense of isolation and security.

Shallow portions of river channels are used for roosting by whooping cranes when the species is on the Platte River (USFWS

Table 11. Unobstructed channel widths (visible distance along a line perpendicular to the channel) reported at 41 whooping crane riverine roost sites, ranked from largest to smallest for sightings on the Platte River system and for sightings on other rivers.

	Unobstructed channel width (ft)	
Rank	Platte River System	Other Great Plains Rivers
1	unlimited	2050
2	1365	1837
3	1207	1640
4	1152	1575
5	1087	1476
6	1048	1276
7	1019	1247
8	986	1230
9	975	1230
10	881	1201
11	856	1050
12	850	899
13	831	810
14	827	600
15	755	512
16	699	489
17	696	
18	600	
19	570	
20	552	
21	507	
22	495	
23	475	
24	373	
25	172	

1981). Several characteristics common to whooping crane roost sites were described by Johnson and Temple (1980) including:

(1) Wide channels;

(2) Unvegetated;

(3) Fine substrate, usually sand;

(4) An unobstructed horizontal visibility from riverbank to riverbank of at least 1500 feet upstream and downstream (or to a bend in the river) at all sites:

(5) Open visibility overhead, absence of tall trees, tall and dense shrubs, or high banks near the roost;

(6) Shallow water except in the main channel (all sites evaluated were less than 12 inches deep);

(7) Slow flow, about 1-4 miles per hour, although water in the main channel may be flowing faster;

(8) Proximity to a suitable foraging site (usually within 1 mile);

(9) The presence of unvegetated sandbars with very low elevation above water and near the middle of the river; and

(10) A distance of at least 0.25 miles from roads, houses, and railroad tracks.

Measurements were made describing the streambed at 19 known whooping crane roost sites on the Platte River during 1983-1988 (Lingle et al. 1984, 1986; J. Ziewitz, pers. comm.). A transect from permanent vegetation on one side of the channel to the other side of the channel through the roost site quantified the following characteristics:

(1) Unobstructed channel width of 172 to 1365 feet;

(2) Water filled channel widths of 172 to 1207 feet;

(3) The percentage of the unobstructed width that was water-filled ranged from 59 to 100 percent (X=93.3%);

(4) Depths in these channels ranged from sandbars up to 1 foot above the water, to channels that were 3.5 feet deep.

Non-riverine roost sites are also occupied by whooping cranes throughout the migration corridor (Howe 1987). Although the use of such sites has not been observed within 3.5 miles of the Platte River, characteristics of some non-riverine sites are described by Ward and Anderson (1987) and Shenk and Armbruster (1986). Characteristics common to non-riverine roost sites described by Ward and Anderson (1987) include:

(1) Mean unobstructed visibility of 330 to 3300 feet;

(2) Distance to nearest active road ranged from 2000 to 9000 feet;

(3) Distance to occupied home sites ranged from 820 to 9000 feet;

(4) Bottom substrate was mud;

(5) The wetlands were classified as either lacustrine or palustrine.

B. <u>Foraging</u>

Some whooping cranes in the Aransas-Wood Buffalo flock occupy the Platte River during spring and fall migrations (Tables 3 & 4). Whooping cranes feed in a variety of habitats in the Platte River valley including cropland, wet meadows, palustrine wetlands, and native grassland (USFWS 1981, Lingle et al. in press; NGPC, unpubl. data. In the spring, wetlands along the Platte River and elsewhere along the migration route provide whooping cranes the opportunity to obtain food items that are essential for survival and successful reproduction (USFWS 1987a). Foraging sites generally are associated with sites near nocturnal roosts (USFWS 1987a). Whooping cranes use both plant and animal foods during their migrations. Known animal foods include insects (Swenk 1933, Allen 1952), fish (Allen 1952, Lahrman 1976), amphibians (frogs and salamanders), crayfish, earthworms and snakes (USFWS 1987a). Known plant items consumed include corn, wheat, sedges, and grasses (Allen 1952).

The foraging ecology of whooping cranes on migration is not well known. A reliable and abundant invertebrate food source provided by wet meadows is an important aspect of the spring migration ecology of whooping cranes (USFWS 1987a). Because snow and ice are still present at the time of arrival on the breeding grounds, many foods are not readily available which requires the birds to rely on stored energy and nutrients to survive until the emergence of resident food items (USFWS 1987a). It is not known whether nutrients acquired during migration are essential for successful reproduction, or if the essential nutrients are obtained on the wintering grounds.

2. INTERIOR LEAST TERN

A. Nesting

Interior least terns nest on sandy substrates on riverine sandbars or on adjacent sandpit areas (NGPC 1982-1988). On the Platte River, riverine nesting least terns usually nest on sandbars surrounded by water (Faanes 1983, NGPC 1982-1988). Occupied sandbars are sparsely vegetated or unvegetated, usually isolated by water, and made up of dry, sandy or gravel substrate. These conditions provide wide horizontal visibility, protection from terrestrial predators, and isolation from human disturbance. Data collected on the Platte River in 1987-88 suggest that least terns select nest sites that are at the highest point on the sandbars. Least terns nesting on sandpits occupy sites possessing similar characteristics except for the lack of isolation provided by water and the isolation from human disturbance and terrestrial predators.

Physical characteristics common to some least tern nest sites on riverine sandbars in the Platte River valley in 1979 are displayed in Table 12.

The natural cycle of spring and early summer peak flows contribute to provide adequate physical and biological features including sediment deposition and some vegetation removal that support nesting least terns. Flows may also influence the subsequent selection or nest placement on the sandbars. Faanes (1983) observed nesting areas in the Big Bend of the Platte River were inundated on 21 June 1979 when flows rose from 1,810 cfs on 20 June to 3,000 cfs on 21 June. Flows were less than 1,000 cfs during nest initiation. Nesting was initiated on a sandbar near Alda, Nebraska, during 10 - 12 July 1984 (Lingle, unpubl. data). U.S. Geological Survey data indicate that previously high flows decreased from 8,000 cfs just prior to this period, and ranged from 3,500 cfs on 10 July to 2,370 cfs on 12 July (USFWS 1987a).

B. Foraging

Nesting least terns typically forage in areas less than 1 mile from the nest sites (Faanes 1983). Least terns forage almost exclusively on small fishes captured near the surface (USFWS, unpubl. data). A critical criterion is the need for an adequate abundance of small fishes which provide the only food source for this species in the Platte River valley (USFWS 1987a). Water conditions must be adequate to meet the water quality, depth, temperature, and velocity requirements of such species as sand shiner and Plains killifish (USFWS 1987a). NGPC (1985) listed 13 fish species and their relative abundances near a least tern nest colony on the Platte River near Overton, Nebraska (Table 13).

Table 12. Mean values for physical characteristics of sandbars used for nesting by least terns and piping plovers and some nest characteristics. Data from Faanes (1983).

Characteristic	Least Tern	Piping Plover
SANDBAR		
Distance to nearest bank (m)	104	162
Sandbar length (m)	259	286
Width at nest (m)	59	55
% wooded vegetation	9.6	7.3
% herbaceous vegetation	18.4	18.1
% bare ground	72.0	74.6
NEST		
Height above river stage (cm)	33.0	19.6
Depth to moisture (cm)	2.6	1.0
Distance to nearest channel (m)	18.9	16.4
Depth of nearest river channel (cm)	30.8	26.0
Width of nearest river channel (m)	19.5	14.1

Table 13. Species composition and relative abundance of fish species sampled at 23 least tern foraging sites near the Jeffrey Island colony on the Platte River in 1985. Data from NGPC (1985).

Species	# Sampled	% Total
Sand shiner	634	50.5
Red shiner	247	19.7
Bigmouth shiner	178	14.2
White sucker	72	5.7
Quillback carpsucker	64	5.1
Plains killifish*	29	2.3
Fathead minnow	17	1.4
Creek chub	4	0.3
Gizzard shad	4	0.3
Plains minnow	2	0.2
Common stoneroller	2	0.2
Bigmouth buffalo	2	0.2
River shiner	1	< 0.1

* 100 Fundulus sp. collected were not included in the total

3. PIPING PLOVER

A. Nesting

Habitats occupied by piping plovers during the nesting season are ecologically and physically similar to those of the interior least tern (Table 12) (Faanes 1983, Currier et al. 1985, USFWS 1987a). The data suggest that piping plovers are more tolerant of vegetation in the nesting area than are interior least terns (Faanes 1983).

B. Foraging

The principal difference in foraging strategies between least terns and piping plovers is that the plover eats invertebrates almost exclusively; the least tern primarily eats fish. Most observations of foraging among piping plovers suggest that the bird secures its prey primarily by picking and gleaning on sandy substrates from the wet zones up to dry sand. Following review of the available data, the Biology Workgroup assumed that suitable riverine nesting habitat for piping plovers would also provide suitable riverine foraging habitat. Although piping plovers forage at sandpit nesting areas, Lingle (unpubl. data) has observed piping plovers move from sandpits to riverine habitats to forage.

4. BALD EAGLE

A. Roosting

Wintering bald eagles often congregate at communal roost sites, in some cases traveling 20 km or more from feeding areas to a roost site (Fisher et al. 1981). The same roosts are typically used every year and are usually located in areas protected from wind, harsh weather, and human disturbance (Steenhof 1978, Fisher et al. 1981). The use of large, live trees in sheltered areas provides a more favorable thermal environment and helps to minimize the energy stress encountered by wintering birds (USFWS 1987a). Communal roosting may help to facilitate food-finding and pair-bonding (Steenhof 1978). The proximity of adequate night roosts to the other habitats required by wintering bald eagles such as hunting perches and feeding sites is important (USFWS 1987a). In some locations the absence of a suitable night roost may limit the use of otherwise suitable habitat (USFWS 1987a). Freedom from human disturbance is also important in communal roost site selection (Fisher et al. 1981). Continued human disturbance at a nocturnal roost may cause bald eagles to abandon an area (Hansen et al. 1981, Keister 1981).

Primary habitat of the bald eagle along the Platte River is riparian woodland. Nearly 62% of the bald eagles sighted in the winters of 1978-79, and 1979-80 were recorded in riparian woodlands (Currier et al. 1985, USFWS 1981). Shelterbelts and woodlots away from the river were the next most important habitat component (Table 14) (USFWS 1981). No data were collected on bald eagle use of adjacent reservoirs during 1978-80 (USFWS 1981). Habitat changes in the Platte River valley have enhanced some aspects of winter habitat for bald eagles. The growth of trees in the floodplain has benefitted bald eagles by providing roost sites and perches.

B. Foraging

During their 3-4 month stay in the Platte River valley, bald eagles forage on a variety of rough fish and waterfowl (Lingle and Krapu 1986). Analysis of 2,858 egested pellets indicated the following composition of major prey items: mallard -37%, eastern cottontail - 9%, Canada goose - 8%, carp - 5%, and meadow vole - 3% (Lingle and Krapu 1986). Fish are a more important component of bald eagle diets than the pellet analysis indicates. Fewer fish remains are present in eagle pellets because fish are more easily digested than are birds or mammals (Lingle and Krapu 1986). Through field observations on the Platte River, Lingle and Krapu (1986) found that bald eagles preferred fish above other foods, but their availability declined as ice-cover increased. Reservoir operation has provided additional open water areas used as foraging habitat by bald eagles. When fish are not available, bald eagles forage on birds, small mammals and carrion (Steenhof 1978, Fisher et al. 1981).

5. FORAGE FISH

In general terms, sand shiners occupy relatively shallow water with low velocities. Substrate characteristics occupied by sand shiners include silty sand and sand-sized particles which are important for spawning and egg incubation. Substrate size and cover characteristics of sand shiner habitat are important during the various life stages. A summary of habitat characteristics by life stage and season is shown in Table 15.

Table 14. Habitat use by bald eagles during the 1978-80 winters in the Platte and North Platte River valleys, Nebraska. Data from USFWS (1981).

Habitat type	No. of birds observed	% Total
Riparian woodland	838	61.9
Shelterbelt/woodlot	201	14.8
Tilled field	154	11.4
Grazed pasture	38	2.8
Mowed field	37	2.7
Irrigation canal	35	2.6
Ungrazed pasture	20	1.5
Other	30	2.2
Total	1,353	100.0

Table 15. Most suitable values of habitat variables for sand shiners in the Platte River.

LIFE STAGE/SEASON	DEPTH cm	VELOCITY cm/sec	SUBSTRATE	COVER
Spawning & egg incubation	6.1-30.5	9.1-30.5	Sandy gravel	
Juveniles Summer	<10	10	Silt	Instream
Adult Spring	<20	10	Silt	In or Ou
Adult Summer	20	20-30	Gravel	Instream
Adult Fall	20	20	Gravel	Instream
Adult Winter	3- [illegible]	0		

CHAPTER 4

MODELING ENDANGERED AND THREATENED SPECIES HABITAT NEEDS

1. Why Model?

A. Describe the usefulness of applying models to habitat management.

Wildlife management decisions aim at two kinds of broad goals: (1) to maintain biotic diversity, or (2) to produce specific resources for people to use and enjoy, or both (Salwasser 1986). An important assumption implied when modeling relationships between wildlife and habitat is that some aspect of populations can be predicted from some aspect of habitat (Salwasser 1986). To that end, wildlife managers and land use planners regularly employ species and habitat models to help guide future management decisions. The Biology Workgroup used models to depict incremental changes in habitat based on incremental changes in flow and other parameters, and for development of management alternatives.

Models are simplifications of the systems they depict (Schamberger and O'Neil 1986). The essence of these concepts can be applied in a model to produce some result, or to simulate a desired response. Still, models that appear to be "good models" can provide less than realistic predictions (Rotenberry 1986). In essence, then, mathematical models applied to real-world situations can be used only as a tool to guide management decisions having future effects on an ecosystem. In contrast, models cannot be used to tell a manager what the future will look like.

B. Describe the need to have accurate models of species needs to affect successful management.

Models may lose resolution in attaining simplicity (Schamberger and O'Neil 1986). Models require numerous assumptions, although they can never completely mimic the real world (Maynard-Smith 1974, Hall and Day 1977). Because of the assumptions inherent in development of species/habitat models, the data used in their development must be both accurate and directly applicable to the geographic location being modeled.

For instance, Faanes and Howard (1987) developed a model to describe habitat suitability among black-shouldered kites (Elanus caeruleus) in south Texas. Because of the paucity of data on the species in the geographic area of concern, the authors were forced to use the limited data and literature available to them.

Ultimately, the model of black-shouldered kites in south Texas was based on information primarily from northern California (extreme northern limit of the species range; AOU 1983) and from El Salvador in Central America. Although the model contains many biologically valid assumptions about the kite in south Texas, its accuracy would have been improved considerably had geographically specific information been available and included in the south Texas model.

The same concept is applicable to management of endangered species using the Platte River ecosystem in Nebraska. Although the whooping crane, for example, occupies palustrine wetlands for nocturnal roosting habitat over much of its 2400 mile-long migration corridor (Howe 1987), when occupying the Platte River, whooping cranes use riverine habitats. Data on habitat characteristics in riverine systems on the Great Plains in general, and in the Platte River specifically, greatly increases the accuracy of the model. The Biology Workgroup's Platte River-specific model provides a firm theoretical base for making management decisions.

In the development of its habitat models, the Biology Workgroup had to make assumptions to apply the data. The general assumptions used in the species models were: (1) the future conditions to be modeled were available at the time use data were collected, (2) in some of the model efforts, observed habitat use reflected the needs of the species, (3) current habitat conditions on the Platte River included optimum conditions, (4) the habitat variables incorporated in the model were independent, and (5) that all habitat factors are of equal value.

2. <u>Describe and evaluate previous modeling efforts for endangered and threatened species on the Platte River</u>.

Models available when the Biology Workgroup was formed were generally inadequate to describe habitats occupied by endangered and threatened species on the Platte River. The principal inadequacy of each model examined was the lack of specificity in addressing habitat needs related to endangered species in alluvial systems. For instance, the only least tern model available (Carreker 1985) was developed for application throughout the North American breeding range of the species, including all three subspecies (two of which are coastal). Because of the broad applicability of the Carreker model, habitat needs applicable to the Platte River system were necessarily given only rudimentary coverage in that model. At the same time, no models existed for the piping plover anywhere in its North American breeding range.

Among the habitat models examined during the review process for applicability to whooping crane habitat process was a draft sandhill crane habitat suitability model (Armbruster and Farmer 1981) designed to evaluate the composition, distribution, and spatial relation of cover types, disturbance factors, and potential roosting areas in the central Platte River area occupied by sandhill cranes. A simulation model developed by the Bureau (Latka and Yahnke 1986) was designed to predict the distribution of roosting sandhill cranes in the channels of the Platte River based on microhabitat features of flow given certain macrohabitat constraints. Currier and Eisel (1984) evaluated the impact of flow level on sandhill crane and whooping crane roosting habitat. Currier and Eisel's model evaluated roosting habitat suitability based on wetted width criteria and was developed through analysis of aerial photographs taken at different flows. Currier et al. (1985) used a Geographic Information System (GIS) to determine the availability of optimum whooping crane roost sites in the Big Bend of the Platte River. The GIS model does not have a flow component.

A problem common to most modeling efforts, and especially those involving endangered species, is the paucity of data beyond the minimum needed to generate data points. Most of the models examined at the beginning of the Biology Workgroup's review process were not used because they either did not apply to the Platte River, or to the endangered species involved, or the models did not evaluate habitat vs. flow relationships. The Habitat Suitability Index (HSI) modeling approach designed by the Fish and Wildlife Service enables the development of suitability curves for various habitat parameters which evaluate a particular habitat component on a scale of 0.0 to 1.0. The habitat models examined initially by the Workgroup did not provide a means for assigning a numerical value to a habitat character, or a mechanism for tying together most aspects of the habitat characters portrayed.

A summary analysis of the earlier available models led the Biology Workgroup to conclude that more applicable models should be developed to address the habitat and management needs of endangered species occupying Platte River habitats. State-of-the-art technology under development by the National Ecology Research Center in Fort Collins, Colorado, presented the possibility of assessing incremental changes in quantity and quality of the instream habitat at incremental flows (Instream Flow Incremental Methodology). Field data collected by the Bureau and others enabled the application of the Instream Flow Incremental Methodology. The Biology Workgroup recommended that models be developed that would address habitat needs of each of the endangered species occupying the Platte River. The models would be specific to certain reaches of the river and would quantify habitat vs. flow relationships for each species at the time of the year when the species was present on the Platte River.

3. Area to be modeled by the Platte River Management Joint Study.

The area considered in this report for modeling habitats and developing a habitat management plan is from about Lexington, Nebraska, downstream to near Chapman, Nebraska.

Although specifically applicable to the Big Bend reach of the Platte River, the existing models could be adapted to most other reaches of the Platte River system in Nebraska. This is especially important if a holistic management plan for endangered species models on the entire Platte River system is needed. The area of applicability is consistent with the hydrologic models being developed by the Hydrology Workgroup (D. Woodward, pers. comm.).

4. The Platte River Management Joint Study effort to develop models applicable to the habitat needs of endangered and threatened species.

Five workshops were organized by the Grand Island Field Office of the U.S. Fish and Wildlife Service and were held in Grand Island, Nebraska, in 1986 to develop habitat models for endangered species and forage fishes.

A. Whooping Crane

The first whooping crane workshop was held 19 - 21 May 1986 and involved 21 individuals and species authorities representing Federal, State, and private conservation organizations and agencies, and water development interests. A report titled, "Whooping crane habitat criteria for the Big Bend area of the Platte River" (Shenk and Armbruster 1986), was produced after workshop completion which contained habitat suitability curves. The report contained a list of participants at the workshop.

An additional workshop, involving 14 individuals and species authorities representing Federal, State, and private conservation organizations and agencies, was held in November 1986 to further refine the suitability curves. The product of this effort was a report titled "Whooping crane roosting habitat criteria for the Platte and North Platte Rivers in Nebraska" (USFWS 1987b). These criteria were further refined by the Biology Workgroup and species authorities in 1988. The resulting model was based on three aspects of whooping crane biology that are assumed to best describe roosting habitat occupied by the birds in the Platte River system.

B. Least Tern and Piping Plover

The least tern and piping plover workshop was held 21 - 23 May 1986, and involved 16 individuals and species authorities representing Federal, State, and private conservation organizations, as well as water development interests. A report containing draft habitat suitability curves titled "A review of habitat criteria for least terns and piping plovers using the Platte River" was produced after workshop completion (Armbruster 1986).

An additional workshop, involving 10 individuals and species authorities representing Federal, State, and private conservation organizations and agencies, was held in November 1986 directed at refinement of the habitat suitability criteria drafted for least tern and piping plover habitat in May 1986. The report from the November effort titled, Interior least tern and piping plover riverine nesting habitat criteria for the Platte River in Nebraska" (USFWS 1987c) was prepared in February 1987.

These criteria were further refined by the Biology Workgroup and species authorities in 1989. The resulting model is based on aspects of least tern and piping plover biology that are assumed to best describe nesting habitat occupied by the birds in the Platte River system.

C. Forage Fishes

A workshop to develop suitability curves for forage fishes consumed by least terns and bald eagles in the Platte River system was held in July 1986. The workshop was attended by 21 individuals and species authorities representing Federal, State, and private conservation organizations, and water development interests. A report titled "Habitat suitability index curves for channel catfish, common carp, sand shiner, plains killifish, and flathead chub" was developed by consensus discussion for use in the Instream Flow Incremental Methodology on the central Platte River (Fannin and Nelson 1986).

Two additional meetings (5 April and 13 July 1988) were held with species authorities and members of the Biology Workgroup. The meetings enabled further refinement of the habitat suitability curves. Ultimately the modeling process was centered on two species, the sand shiner and channel catfish rather than the five species originally described. The sand shiner was selected because of the similarity of its habitat preferences to those of the other forage fishes considered, as well as its relative abundance. The channel catfish provides an important fishery in the Platte River system, and was selected because its habitat needs are assumed to encompass the habitat needs of other forage fishes preyed on by bald eagles.

Concurrent with development of the habitat suitability curves, the physical habitat satisfactory for forage fish in the Platte River was measured using the appropriate PHABSIM/IFIM techniques. As a product of investigations in the Platte River system, data were gathered at sites on the main channel(s) of the North Platte, South Platte, and Platte Rivers, and several sidechannels and adjacent wetlands (Chadwick and Assoc. 1988, Peters et al. 1988). These data were collected at all sites during high and medium flows, and at most sites during low flows and were reviewed by species authorities.

5. <u>How the species models will be applied to the Platte River System</u>.

As originally envisioned, the species/habitat models will be used as one tool in assessing the impacts of changes in discharge in the Platte River system. When properly applied, the models may also be used to evaluate the implementation of various habitat management techniques. For instance, the whooping crane may be used to quantify change in habitat value that might occur near Kearney, Nebraska, after the withdrawal of an additional 10,000 acre-feet of water from the North Platte River. The least tern/piping plover model may be used to determine above what flows nests on riverine sandbars will be inundated, or below what flows suitable nesting habitat is exposed. Likewise, the forage fish model may be used to predict what impact might occur to sand shiner habitat if flows in June are modified for one month.

The above examples point out the utility of applying mathematical models to biological phenomena. However, as Rotenberry (1986), Salwasser (1986), and numerous other researchers have pointed out, models are only tools to assist in making informed decisions. Models cannot be used to tell managers what the future will be. In the end, trained biologists will use the models to make predictions from which managers will make decisions. The Platte River endangered species models will be one of several information tools used in developing those predictions.

6. <u>Model Verification and Validation</u>

Verification evaluates how well the model matches the builders perception of the system. In contrast, validation determines how well the model conforms to the real-world system.

Although models presented in this report have been incrementally validated, they are not "final". These models are open-ended and flexible enough to accommodate change when change is biologically warranted. The intent of the Biology Workgroup is to assure that any changes in the existing model components will be examined as rigorously as were the original components. A model verification and validation technique will be presented in the final report.

CHAPTER 5

MODELING OF ENDANGERED AND THREATENED SPECIES HABITAT NEEDS

The Biology Workgroup developed mathematical models for whooping crane roosting habitat and for forage fish habitat in the Platte River. The Workgroup also developed a management based approach for dealing with least tern and piping plover nesting habitat.

1. WHOOPING CRANE MODEL

This report describes a whooping crane roost habitat suitability model being developed for the Platte River. Suitability criteria are used in conjunction with hydraulic simulations of Instream Flow Incremental Methodology (IFIM) (Bovee 1982) to generate a relationship between river discharge and roosting habitat. Suitability index (SI) criteria used in the model were developed with input from whooping crane experts and the Biology Workgroup.

The IFIM consists of a collection of computer models and analytical procedures designed to predict incremental changes of habitat resulting from incremental changes in river discharge. The model is based solely on physical features of roosting habitat. The purpose of this application is to characterize the relationship between river discharge and the quantity and quality of whooping crane roosting habitat based on physical habitat parameters within the channel. The model is designed to be used as a tool to evaluate alternatives for managing whooping crane roost habitat on the central Platte River.

Roosting Habitat Criteria

Habitat suitability criteria were designed to implement habitat parameters in the model. The habitat criteria were originally developed by consensus of whooping crane and modeling experts (Shenk and Armbruster 1986, USFWS 1987b). An alternate depth criterion was subsequently developed for the Biology Workgroup by the whooping crane model subcommittee (1988), and the suitability index curves were refined to include data collected at roost sites used through the spring 1989 migration season.
Four habitat parameters were used to describe the principal qualities of roost sites on the Platte River which are compatible with IFIM simulation. Those parameters are the channel width, wetted area within the unobstructed channel, the distribution of depths in the wetted area, and lack of disturbance.

Two of the parameters, wetted area and water depth, vary with flow. The other two parameters, areas subject to disturbance and unobstructed channel width, do not; those parameters characterize factors that are constant and specific within each river segment. The "freedom from disturbance" criterion is a binary criterion in the model and is used to eliminate areas of the river subject to disturbance from further consideration. The unobstructed channel width, in combination with the longitudinal characteristics of the river, describe both the visibility in the unobstructed channel and the open areas of channel available to the cranes. Suitability criteria and index curves were developed to describe the discharge dependent parameters.

The standard used to define criteria and structure suitability curves is "habitat use". Habitat use data describe the whooping cranes use of habitat with particular characteristics. The Biology Workgroup assumed that 1) the species will select and use areas that are best able to satisfy its life requisites, and 2) as a result, greater use will occur in higher quality habitat (Schamberger and O'Neil 1986).

Suitability is defined in terms of the assumed relationship between optimum conditions and the opposite extreme of no resource available. Suitability index curves were produced for each habitat criteria, with values ranging from 0.0 to 1.0. The index values represent an interpretation of the biological significance of a measure of the habitat criterion. In some cases, conditions identified as optimum (suitability index equal to 1.0) represent a compromise between biological and management considerations. For example, a number of whooping crane sightings have been made on rivers with wetted widths greater than 1000 feet. The channel of the Platte River was historically several thousand feet wide throughout much of the study area. Today, however, only a few relatively short reaches have channels widths greater than 1000 feet. From a practical standpoint, a water width of 1000 feet was judged to be sufficient to provide a desirable management condition. The suitability index curve was constructed accordingly.

The information used to develop the criteria are from confirmed sightings and direct observations of roost sites made on the Platte River by professional biologists. A nocturnal roost is defined as the location occupied by a single or group of whooping cranes in the late evening as it became dark or when the cranes were first observed in the early morning, between first light and shortly (15 minutes) after sunrise.

The data used to develop the suitability criteria have been collected on the Platte River system since 1966. Physical habitat features have been systematically measured at roost sites on the Platte River since the 1983 fall migration. The suitability index curves are derived from roosting habitat on the Platte River system under present conditions.

a. Disturbance and Excluded areas

Whooping cranes usually avoid areas within one-quarter mile of certain types of disturbance (USFWS 1981). Disturbances identified during the IFIM study design were roads, railroad tracks, and bridges. Reaches of the river within one-quarter mile of these disturbances were excluded from representation.

Other reaches of river are excluded because of overhead line crossings. Overhead lines pose a flight hazard to cranes attempting to locate roosting areas (Faanes 1987). River reaches in the vicinity of overhead lines were determined to be undesirable for modeling, and a one-quarter mile length of river upstream and downstream of line crossings was excluded. The lengths of river represented by each study site have been adjusted to exclude lengths of river influenced by disturbances and overhead lines (Table 16).

b. Unobstructed Channel Width

Whooping cranes roosting on the Platte River generally occupy sites with broad channels, free of woody vegetation, and with good horizontal and overhead visibility (USFWS 1981). The unobstructed channel width criterion is used to describe these features. Other factors being equal, broad, active channels with wide unobstructed views have greater value than narrow channels. The unobstructed channel width criterion includes the characteristics of "unobstructed view" described by Shenk and Armbruster (1986), and the criterion described by USFWS (1987b).

Channels of the Platte River that normally carry flow (active channels) are bounded by woody, perennial vegetation. The banks and vegetation > 3 feet in height form visual obstructions to cranes standing in the river. The location of river banks and perennial woody vegetation greater than three feet in height (USFWS 1987b) is coded in the hydraulic data files for each IFIM transect, and the width of the unobstructed channel is measured as the distance between obstructions along a transect.

Channel widths used by whooping cranes on the Platte River are given in Table 11. Channel widths have ranged from 172 to 1365 feet. Of 24 roost sites evaluated on the Platte River, 20 have been in channels greater than 500 feet wide, and two other sites were in channels 495 and 474 feet wide. In contrast, the availability of channels greater than 500 feet on the central Platte River is limited (USFWS 1981). Use of channels generally greater than 500 feet is substantiated by observations made at a number of other riverine roost sights (R. Lock pers. comm.). Channels having widths < 170 feet, the narrowest channel used by whooping cranes, are excluded from the model.

Table 16. Description of the IFIM study sites used in the simulation of the whooping crane roosting habitat versus discharge relationship.

Site number & approximate location	River length site represents[a] (miles)	Measurement date	Measured discharge (cfs)	Range of discharges simulated (cfs)
Site 2 Jeffreys Island	3.9	10/10/84	2030	825-5155
		04/10/85	2290	916-5725
		07/22/85	640	250-1600
Site 4A Elm Creek	3.0	03/26/85	1871	800-4700
		07/08/85	227	090-0570
Site 4B Odessa	5.0	03/27/85	1716	686-4290
		07/09/85	215	086-0538
Site 5[b] Kearney	8.0	05/06/85	2063	825-5158
	10.7	07/23/85	520	208-1300
Site 6 Audubon Sanctuary	7.6	10/03/84	1430[c]	600-3500
		04/03/85	1977	800-4900
		07/17/85	290	120-0750
		06/09/86	549	220-1372
Site 7 Gibbon	11.2	10/09/84	893	357-2233
		04/22/85	335	134-0838
		07/15/85	209	083-0522
Sites 8AN Denman	7.3	03/20/85	1525[d]	614-3843
		07/24/85	177	070-0442
Site 8AS Denman	7.3	03/20/85	1746[d]	700-2600
		07/30/85	360	150-0900
Site 8B Denman	2.3	03/21/85	3336	1350-5000
		07/12/85	415	166-1038
		05/21/86	1802	721-4500
Site 8C Denman	3.0	10/15/84	4270	1708-5000
		04/18/85	1372	550-3430
		07/19/85	540	216-1350
Site 9BW[e] Mormon Island Crane Meadows	16.3	04/02/85	1299[f]	780-3200
		07/10/85	110	006-0275
		10/02/85	858	500-2150
		04/03/86	1113	450-2800
		06/12/86	604	250-1500
		03/22/88	1120	450-2800

Table 16 (continued).

Site 9BE[e] Mormon Island Crane Meadows	16.3	04/01/85	1305[f]	522-3263
		07/11/85	96	038-0240
		10/03/85	950	380-2350
		06/11/86	530	212-1325
		03/24/88	1140	456-2850
Site 10 Mormon Island Crane Meadows	8.2	10/01/84	464[g]	186-1160
		04/04/85	380	152-0950
		03/23/88	564	225-1410
Site 11 Mormon Island Crane Meadows	16.5	10/04/84	758[g]	300-2000
		04/12/85	885	350-2200
		07/20/85	350	150-0850
Site 12A Chapman	5.4	10/12/84	2225	890-4500
		04/15/85	1837	600-3900
		07/16/85	215	090-0550
		06/13/86	1068	427-2670
Site 12B Phillips	4.4	04/16/85	1857	743-4643
		07/25/85	600	239-1495

a/ The segment lengths that are reported have been adjusted (reduced to account for reaches subject to disturbances, such as roads and bridges.

b/ Site 5 represents two river segments, Segment 3 and Segment 5.

c/ Site 6 does not represent all river channels; reported discharges are approximately 68 percent of the total river flow.

d/ Site 8A is a split channel; 8AS carries 60 percent of the total flow and 8AN carries 40 percent.

e/ Sites 9BW and 9BE represent the same river segment.

f/ Flow at Sites 9BW and 9BE relate to the total flow as: Total flow (cfs) = (Reported flow x 1.81) + 354 cfs.

g/ Site 10 flow relates to total flow as: Total flow (cfs) = (Reported flow x 7.35) + 266 cfs.

h/ Site 11 flow relates to total flow as: Total flow (cfs) = (Reported flow x 2.64) - 144 cfs.

The whooping cranes requirement for a wide unobstructed view includes upstream and downstream visibility. Characteristics of upstream and downstream visibility at roosts on the Platte River are reported by Faanes (in press). Upstream and downstream visibility are not directly measured by the model, however, aspects of the field design (i.e., transect placement and transect weighting) are used to represent the longitudinal characteristics of the river channel at each site. The unobstructed channel width criterion in combination with the longitudinal characteristics are used to define the area evaluated. The longitudinal characteristics of the channel are considered in the calculation of available habitat.

c. Water Width

This criterion characterizes the expanse of water that occurs in the channel at roost sites. An expanse of water apparently provides cranes a sense of isolation and security (Shenk and Armbruster 1986, USFWS 1987b). The water width is computed as the sum of the wetted widths in the unobstructed channel (USFWS 1987b).

The water width in unobstructed channels used by whooping cranes shown in the Platte River and other Great Plains rivers are shown in Table 17. The greatest observed water width used by whooping cranes on the Platte River is 1207 feet. Water widths > 1207 feet have been reported at a number of roost sites on other rivers in the migration corridor. The narrowest water width in the channel at sites used by whooping cranes on the Platte River is 121 feet (K. Johnson unpubl. data, presented in Shenk and Armbruster 1986).

The suitability index curve constructed for this criterion has a value of 0.0 for widths less than 120 feet. A suitability value of 0.9 is assigned to wetted widths of 850 feet and a suitability value of 1.0 is assigned to wetted widths of 1000 feet or greater (Figure 2).

Table 17. Water width in the unobstructed channels reported at 35 riverine roost locations used by whooping cranes. Total water widths are ranked from largest to smallest for Platte River sightings and for other Great Plains rivers.

	Water Width (ft)	
rank	Platte River	Other Rivers
1	1207	1640
2	1087	1575
3	1048	1230
4	963	1230
5	948	1230
6	861	1115
7	843	1050
8	831	984
9	827	810
10	826	787
11	804	489
12	755	
13	748	
14	696	
15	646	
16	600	
17	562	
18	520	
19	507	
20	495	
21	475	
22	356	
23	172	
24	~~121~~ N. Platte R.	

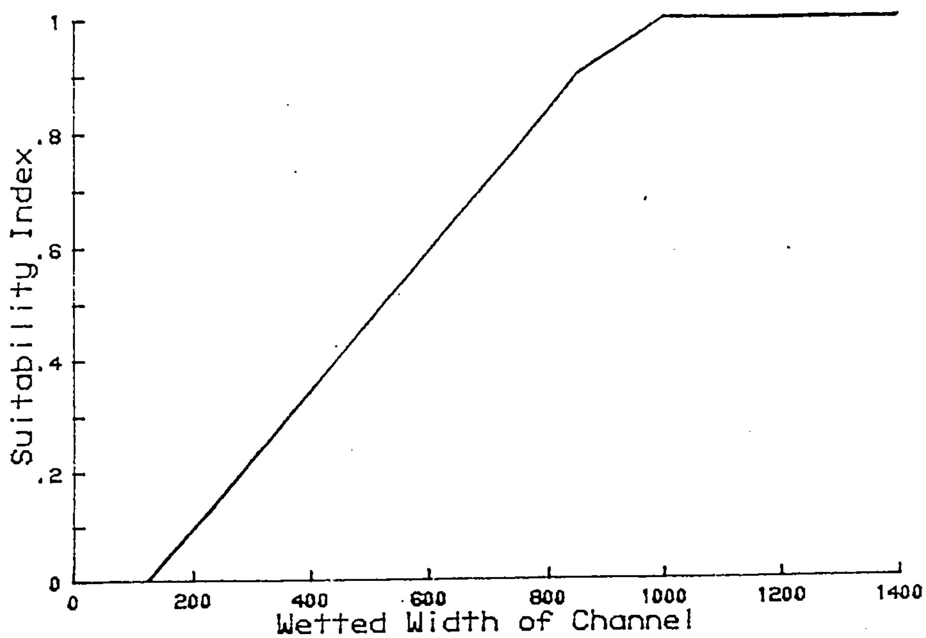


Figure 2. Suitability index curve for the wetted width criterion used in the whooping crane roosting habitat simulation model.

d. Depth

Whooping cranes using the Platte River often roost on shallowly submerged sandbars at some distance from the edge of water and visual obstructions. Deeper water has bounded the submerged sandbar or specific locations where cranes stood. The actual depths of water whooping cranes stand in can vary within certain limits if the overall suitability at the site is sufficiently met. Because of natural variation in the alluvial channel bed, a suitable roosting site will have a variety of water depths, e.g., submerged sandbars that are bounded by a number of deeper channels or thalwegs within the main channel.

The depth criterion was empirically developed based on the variation of depths measured at roost locations. Channel profiles were collected at 21 locations used by whooping cranes on the Platte River (Figure 3). Measurements of water depths were collected by placing a transect across the channel at the roost site shortly after cranes departed. Each transect was placed perpendicular to the channel and between the banks or points of visual obstruction. Measurements of water depth were taken at 10 foot intervals along the transect.

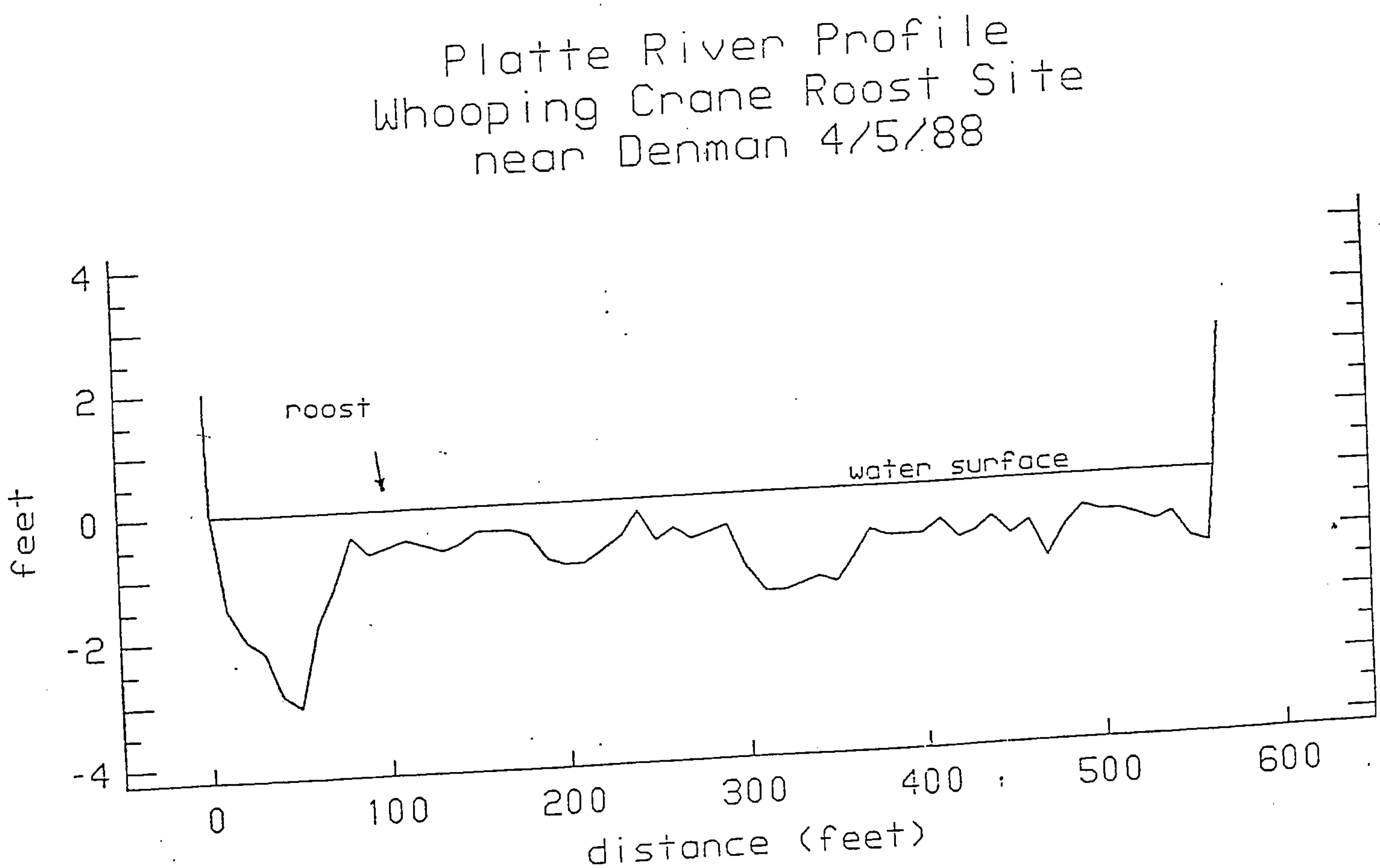


Figure 3. Profile of the river channel at a whooping crane roost site near Denman, Nebraska.

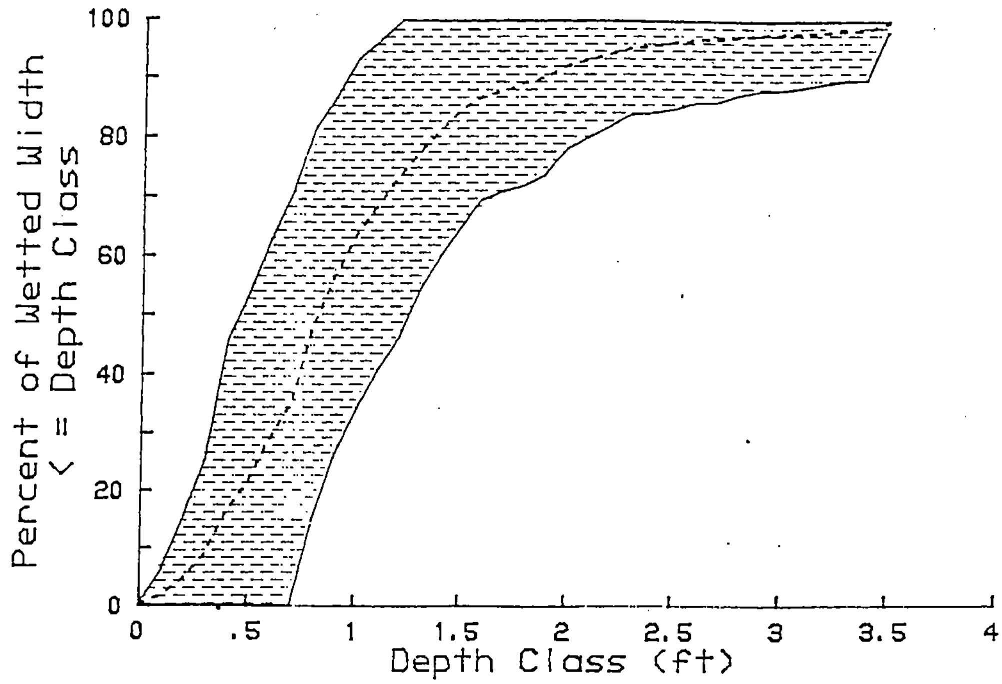


Figure 4. Cumulative depth distribution curve for whooping crane roost sites on the Platte River. The curve is the mean plus and minus 2 standard deviations of the cumulative distribution functions for 21 roosts sites. This range (shaded area) is the suitable zone used in the whooping crane model.

The proportion of the wetted width was computed for each 0.1 foot increment in depth, and a cumulative distribution function (<u>cdf</u>) was developed for each roost site to describe the statistical distribution of depths at the site. A range of suitable depths was calculated by averaging the <u>cdf</u> curves of all 21 roosts sites (Figure 4). The suitable range was defined as the mean <u>cdf</u> curve, plus and minus two standard deviations.

The suitability index of transects at the IFIM study sites was determined by how well the <u>cdf</u> for the transect at a given flow conforms with the <u>cdf</u> computed for whooping crane roost sites. The suitability index of the transect was calculated as the proportion of the points on its <u>cdf</u> curve that fell within the suitable range. This calculation was repeated for each transect segment for each simulated flow. A detailed description of the depth criterion was provided in a report prepared by the Whooping Crane Model Subcommittee in 1988.

IV. IMPLEMENTATION OF WHOOPING CRANE HABITAT VARIABLES

The habitat suitability criteria were applied to the central Platte River study area using hydraulic simulation and a physical habitat simulation program. The physical habitat simulation was implemented by a computer program originally developed by the Platte River Whooping Crane Trust and modified by the Bureau. Physical roosting habitat used in this model was considered from standard procedures to be a function of habitat quality (suitability) and the quantity (area) of available habitat. This approach was based on a similar concept often used with HSI models when they are applied in Habitat Evaluation Procedures (HEP) and IFIM system models. The channel area within the study area is a constant, and incremental changes in river flow result in incremental changes in the quality of habitat within the study area.

An IFIM transect represents the profile of one or more channels, depending on channel morphology. Individual channels represented by a transect are referred to as "transect segments" (Figure 5). A transect segment represents the active portion of the river; that portion which conducts flow and is bounded either by stable banks or permanently vegetated islands. The channel may carry the total Platte River discharge or a portion of it.

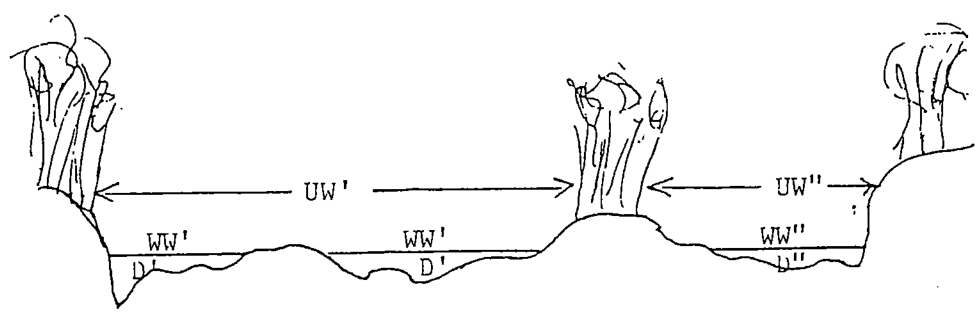


Figure 5. Example of a typical whooping crane roost study site transect in the Platte River.

Transect segments are the sampling unit of the model. Transect segments describe certain fixed physical characteristics. These characteristics include the location of banks and tall woody vegetation, the number and location of channels, and the length of river it represents. The information is coded into hydraulic input files (IFG-4 files) and does not change during hydraulic or habitat simulation.

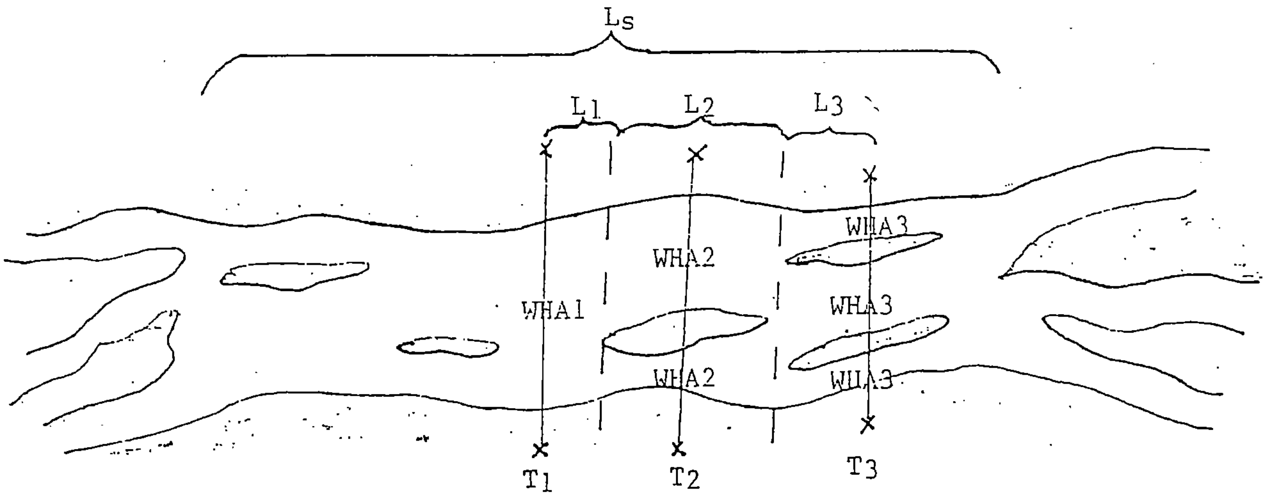
Habitat value is computed as a product of the active channel area and suitability indices. The active channel area is first computed by multiplying the unobstructed channel width of each transect segment by the length of river it represents. This implementation serves two purposes. Operationally, the habitat/discharge relationship generated at a site is a composite for all available channels, provided they meet or exceed the minimum suitability for channel width (170 feet). Greater weight is given to channels that are wider and have greater suitability. Suitability indices are computed for the flow dependent criteria (depth and water width) for each transect segment, and the channel area represented by the transect segment is "weighted", or multiplied, by the suitability indices. A habitat function termed "weighted useable area" (WUA).

WUA is produced for the portion of river channel represented by the segment. The simple equation that expresses this relationship is:

$$\text{Weighted Useable Area} = (UW \times L)(SI_{ww} \times SI_d)$$

where:
- WUA = Weighted Useable Area for a transect segment
- UW = Width of unobstructed channel
- L = Length of river represented by the transect
- SIww = Suitability index for water width
- SId = Suitability index for water depth

The habitat values of all transect segments are added together to derive the WUA for the study site (Figure 6). The habitat value is expressed in terms of the WUA value per 1000 linear feet of river for each river segment. WUA is a composite index of the relative quality and quantity of roost habitat.



$$WUA\ /\ 1000\ ft = \sum_{t=1}^{3}\left[(\sum WHA)_t\right] \div \sum_{t=1}^{3} L_t \quad \times 1000$$

Figure 6. Channel width and suitability indices for water width and water depth are computed for each transect segment (a). Weighted useable area per unit length of river is computed by summing WUA for all transect segments at the study site and dividing by the total length of the study site (b). T = transect; L = length of river represented by individual transects (Lt) and the study site (Ls).

V. RESULTS OF PHYSICAL HABITAT SIMULATION

Results of flow versus habitat relationships generated by the model are shown in Figures 7 through 18. When sites were measured at different flows, slight shifts were observed in the hydraulic and habitat versus flow simulations. The shifts were caused by shifts in the channel bed between measurements. The model treats the channel bed as static for the hydraulic and habitat simulations of each data set. The flow versus habitat curves presented in this report were combined using a mathematical algorithm developed by the Bureau of Reclamation (in prep.). Irregularities that appear in the resulting habitat/discharge curves of individual sites are reduced when the relationships are combined for the entire study area.

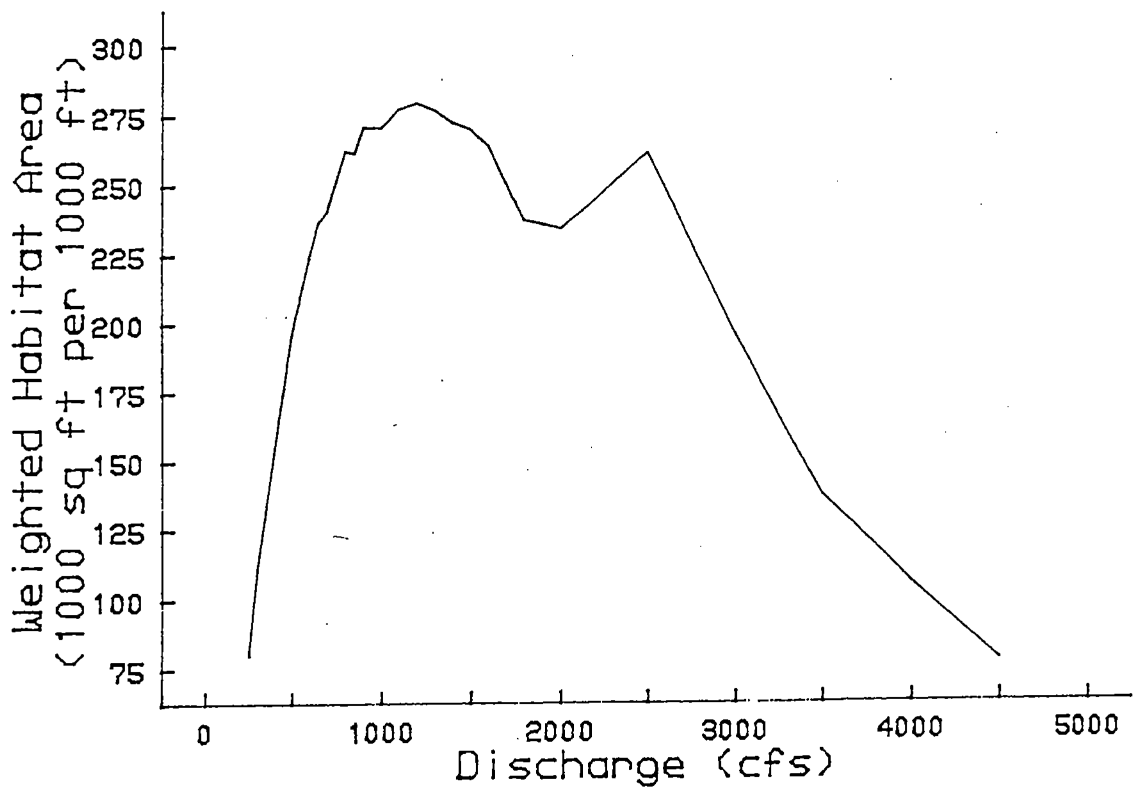


Figure 7. Habitat versus flow relationship for the Platte River segment at Jeffreys Island.

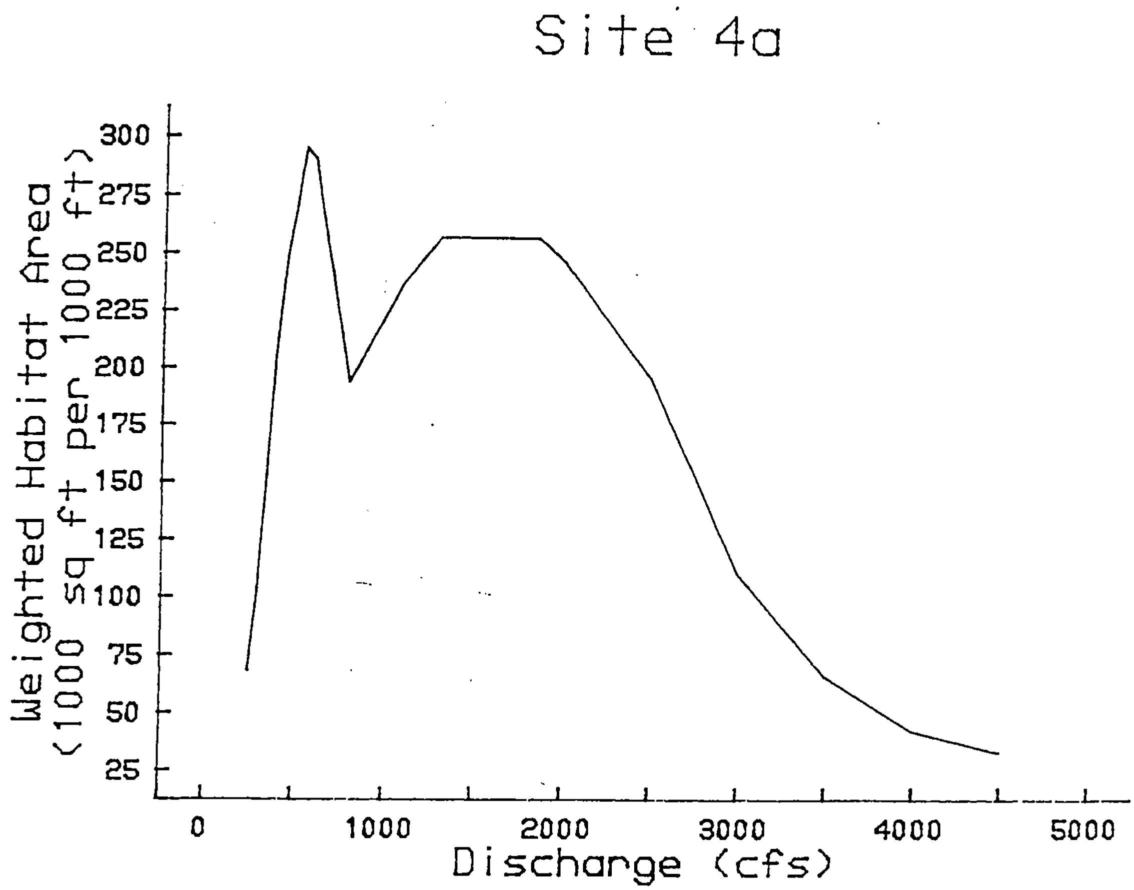


Figure 8. Habitat versus flow relationship for the Platte River at Elm Creek.

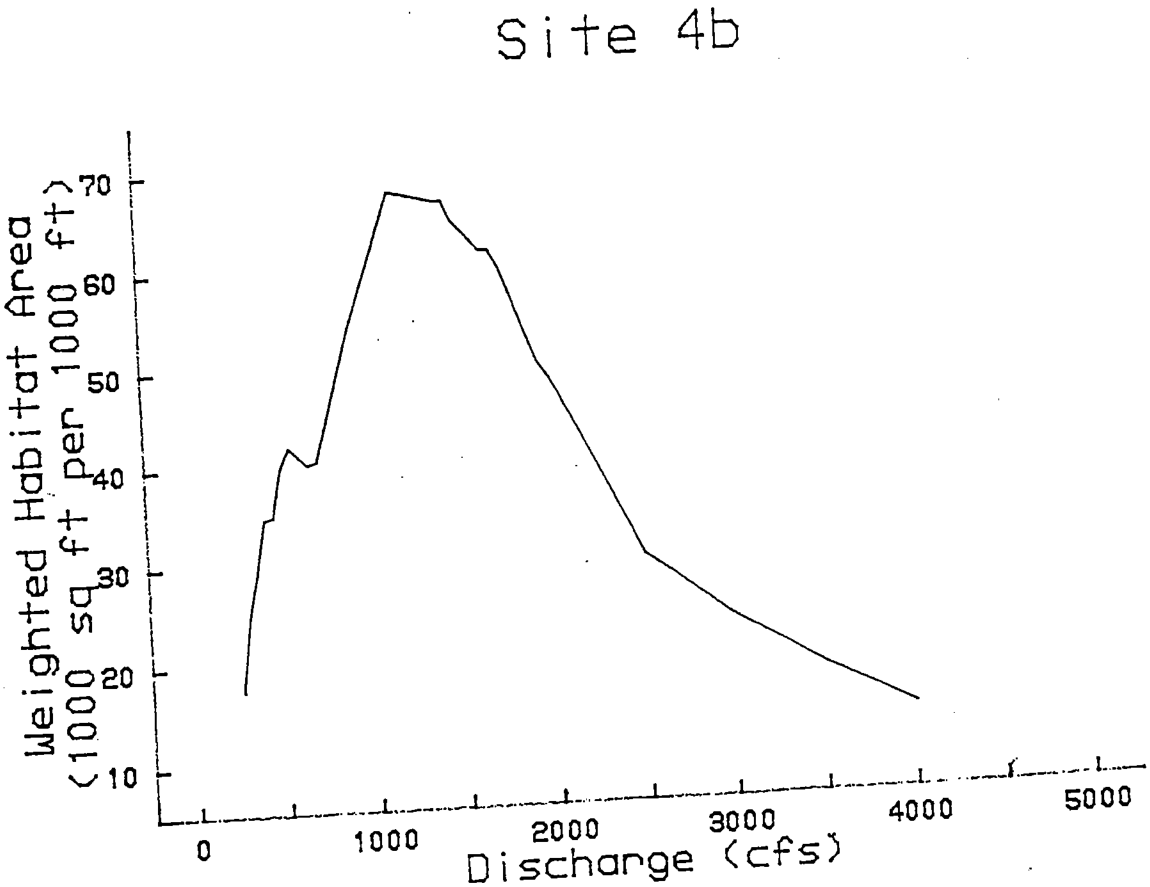


Figure 9. Habitat versus flow relationship for the Platte River segment at Odessa.

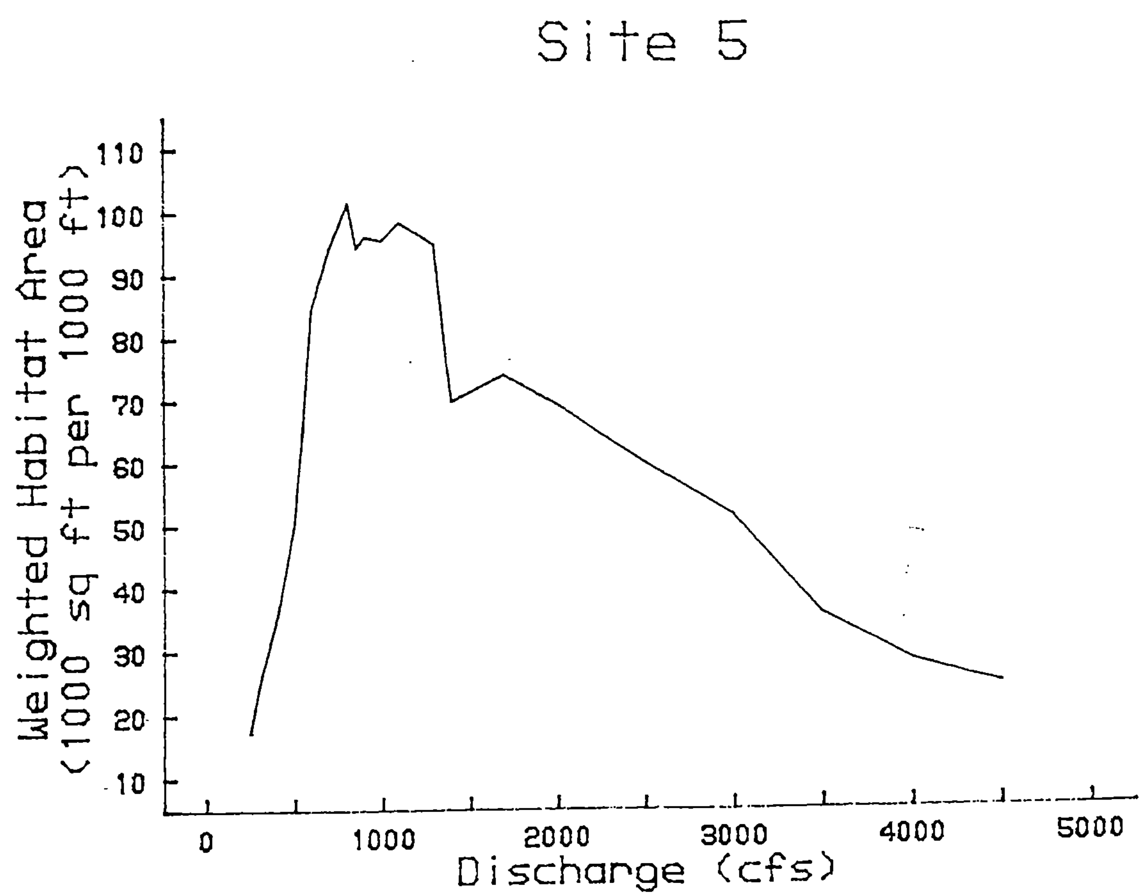


Figure 10. Habitat versus flow relationship for the Platte River segment at Kearney.

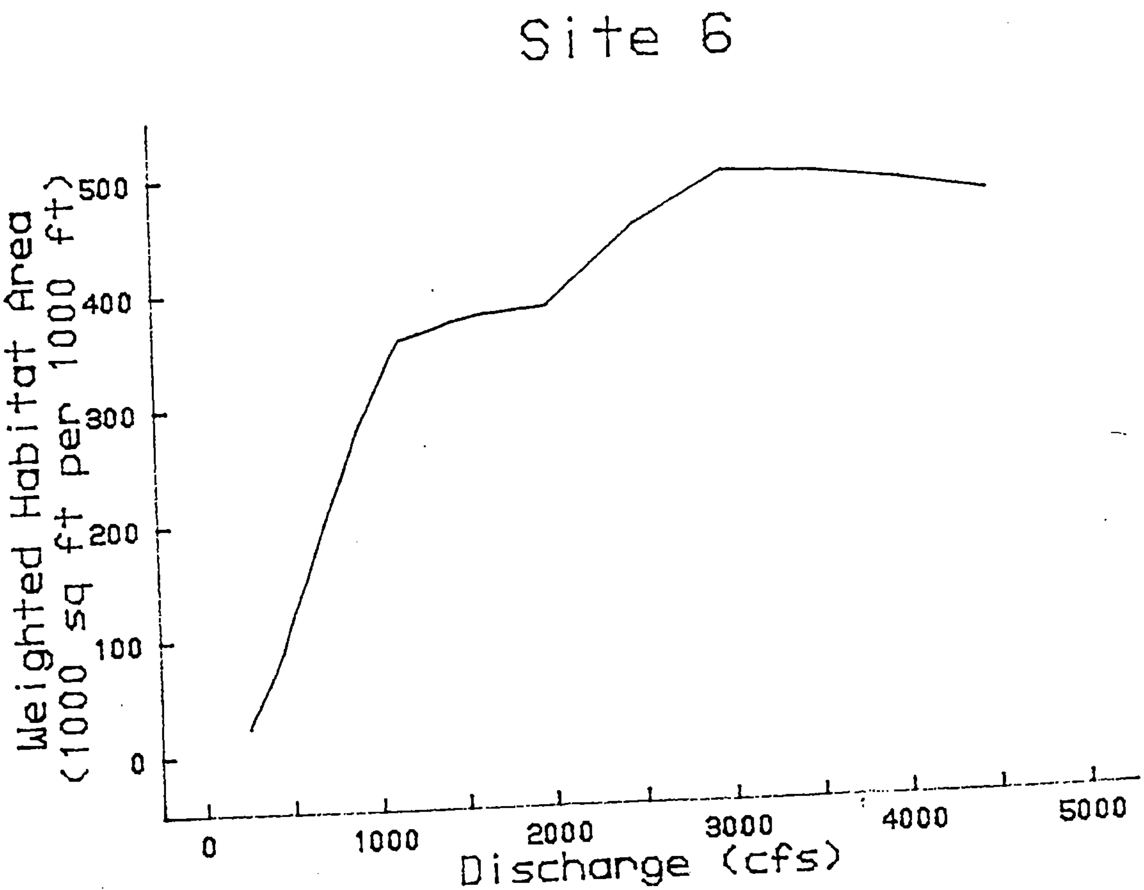


Figure 11. Habitat versus flow relationship for the Platte River segment at the National Audubon Society Sanctuary.

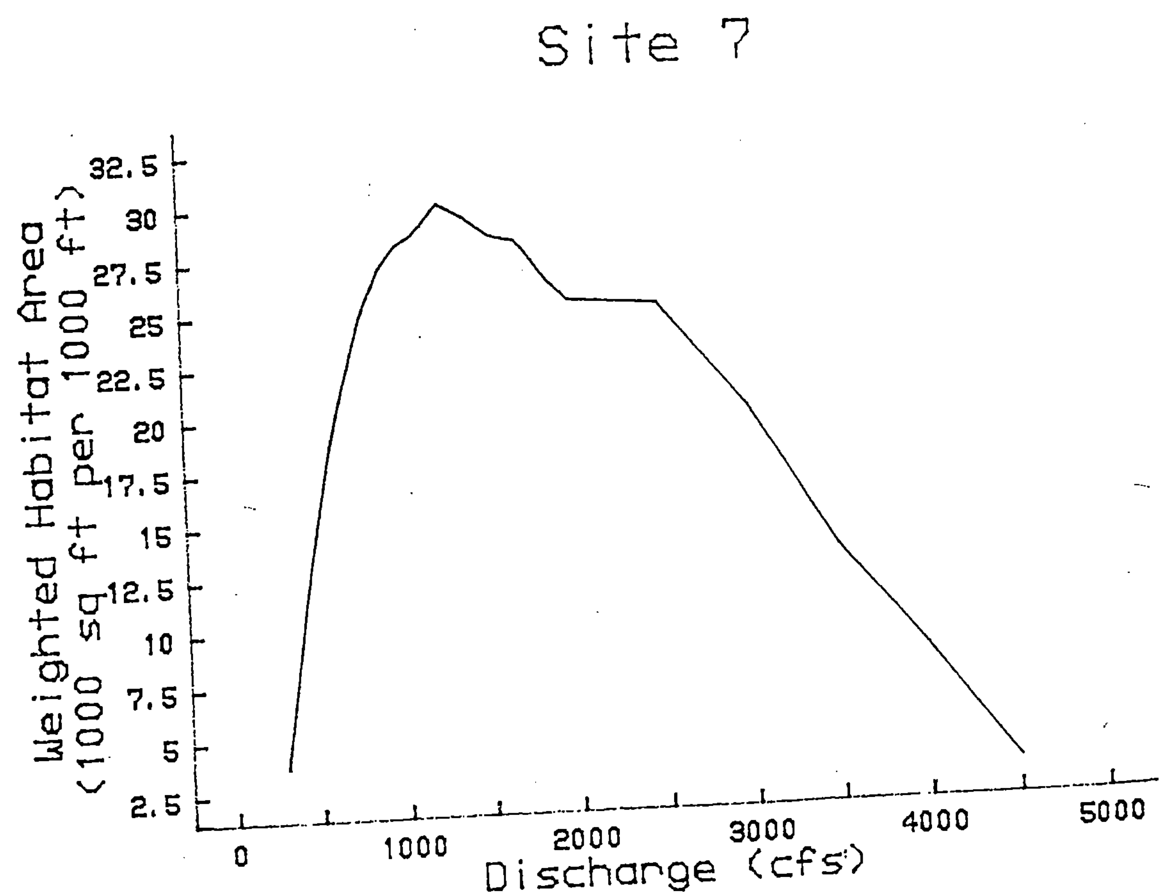
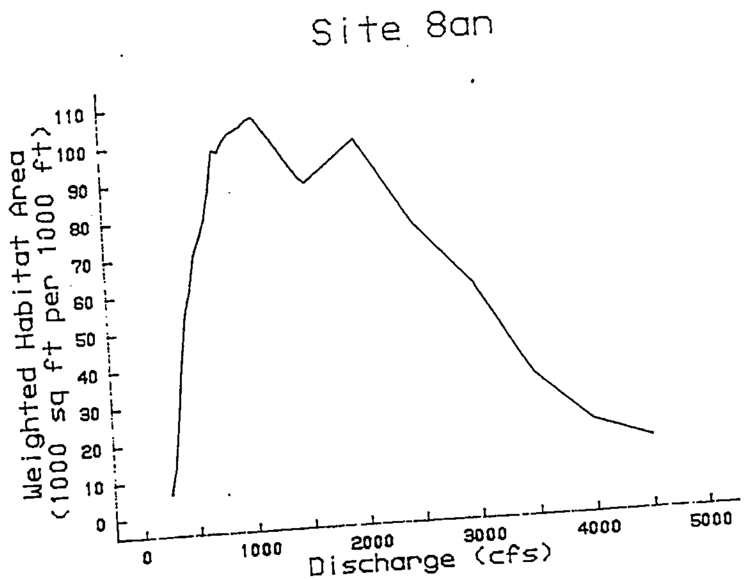


Figure 12. Habitat versus flow relationship for the Platte River segment at Gibbon.



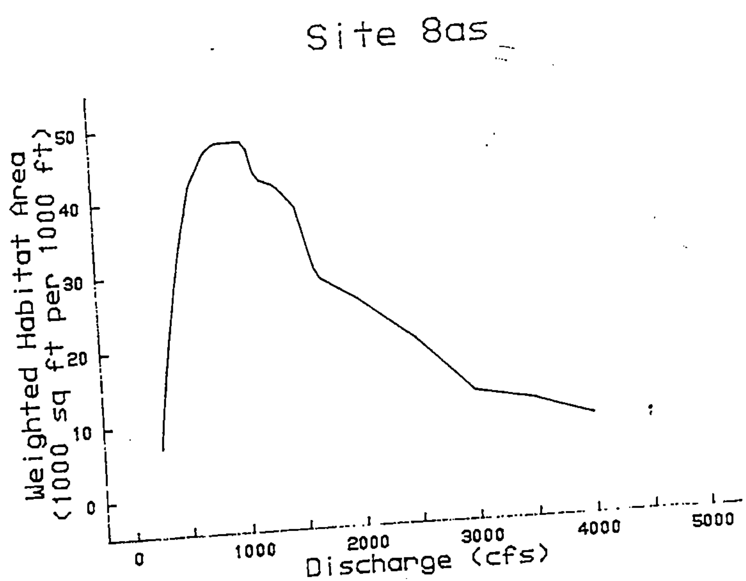
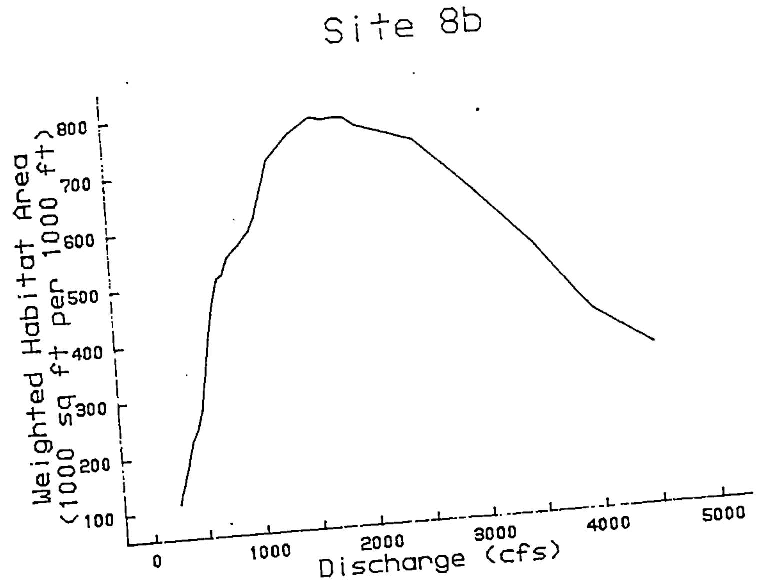


Figure 13. Habitat versus flow relationship for the Platte River segments near Denman (Sites 8AN, 8AS).



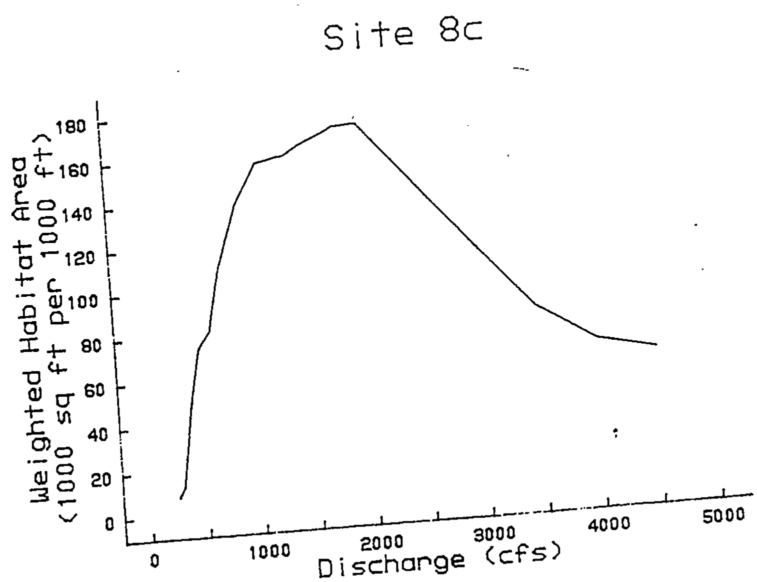
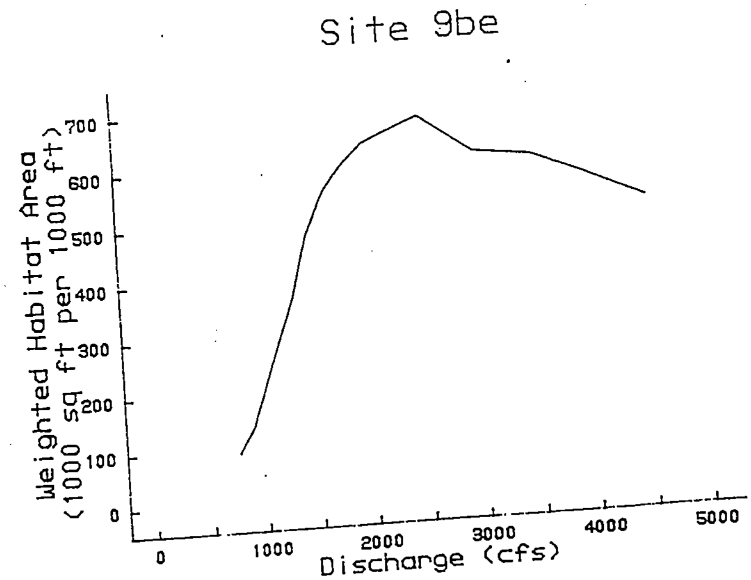


Figure 14. Habitat versus flow relationships for the Platte River segments at Denman (Sites 8B, 8C).



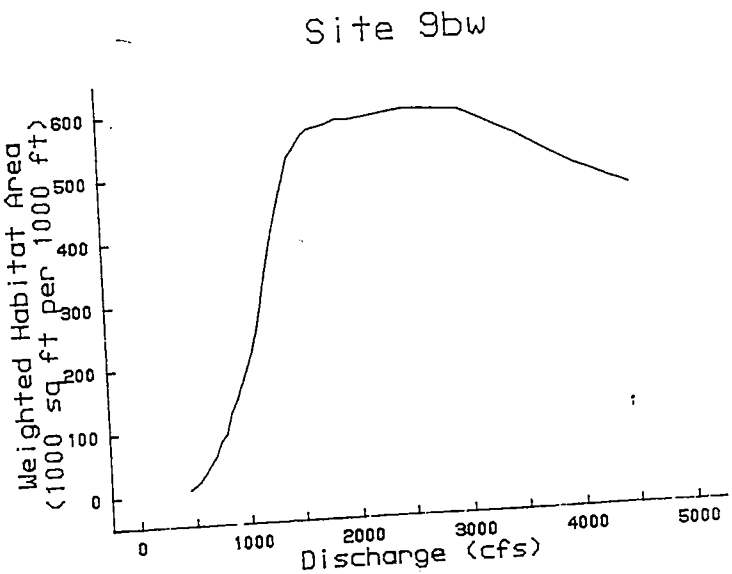
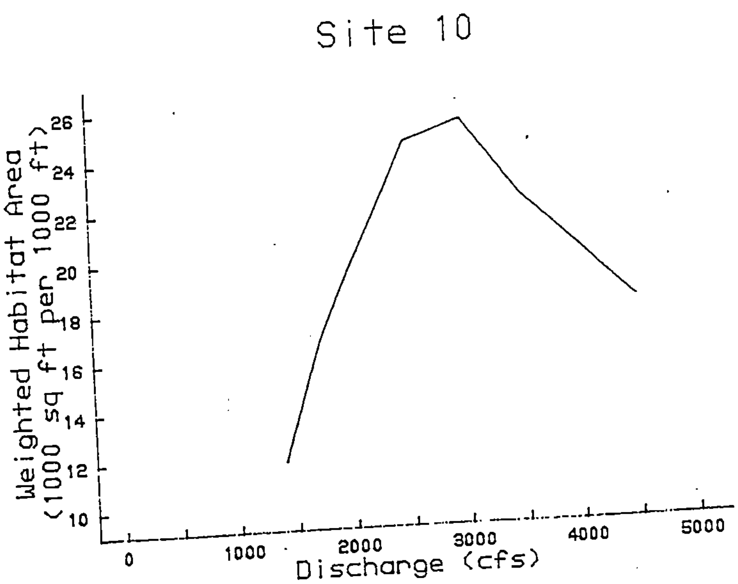


Figure 15. Habitat versus flow relationships for the Platte River segments at the Mormon Island Crane Meadows (Sites 9BW, 9BE).



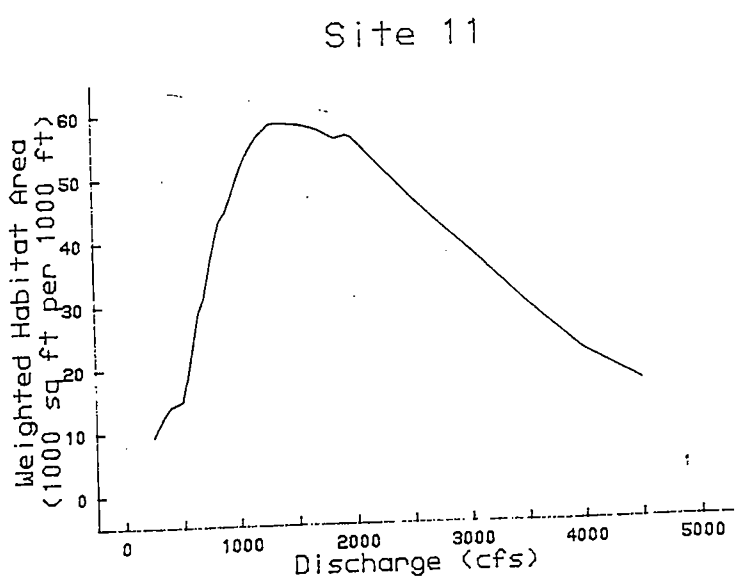


Figure 16. Habitat versus flow relationships for the Platte River segments at the Mormon Island Crane Meadows (Sites 10, 11).

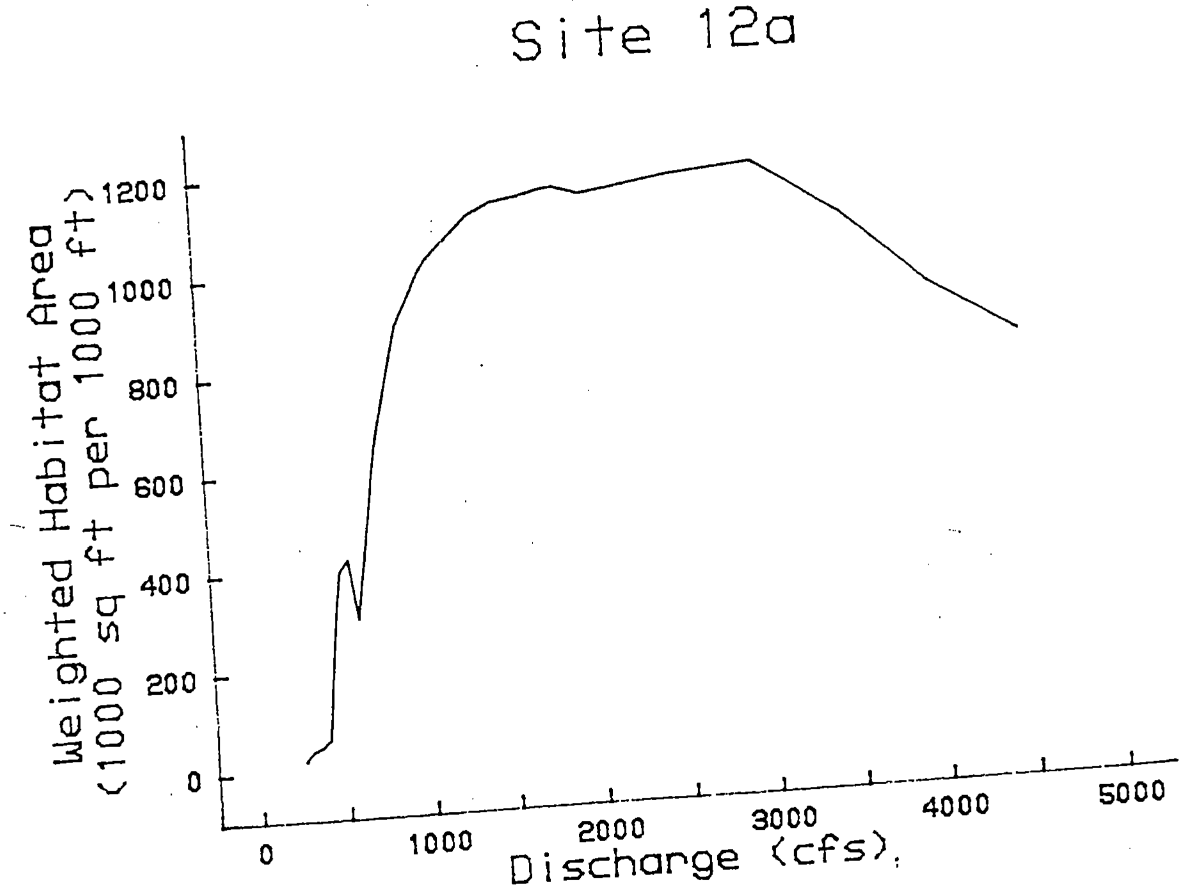


Figure 17. Habitat versus flow relationship for the Platte River segment at Chapman.

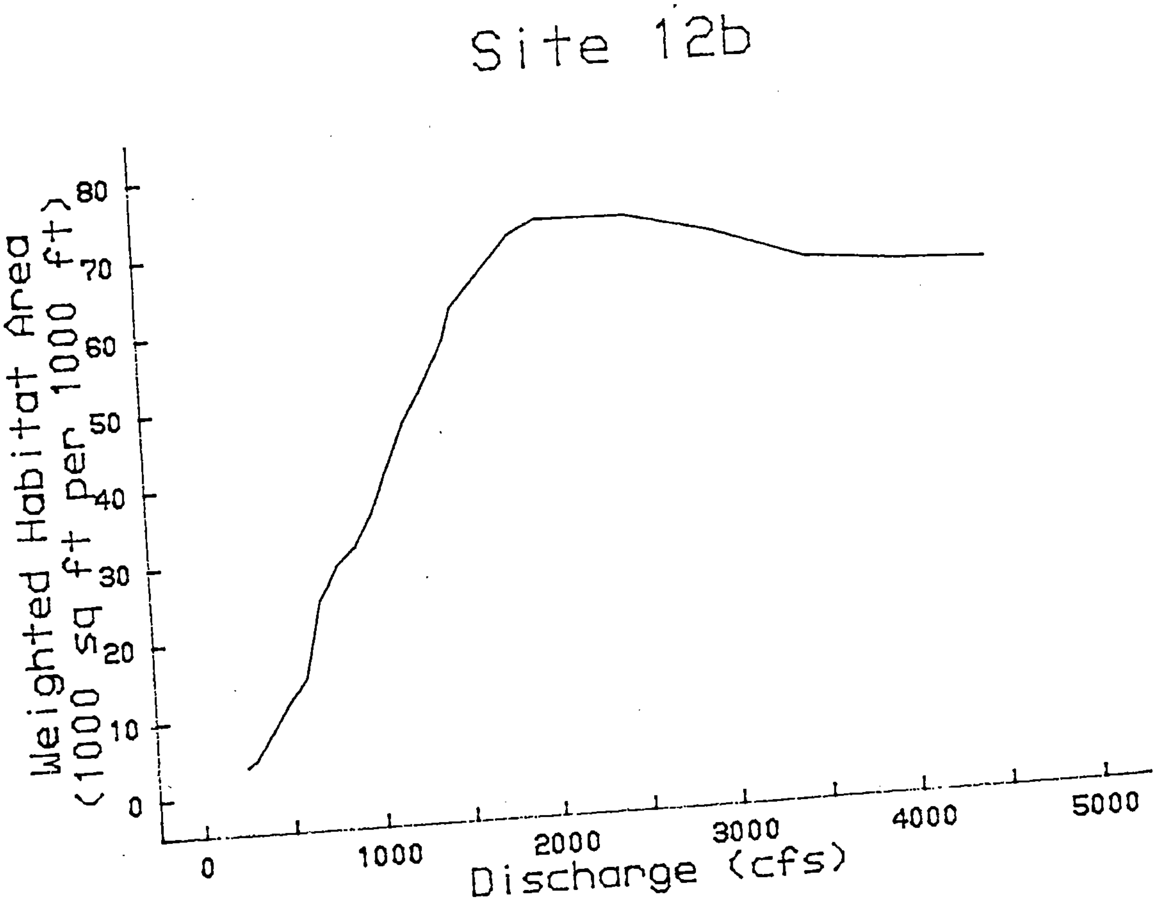


Figure 18. Habitat versus flow relationship for the Platte River segment at Phillips.

To produce a flow versus habitat relationship for the study area, the WUA relationships for each site are first multiplied by the length of the river segment represented by the site. The WUA for the river segments are then added together. The physical habitat versus flow relationship for the study area is shown in Figure 19.

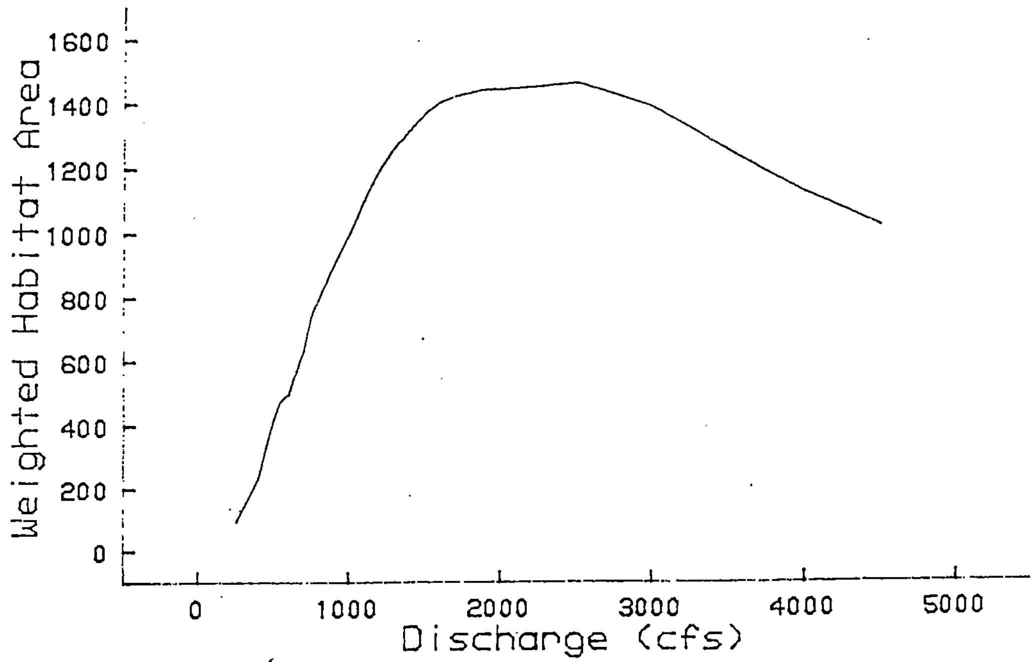


Figure 19. **Habitat versus flow relationship simulated for whooping crane roosting habitat for the central Platte River study area.**

VI. ASSUMPTIONS AND LIMITATIONS

The model is based on physical features of roosting habitat which are discharge related. Several issues important to maintaining the ecological value of whooping crane migratory and roost habitat on the Platte River are beyond the scope of the model. These issues include, but are not necessarily limited to the hydrology of wet meadows, the importance of feeding in riverine habitat, the maintenance of river channel morphology, and the juxtaposition of land use and habitat types.

The model is applicable to roost habitat characteristics within the banks of the river channel proper. Occasionally, roosting opportunities occur in the riverine setting but outside of the channel due to bank overflow, or when lowlands adjacent to the channel fill with groundwater. Although these events can be related to river discharge, the model does not address the value of habitats outside the river channel.

The hydraulic measurements and subsequent simulations represent the conditions which presently exist on the river. Several relationships among these and other habitat criteria have been examined which could bear further consideration in habitat management and recovery decisions. Further investigation and interpretation of the relationships will depend on formulation of specific management objectives for the recovery of roosting habitat.

2. LEAST TERN/PIPING HABITAT MANAGEMENT

The Workgroup reviewed the criteria for least tern and piping plover habitat developed in the May 1986 workshop (Armbruster 1986). The Workgroup then identified criteria that fell within the constraints established, and suggested refinements believed appropriate. Definitions for each of the criteria were reviewed and refined.

Subsequent attempts to develop a mathematical model proved difficult. The major impediment was the ephemeral nature of least tern and piping plover habitat. For instance, some of the habitat characters available to the birds at the time of their arrival change by the time of nest initiation. Further changes in flow heights, nest elevations, and vegetation height (among others) occur by the time the eggs hatch. Additional changes occur before the young have fledged. These conditions made model development extremely difficult.

As an alternative, the Biology Workgroup chose to develop a management-based approach to describing least tern and piping plover habitat needs. The basic components of this approach are knowledge of:

1. sandbar habitat characteristics obtained from aerial videography data (Sidle and Ziewitz 1990);

2. minimum and maximum sandbar heights;

3. techniques for constructing or rehabilitating sandbar habitat, and;

4. the number of secure nesting areas needed for least terns and piping plovers in the Central Platte River valley.

Recovery plans for the interior least tern and piping plover call for the maintenance of the distribution and range of both species, protection of essential habitat, and the restoration of nesting habitat (USFWS 1988, 1990). Essential habitat along the Platte River refers to sandbars in the river channel. Given the degraded habitat conditions for these birds in the Central Platte valley, channel habitat restoration is necessary.

Habitat restoration for least terns has already been accomplished elsewhere in North America, and is the cornerstone of efforts for the recovery of the endangered California least tern (S.a. brownii). Coastal least terns nest on artificial sites of dredged sand and gravel (Jernigan 1977, Buckley and McCaffrey 1978, Chaney et al. 1978, Parnell et al. 1986, Soots and Landin 1978, Jackson and Jackson 1985). Smith and Stucky (1988) outlined a proposal for restoring habitat for interior least terns on the Mississippi River by dredging sand to form new nesting structures.

The Platte River Whooping Crane Trust has been clearing islands of permanent woody vegetation as a means of restoring habitat in the central Platte River for cranes and other migratory birds (Lingle 1988, Currier 1984). Interior least terns and piping plovers have nested on one island cleared by the Trust, but only on portions of the island that had been inundated by high flows following clearing (Lingle 1988). Other portions of the island that were not inundated were relatively rough and soon supported a thick growth of annual vegetation.

To achieve a relatively smooth and clean substrate that interior least terns and piping plovers are known to use, and the elevation necessary to escape inundation during the nesting season, the Biology Workgroup recommends dredging sand onto cleared islands or existing unvegetated sandbars. Using this technique, the Workgroup recommends the following guidelines for habitat restoration projects in the Central Platte regarding channel dimensions, sandbar area, and sandbar height.

Channel Dimensions

Habitat restoration in the Central Platte should focus on the widest channels, given the apparent preference shown for greater channel width in comparison to nest sites with systematic sample sites (Sidle and Ziewitz, in prep.). Mean channel width of 0.25 mile segments used for nesting on the Central Platte was 969 feet. Mean channel width of the 0.25 mile reaches immediately above and below the Central Platte nest sites was 901 feet. Channel width was calculated as the active channel area divided by the 0.25 mile reach length. Active channel area is the total channel area minus the area of permanent islands.

The Workgroup recommends undertaking habitat restoration in 0.75 mile reaches where channel width is at least 969 feet in the central 0.25 mile, and at least 901 feet in the upper and lower 0.25 miles. Those dimensions apply to a single contiguous channel, not to multiple channels on opposite sides of long, permanent islands (Sidle and Ziewitz, in prep.).

If habitat restoration proves successful in channels that meet the width and length requirements described above, similar restoration projects should be undertaken in narrower channels, given the much greater availability of narrower channels in the Central Platte (Sidle and Ziewitz, in prep.). The Workgroup recommends undertaking this second effort in 0.75 mile reaches where channel width is at least 595 feet, which was the width of the narrowest site used for nesting in 1988. Clearing vegetation (without dredging from permanent islands, is a third option that may provide conditions suitable for a nesting sandbar.

Sandbar Area

Within the central 0.25 mile of a suitable 0.75 mile reach, as defined above, one or more mid-channel sandbars should be dredged to a high, relatively clean and smooth nesting substrate. Nest sites on the Lower Platte River had a mean size of 3.6 acres of dry, sparsely vegetated sand during the period when most nests were initiated. USFWS (1987c) identified 800 cfs during the summer in the Central Platte as a flow which would maintain forage fish for least terns, and restrict sandbar access by mammalian predators and recreational vehicles. Using the Lower Platte River as a nearby model of better habitat conditions (Sidle and Ziewitz, in prep.) the Workgroup recommends that the size of the restored sandbars in the Central Platte should provide at least 3.6 acres of suitable habitat relative to a discharge of 800 cfs. Given the apparent preference shown for greater sandbar area in comparison to nest sites in the systematic sample (Sidle and Ziewitz, in prep.), sandbars larger than 3.6 acres should be created wherever practical. No data exist that suggest a maximum sandbar size, however mid-channel sandbars isolated by flowing water are recommended. The Workgroup believes that sandbars up to 10 acres in size located in sufficiently wide channels with adequate nesting season flows should provide suitable nest sites.

Sandbar Height

At the Grand Island river gage, a discharge of 800 cfs is equivalent to 1.5 feet above the stage at zero flow. At least 3.6 acres of the restored sandbar, which is the minimum size described above, should be greater than 1.5 feet in height. The mean peak discharge (computed from mean daily discharge records) for June 15 to August 31 during 1957 to 1988 was 5248 cfs, which is equivalent to a stage of 3.0 feet. A sandbar this high would have escaped inundation between June 15 and August 31, in 21 of the 32 years between 1957 and 1988, and would have been 1.5 feet above the desired summer flow of 800 cfs. Sandbars ≥ 3.0 feet would afford even greater protection from flooding. Schwalbach (1988) recommended a minimum of 0.5 feet clearance between the lowest active nests and water levels. The maximum daily discharge between June 15 and August 31 in 1957 to 1988 was 23,500 cfs, equivalent to a stage of about 5.8 feet. The Workgroup recommends restoring sandbars by dredging at least 2.0 acres to a height greater than 3.5 feet. Consideration should be given to providing at least 1.0 acre at a height ≥ 5.8 feet.

The minimum channel and sandbar dimensions described above are shown in Figure 20. A 0.75 mile reach is depicted with outer banks spaced uniformly 1000 feet apart. Three 1-acre permanent islands occur in the upper and lower 0.25 mile portions of the reach, which are subtracted from the total channel area in these portions to yield an average active channel width of 901 feet. Mean active channel width in the central 0.25 mile is 969 feet due to the presence of a single permanent island slightly less than 1 acre in size within the outer banks. The restored sandbar, shown near the center of the reach is included in the active channel area. Contours of the restored sandbar are drawn corresponding to the elevations of 1.5 feet (3.6 acres), 3.5 feet (2.0 acres), and 5.8 feet (1.0 acres). A cross section of the reach through the middle of the restored sandbar also shows these elevations.

3. FORAGE FISH MODEL

A workshop to develop suitability curves for forage fish in the Platte River was held in July 1986. Twenty-one individuals representing federal and state agencies, private conservation organizations and water development interests attended this workshop. Not all of the attendees were species experts (<u>sensu</u> Fannin and Nelson 1986). The attendees developed 52 Type 1 Habitat Suitability Index (HSI) curves (Bovee 1986) for five forage fish species using a modified Delphi technique (Crance 1982). By species considered, 11 HSI curves were developed for various life stages or activities of channel catfish (Ictalurus punctatus), 14 for common carp (**Cyprinus carpio**), and nine each for sand shiner (**Notropis stramineus**), plains killifish (Fundulus zebrinus), and flathead chub (**Hybopsis gracilis**).

Some of the species experts met again in April and July, 1988. Absent individuals were provided an opportunity to comment on the proceedings of the meeting(s) missed. These meetings further refined the curves and targeted the modeling process on two

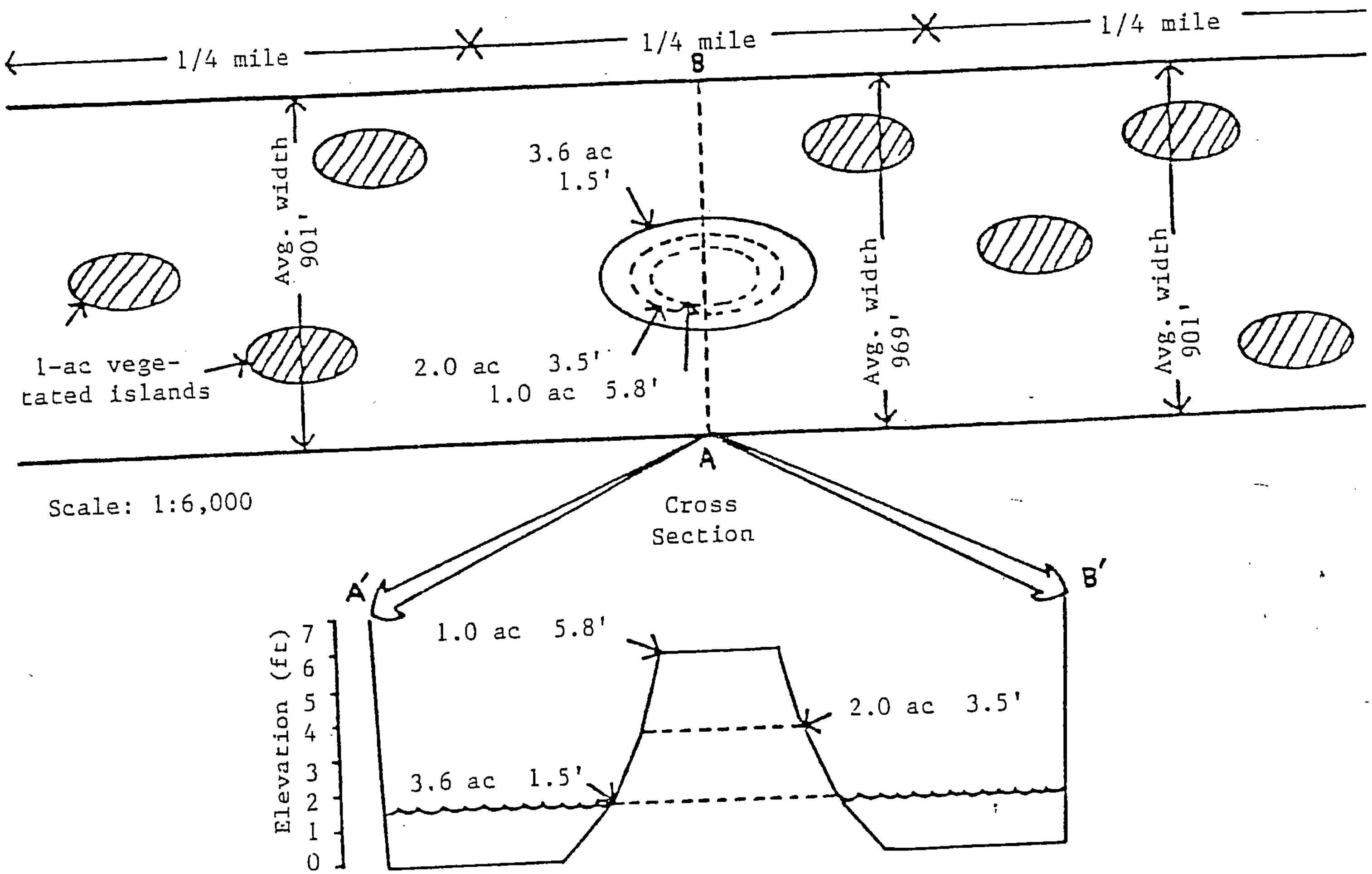


Figure 20. Minimum channel and sandbar dimensions for interior least tern and piping plover nesting habitat restoration on the Central Platte River.

species - sand shiner and channel catfish - rather than the five species discussed in Fannin and Nelson (1986).

On April 17, 1988, the species experts recommended that: 1) curves for common carp were unnecessary because suitability curves for channel catfish adequately model the needs of carp; 2) curves for flathead chub were unnecessary because of its relative scarcity in the central Platte River; and 3) curves for the plains killifish were unnecessary because similar sand shiner curves would adequately model killifish habitat requirements. Further, the experts agreed that the sand shiner, a common forage item for least terns, require physical habitat characteristics (e.g., depth and velocity) which adequately support other forage fish. For that reason, the experts chose the sand shiner to represent all species of the least terns forage fish in the Platte River.

Concurrent with the derivation of Type 1 HSI curves, Dr. Ed. Peters, (University of Nebraska-Lincoln) was investigating habitat suitability in the river reach downstream of the confluence of the Loup and Platte rivers. Preliminary results of his research (Peters et al. 1988) were available for consideration by species experts at the July 1988 meeting.

On July 13, 1988, the species experts reiterated that the two important species for modeling forage fish habitat in the Platte River were sand shiner and channel catfish. The implicit assumptions were: 1) if habitat is suitable for sand shiner, it is suitable for other forage fishes of least terns; 2) if habitat is suitable for channel catfish, it is suitable for other forage fish of bald eagles; 3) except for those life stages or time periods which were not sampled by Peters et al. (1988) the Type !!! HSI curves would be used for sand shiners and channel catfish; and 4) curves not derived by Peters for species, seasons, or life stages of interest would be taken from Fannin and Nelson (1986) as subsequently modified by species experts. The modifications considered were a) apply cold season curves regardless of the presence of ice cover on the river; and b) make minor changes to the channel catfish food "life stage" curve.

As of August 25, 1988, the habitat suitability curves to be used in the IFIM models were those for:

1. Channel catfish, with habitat ratios derived by NGPC and the Service,

2. Channel catfish food,

3. Sand shiner.

In addition to the HSI curves derived by the species experts, other researchers concurrently developed HSI curves for Platte

River fishes:

1. In fall 1989, Dr. Peters reanalyzed the data from Peters et al. (1988) to derive warm season curves for selected forage fish. Both are discussed by Peters, et al. (1989).

2. In 1987 and 1988, Chadwick and Associates, under contract to the Central Nebraska Public Power and Irrigation District (the Districts) conducted field studies in the upper Platte River and derived HSI curves for fish. A draft report was available in 1988 (Chadwick and Associates 1988). A final report was published in 1989 (Chadwick and Associates 1989).

3. In 1988, in preparation for the Prairie Bend project, the Bureau derived HSI curves for sand shiners only during the warm season using a recombination of Peters' 1988 spring, summer, and fall data.

The Workgroup believed that the species experts who derived the original Type 1 HSI curves should be given the opportunity to review the results of the additional research. The Workgroup then compiled all of the above curves for the species of interest and sent them out for comment to the experts in April 1989. Specifically, the experts were asked if they believed that a curve or curves previously agreed on should be replaced by one of the curves drafted by the Bureau, Chadwick and Associates, or Dr. Peters' recombination of data.

In order to give all parties a chance to provide final input to the HSI curve selection process, on February 22, 1990, the Workgroup hosted a meeting with members of the Service, Bureau, NGPC, and the Districts. Meeting attendance was limited to those who had actually collected data or derived HSI curves for fish in the Platte River. The meeting emphasized methods, assumptions, and techniques used by all of the researchers to derive their HSI curves. The purpose of the meeting was to provide the Workgroup with recommended curves.

RECOMMENDED HSI CURVES AND MODELING APPROACH

The principal objective of this effort is to identify conditions necessary to provide an adequate riverine environment to sustain the maximum diversity and abundance of forage fishes needed to support the recovery goals for endangered species.

At the conclusion of the February 22, 1990, meeting, the Service and NGPC met to develop recommendations and choose HSI curves for modeling forage fish habitat. At the outset, the Workgroup agreed that providing habitat for a diverse and abundant fishery in the river was the ultimate goal. Much additional data had been collected since the species experts met in 1986. The Workgroup has incorporated this new information into the modeling process.

The thrust of the original species experts' work was to select two species that had habitat requirements adequate to support all other forage fishes in the river. This "two-species" approach encumbers a single set of HSI curves to be equally applicable to the diverse habitat of the river (i.e., edges, backwaters, floodplains, riffles, sloughs, bridge abutments, etc.). Although it may be possible that habitat requirements of a single generalist species would be adequate to model habitat of all other species in small rivers, "organisms in large rivers often show a greater tendency toward habitat zonation and isolation and the use of specialized habitat types" (Stalnaker, et al. 1989). Overall, generalist species (those with a wide range of habitat preferences) may be relatively insensitive to flow changes (Leonard and Orth 1988); although other factors may also influence their habitat use.

The Service and NGPC recommended applying a "guild" approach to modeling fish habitat in the Platte River. A guild is a "group of species which exploit the same class of environmental resources in a similar way" (Root 1976, in Leonard and Orth 1988). The advantages of guilding are: 1) it addresses the greater habitat partitioning in larger rivers; 2) it reduces potential errors of applying a single set of habitat curves to the variety of habitats in a large river, if guild representatives are selected properly; and, 3) it more likely permits recommendations for instream flows which are compromises among the needs of all species. Although all HSI models are simplifications of natural systems, the guild approach is less a simplification than the single-species approach because it incorporates more than one species.

Thirteen species of Platte River fish have HSI curves for at least one of the traditional HSI variables (Table 18). Except for the plains killifish, the curves from Peters, et al. (1989) were selected for guild analysis based on sampling protocol (pre-positioned grids and proportional sampling), availability of cover curves, the availability of data, and the transferability of the curves based on the range of conditions present during data collection. The plains killifish models of Chadwick and Associates (1989) were used in the absence of a curve from Peters.

After the Service and NGPC chose the method of approach and appropriate HSI curves for all candidate species, the Service selected characteristic fish for the guilds. The Service based its selection on the technique suggested by Leonard and Orth (1988). Rather than using the single variable of velocity, the

Table 18. Habitat Suitability Index (HSI) curves for various Platte River fishes published by several investigators.

	Variable[b]			
Species/Life stage/Season[a]	Depth	Velocity	Substrate	Cover
Western silvery minnow	P	P	P	P
Plains minnow	P	P	P	P
Speckled chub	P	P	P	P
Flathead chub	P,F	P,F	P,F	P,F
River shiner/Juvenile/ Summer	P	P	P	P
River shiner	P	P	P	P
River carpsucker/Juvenile	P	P	P	P
Red shiner	P,C	P,C	P,C	P
Sand shiner	P,F,C	P,F,C	P,F,C	P,F
Channel catfish/Juvenile	P,C	P,C	P,C	P
Channel catfish	P,F	P,F	P,F	P,F
Flathead catfish	P	P	P	P
Plains killifish	C,F	C,F	C,F	[c]

[a]Unless otherwise noted, all are adults during the warm season.

[b]P = Peters, et al. 1989; F = Fannin and Nelson 1986; C = Chadwick and Associates 1989.

[c]Chadwick and Associates did not provide cover curves for any of the species they analyzed, but they have indicated that the information is available for curve development.

Service used both the velocity and depth variables to partition the Platte River habitat into four guilds. The four guilds were: 1) a slow/shallow guild, 2) a fast/shallow guild, 3) a slow/deep guild, and 4) a fast/deep guild (Figure 21). The X-Y coordinates of the velocity and depth at HSI = 1.0, 0.8, and 0.5 were plotted on the grid for each species in Table 18. Then the plots were inspected to select species characteristic for each of the guilds. This procedure is equivalent to ranking all common species by velocity preference as recommended by Leonard and Orth (1988).

By inspection of Figure 21, there were three guilds represented--none of the species in Table 17 were characteristic of the fast/deep guild. The channel catfish adults and flathead catfish (Pylodictus olivaris) adults were the members of the slow/deep guild, the speckled chub (Hybopsis aestivalis) represented the fast/shallow guild, and the remainder (excepting the channel catfish juvenile, which did not obviously fit in any guild) represented the slow/shallow guild. In keeping with the second suggestion of Leonard and Orth (1988) for selecting representatives for guilds, "Select species from the extremes of the...preference continuum," the Service next integrated the areas underneath the velocity and depth HSI curves for all the fish in the slow/shallow guild. The fish with the smallest total integrated area was the fish considered to have the most extreme velocity and depth requirements (Table 18).

The Service selected the channel catfish adult (Figure 22) as the characteristic species of the slow/deep guild; an adequate additional or alternate representative would be the flathead catfish. The velocity and depth requirements of these two fishes were about equally "extreme," with only about 5% difference between the integrated area under the depth and velocity curves. The Service selected the speckled chub (Figure 23) as the characteristic species of the fast/shallow guild, because it is the only member of the guild.

The fast/deep guild had no members. A strong candidate member is the goldeye (Hiodon alosoides). Dr. Peters' work on the Platte River is continuing, and he may be able to construct HSI curves for this species in the near future.

The slow/shallow guild has many species from which to choose a characteristic (Table 18). The Service selected the plains killifish (Figure 24) as the characteristic species. This species was the next most extreme in habitat preference (depth and velocity) in the guild and is much more easily identifiable, for validation purposes, than the most extreme example, the juvenile river shiner (Notropis blennius). The western silvery minnow (Hybognathus argyritis) is an acceptable additional species characteristic of this guild.

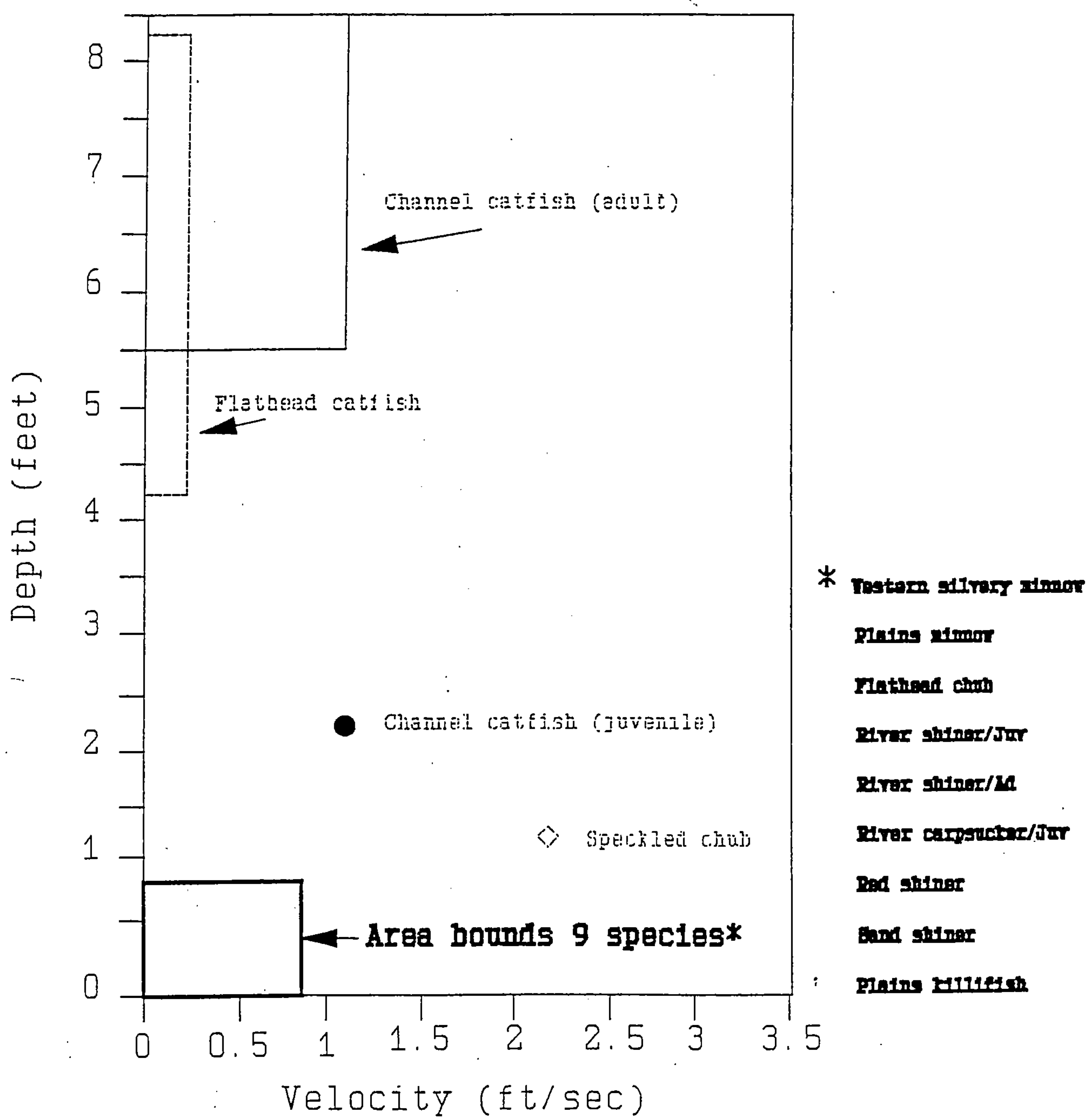


Figure 21. Depth/velocity plot of HSI = 1.0 for fish in the Platte River.

Table 19. Integrated areas under depth and velocity preference curves for Platte River fishes in the slow/shallow guild. The lowest rank signifies the most extreme velocity and depth requirements.

	Western Silvery Minnow	Plains Minnow	Flathead Chub
Depth area =	22.00	24.36	30.30
Velocity area=	29.75	41.50	68.63
Total Area =	51.75	65.86	98.93
Rank =	3	7	9

	River Carpsucker	Red Shiner	Sand Shiner
Depth area =	33.75	35.05	29.08
Velocity area=	26.25	32.13	30.25
Total Area =	60.00	67.17	59.33
Rank =	5	8	4

	Juvenile River Shiner	Adult (warm) River Shiner	Plains Killifish
Depth area =	10.60	30.27	11.49
Velocity area=	17.36	32.75	21.96
Total Area =	27.97	63.02	33.45
Rank =	1	6	2

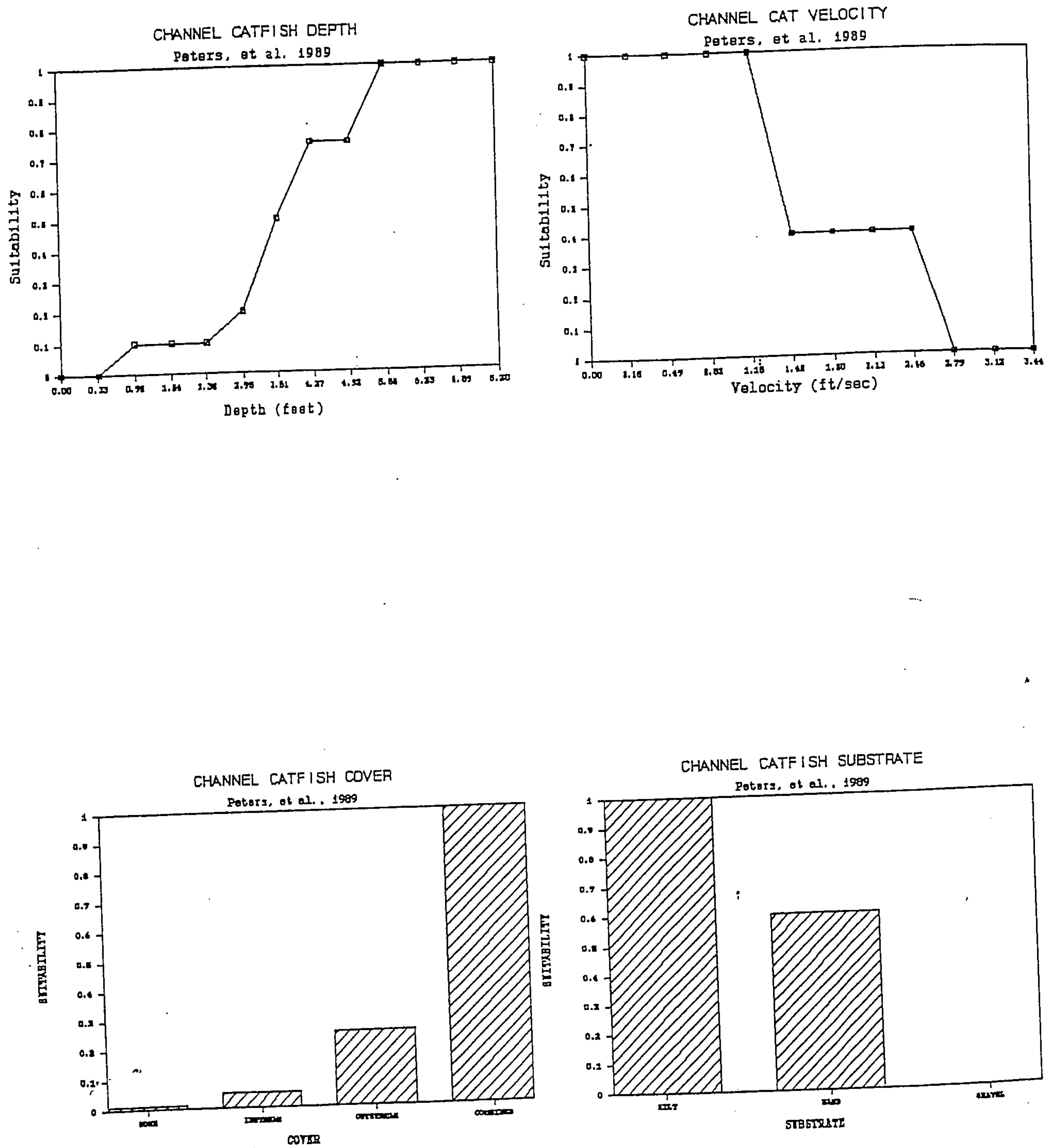


Figure 22. Habitat suitability curves for channel catfish.

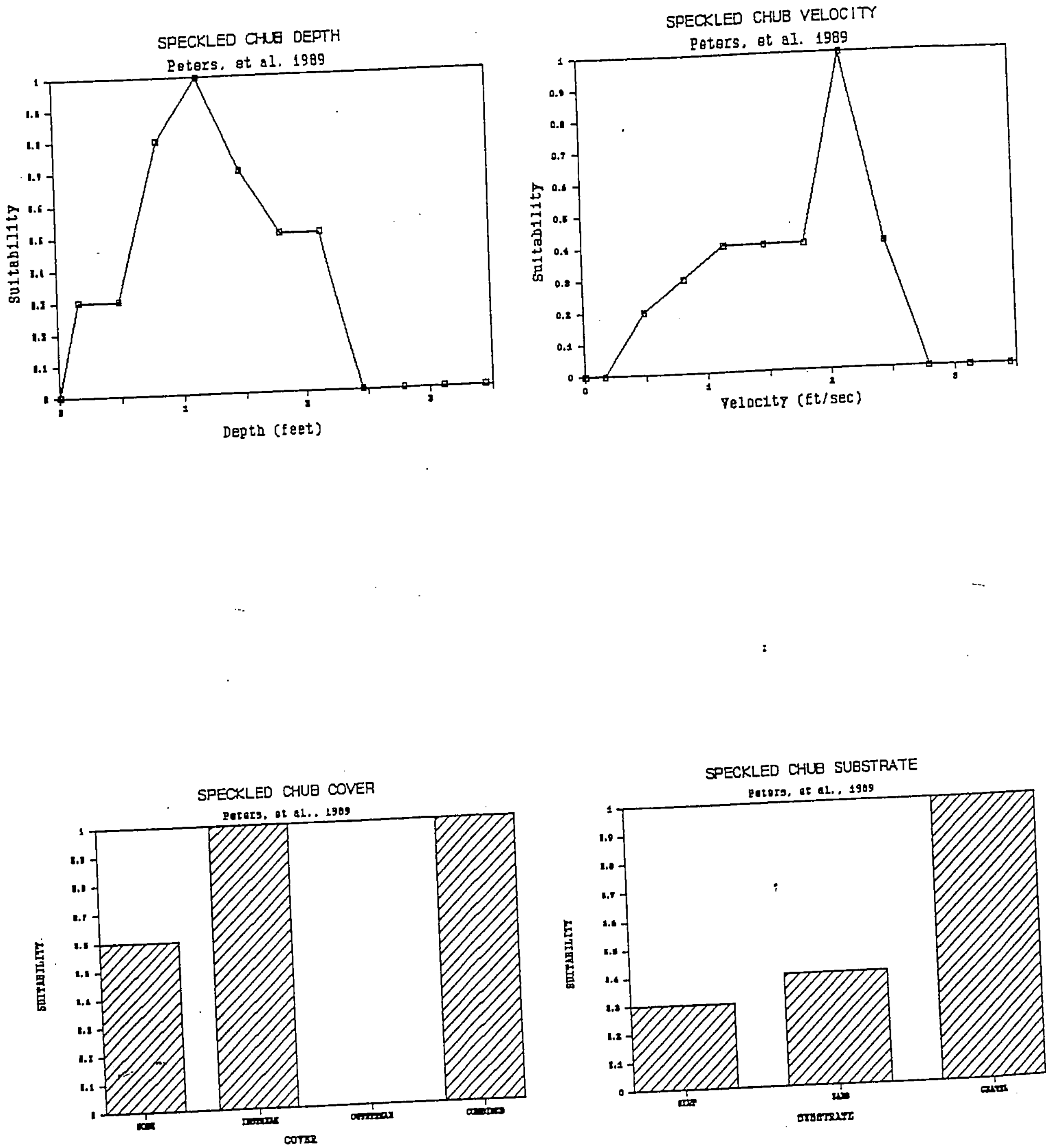


Figure 23. Habitat suitability curves for speckled chub adults.

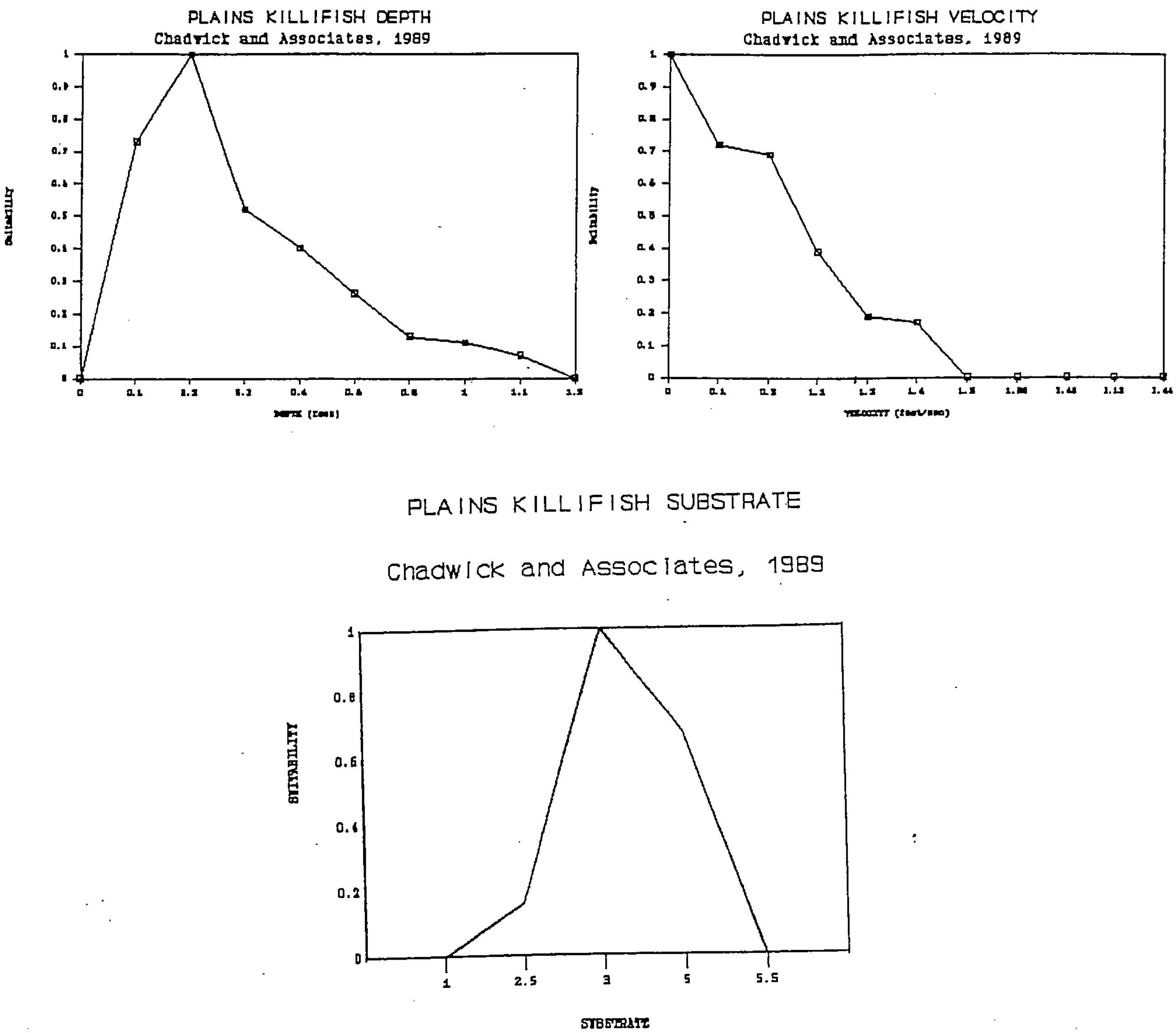


Figure 24. Habitat suitability curves for plains killifish adults. No curve is available for cover for this species.

ADDITIONAL RECOMMENDATIONS

The Workgroup adopted the guilding approach recommended by the Service and NGPC. The Workgroup recommends that this approach be applied in evaluation of management alternatives. The Workgroup recommends further that:

1. Additional data be collected to validate the HSI curves.

2. Application of the guilding approach in the PHABSIM process should be evaluated further.

3. The effect of including additional characteristic species (such as invertebrates) should be evaluated.

4. Additional research must be conducted to address special habitat types (e.g., sloughs, backwaters, etc) either by aerial photography or field work.

5. Cover codes need to be evaluated and standardized for all HSI curves and transect data (IFG-4 data decks).

CHAPTER 6

HABITAT MANAGEMENT ALTERNATIVES

Under current management programs implemented by the Platte River Whooping Crane Trust and the National Audubon Society about 8,000 acres of river channel, wet meadows, and riparian forest have been dedicated to management. Not all of this land is now or will be available to be developed specifically for endangered species management in the Big Bend of the Platte River. An additional 470 acres of land was recently acquired by the Wyoming Water Development Commission to offset the effects to downstream habitats from construction of the Deer Creek project in Wyoming. Management responsibilities for the Wyoming land have been turned over to the U.S. Fish and Wildlife Service.

Although the three entities mentioned above have developed their own management plans for the land under their jurisdiction, no coordinated habitat management scheme currently exists in the Big Bend reach of the Platte River. As an aid to future management direction the Biology Workgroup developed a series of eight possible management alternatives that could be implemented in the Platte River system.

The eight management alternatives developed are listed below. Presentation of these alternatives is in no particular order of preference. Following the alternatives, we provide a narrative description of methods that could be used to implement each alternative. The implementation methods are also listed in no particular order of preference.

The Biology Workgroup purposefully did not discuss water management methods in the description of alternatives. These methods will be developed more fully by the Hydrology Workgroup. However, the Biology Workgroup has developed a list of water management alternatives it believes will be useful to the Management Alternatives Workgroup in their deliberations.

PLATTE RIVER HABITAT MANAGEMENT ALTERNATIVES

A. Historic Conditions Plan

1. Conditions that are the goal of this alternative -- The principal goal of this plan is the restoration of the Platte River and associated habitats to its pre-1850 condition in the reach from Lexington to Chapman, Nebraska.

2. Describe the configuration of the managed areas: -- This alternative would involve the river channel and all lands for one mile on either side of the high banks of the river.

3. Describe the river reach that would be included in this alternative -- This plan would include the entire Big Bend reach from the J-2 return near Lexington, Nebraska, downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

   a. <u>In-Channel Vegetation Management</u>

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing
      6. Sediment supply and transport
      7. Instream structures
      8. Inundation flows
      9. Remove woody vegetation to reduce seed sources

   b. <u>Wet Meadow Management</u>

      1. Fire management
      2. Regulated grazing
      3. In-meadow water control structures
      4. Closing drainage ditches
      5. Conversion of agricultural land to wet meadows
      6. Change bank elevation
      7. Groundwater regulation
      8. Quantity and timing of flows
      9. Water quality improvement
      10. Haying

   c. <u>On-Site Species Management</u>

      1. Predator control
      2. Regulation of human activities
      3. Law enforcement
      4. Site-specific management

5. List the habitat protection techniques applicable to this alternative:

   a. <u>Methods</u>

      1. Fee title ownership
      2. Cooperative agreements with private landowners
      3. Conservation easements

4. Tax incentives for habitat maintenance by private landowners
5. Technical assistance by agencies
6. Land registry programs
7. Agricultural land management
8. Leasing
9. Zoning
10. Special designations
11. Floodplain management
12. Education

b. <u>Habitat Impacts</u>

1. Regulate industrial development
2. Regulate existing and future surface water development
3. Regulate groundwater development
4. Bank stabilization/channel stabilization activities
5. Road and bridge construction
6. Airport development
7. Adequate marking and routing of overhead wires
8. Regulate residential development
9. Sand and gravel development
10. Regulate agricultural development
11. Pesticides
12. Hazardous substance control
13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

<u>PROS</u>

1. Return all habitats to their pristine condition.

<u>CONS</u>

1. To implement this alternative, virtually all development in the Platte River valley would have to be removed including highway bridges and power lines. This alternative is impractical given the ownership, social structure, county, state, and national infrastructure requirements.

B. <u>Segment Management Plan</u>

1. Conditions that are the goal of this alternative -- Provide an area of habitat suitable for endangered species in each of the ten highway bridge segments between Lexington and Chapman, Nebraska.

2. Describe the configuration of the managed areas -- This alternative would involve discreet areas of habitat centered on the main channel of the river. Habitats within the areas would include a complex of shallow and deep river channel, unvegetated riverine sandbars, wet meadows, croplands, and some large trees to be used for bald eagle perches and roosts. Wet meadows would be confined to areas within one mile on either side of the high banks of the river. Segments would be smaller areas (e.g. 2500 acres) than the blocks in Alternative C.

3. Describe the river reaches that would be included in this alternative -- This plan would include each of the 10 bridge segments in the Big Bend of the Platte River from the J-2 return near Lexington, Nebraska, downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

   a. In-Channel Vegetation Management

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing
      6. Sediment supply and transport
      7. Instream structures
      8. Inundation flows
      9. Remove woody vegetation to reduce seed sources

   b. Wet Meadow Management

      1. Fire management
      2. Regulated grazing
      3. In-meadow water control structures
      4. Closing drainage ditches
      5. Conversion of agricultural lands to wet meadows
      6. Change bank elevation
      7. Groundwater regulation
      8. Quantity and timing of flows
      9. Chemical treatment
      10. Water quality improvement
      11. Haying
      12. In-channel water control structures
      13. Pumping

   c. On-Site Species Management

1. Predator control
2. Regulation of human activities
3. Law enforcement
4. Site-specific management

5. List the habitat protection techniques that are applicable to this alternative --

   a. <u>Methods</u>

      1. Fee title ownership
      2. Cooperative agreements with private landowners
      3. Conservation easements
      4. Tax incentives for habitat maintenance by private landowners
      5. Technical assistance by agencies
      6. Land registry programs
      7. Agricultural land management
      8. Leasing
      9. Zoning
      10. Special designations
      11. Floodplain management
      12. Education

   b. <u>Habitat Impacts</u>

      1. Regulate industrial development
      2. Regulate existing and future surface water development
      3. Regulate groundwater development
      4. Bank stabilization/channel stabilization activities
      5. Road and bridge construction
      6. Airport development
      7. Adequate marking and routing of overhead wires
      8. Regulate residential development
      9. Sand and gravel development
      10. Regulate agricultural development
      11. Pesticides
      12. Hazardous substance control
      13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

   <u>PROS</u>

   1. Provide roosting opportunities visible to whooping cranes wherever they cross the Platte River in its Big Bend reach.
   2. Achieve equal and frequent distribution of habitats for all endangered species.

3. Increased availability of habitat over current conditions.
4. An operational plan for this alternative currently exists.
5. Distribution of the endangered species over widespread areas reduces the potential negative effects of stochastic events (e.g., oil spills, storms, disease, drought, etc.) from decimating their populations.
6. Fewer land ownerships would be involved per river segment.
7. Increased opportunities for coordinated management of habitats.
8. Increased opportunities for public access to the river.

CONS

1. Increased management costs.
2. Logistical difficulties.
3. Greater likelihood of disturbance due to increased area of perimeter.
4. Habitat degradation will still occur in unmanaged areas.
5. May require more extensive restoration of degraded habitats.
6. Suitable habitat may not be available in each segment.
7. Increased administrative costs.
8. Increased opportunity for genetic isolation among nesting least terns and piping plovers.

C. Block Management Plan

1. Conditions that are the goal of this alternative -- Intensive management of up to four specific habitat areas on the Platte River evenly distributed between the J-2 return downstream to near Chapman, Nebraska.

2. Describe the configuration of the managed areas -- This alternative would involve blocks of habitat centered on the river channel and extending out up to 1.5 miles from either of the high banks of the river. Ideally, each management block would be centered within single bridge segments to avoid disturbance.

3. Describe the river reaches that would be included in this alternative -- The Block Management Plan would involve habitat in discreet river reaches including: 1) the Overton area extending from the J-2 river return downstream to the Elm Creek bridge; 2) the Kearney-Gibbon area extending from 2 miles downstream from the Kearney bridge to 2 miles downstream from the Gibbon bridge; and 3) the Mormon Island reach extending from 2 miles above the Wood River bridge to

2 miles downstream from the U.S. Highway 34 bridge near Grand Island.

4. List the habitat management techniques that are applicable to this alternative --

   a. <u>In-Channel Vegetation Management</u>

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing
      6. Sediment supply and transport
      7. Instream structures
      8. Inundation flows
      9. Remove woody vegetation to reduce seed sources.

   b. <u>Wet Meadow Management</u>

      1. Fire management
      2. Regulated grazing
      3. In-meadow water control structures
      4. Closing drainage ditches
      5. Conversion of agricultural lands to wet meadows
      6. Change bank elevation
      7. Groundwater regulation
      8. Quantity and timing of flows
      9. Chemical treatment
      10. Water quality improvement
      11. Haying
      12. In-channel water control structures
      13. Pumping

   c. <u>On-Site Species Management</u>

      1. Predator control
      2. Regulation of human activities
      3. Law enforcement
      4. Site-specific management
      5. List the habitat protection techniques applicable to this alternative --

   a. <u>Methods</u>

      1. Fee title ownership
      2. Cooperative agreements with private landowners

2. Cooperative agreements with private landowners
3. Conservation easements
4. Tax incentives for habitat management by private landowners
5. Technical assistance by agencies
6. Land registry programs.
7. Agricultural land management
8. Leasing
9. Zoning
10. Special designations
11. Floodplain management
12. Education

b. <u>Habitat Impacts</u>

1. Regulate industrial development
2. Regulate existing and future surface water development
3. Regulate groundwater development
4. Bank stabilization/channel stabilization activities
5. Road and bridge construction
6. Airport development
7. Adequate marking and routing of overhead wires
8. Regulate residential development
9. Sand and gravel development
10. Regulate agricultural development
11. Pesticides
12. Hazardous substance control
13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

<u>PROS</u>

1. Large units are more efficiently managed.
2. Large units are more cost efficient at initial acquisition.
3. Large units are more efficient in minimizing disturbances.
4. Large units are more efficient in providing contiguous area to satisfy the species habitat requirements (e.g., feeding, roosting, nesting, habitat all in one unit).
5. Increased availability of habitat over current conditions.
6. Achieves equal distribution of habitats for all endangered species.
7. Less restoration management may be required if the blocks are centered on the best available existing habitat.

9. Reduction in the probability of reduced gene flow among nesting least terns and piping plovers.
10. Increased opportunities for coordinated management of habitats.
11. Increased opportunities for public access to the river.

CONS

1. Increased likelihood of population declines among whooping cranes due to stochastic events.
2. Habitat degradation would continue to occur outside of the managed areas.
3. Acquisition difficulties could arise from dealing with increased numbers of landowners.
4. Nesting, roosting, and foraging opportunities are less frequently distributed.
5. Reduced likelihood of obtaining a contiguous tract of desireable habitat.

D. Block/Segment Plan

1. Conditions that are the goal of this alternative -- A mixture of the Block and Segment Management Plans with smaller managed segments between the intensively managed blocks. Ideally there would be a management area in each bridge segment.

2. Describe the configuration of the managed areas -- This alternative would involve blocks of habitat centered on the river channel and extending out up to 1.5 miles from either of the high banks of the river. The plan also includes areas of habitat centered on the river channel in river reaches between the intensively managed blocks. Managed wet meadows would be confined to areas within one mile on either side of the high banks of the river.

3. Describe the river reaches that would be included in this alternative -- This plan would include each of the ten bridge segments between the J-2 river return near Lexington downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

   a. In-Channel Vegetation Management

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing

6. Sediment supply and transport
7. Instream structures
8. Inundation flows
9. Remove woody vegetation to reduce seed sources

b. <u>Wet Meadow Management</u>

1. Fire management
2. Regulated grazing
3. In-meadow water control structures
4. Closing drainage ditches
5. Conversion of agricultural lands to wet meadows
6. Change bank elevation
7. Groundwater regulation
8. Quantity and timing of flows
9. Chemical treatment
10. Water quality improvement
11. Haying
12. In-channel water control structures
13. Pumping

c. <u>On-Site Species Management</u>

1. Predator control
2. Regulation of human activities
3. Law enforcement
4. Site-specific management

5. List the habitat protection techniques applicable to this alternative --

a. <u>Methods</u>

1. Fee title ownership
2. Cooperative agreements with private landowners
3. Conservation easements
4. Tax incentives for habitat maintenance by private landowners
5. Technical assistance by agencies
6. Land registry programs
7. Agricultural land management
8. Leasing
9. Zoning
10. Special designations
11. Floodplain management

12. Education

b. Habitat Impacts

1. Regulate industrial development
2. Regulate existing and future surface water development
3. Regulate groundwater development
4. Bank stabilization/channel stabilization activities
5. Road and bridge construction
6. Airport development
7. Adequate marking and routing of overhead wires
8. Regulate residential development
9. Sand and gravel development
10. Regulate agricultural development
11. Pesticides
12. Hazardous substance control
13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

The positive and negative aspects of this alternative are essentially the same as those of Alternatives B and C, depending on the mix of the blocks and segments. The principal advantage of this alternative is its flexibility, and therefore may be more pragmatic. This alternative could allow for the maximization of the best features of each of the two previous alternatives.

Specific advantages and disadvantages of this alternative include:

PROS

1. Provide roosting opportunities visible to whooping cranes wherever they cross the Platte River in its Big Bend reach.
2. Achieves equal and frequent distribution of habitats for all endangered species.
3. Increased availability of habitat over current conditions.
4. An operational plan for the segment portion of this alternative currently exists.
5. Distribution of the endangered species over widespread areas reduces the potential negative effects of stochastic events (e.g., oil spills, storms, disease, drought, etc.) from decimating their populations.
6. Increased opportunities for coordinated management of habitats.
7. Large units are more efficiently managed.

8. Large units are more cost efficient at initial acquisition.
9. Large units are more efficient in minimizing disturbances.
10. Large units are more efficient in providing contiguous area to satisfy the species habitat requirements (e.g., feeding, roosting, nesting, habitat all in one unit).
11. Less restoration management may be required if blocks and segments are centered on the best available existing habitat.
12. Protection of wet meadows could be more easily achieved in large units because of increased control of land area.
13. Reduction in the probability of reduced gene flow among nesting least terns and piping plovers.
14. Increased opportunities for public access to the river.

<u>CONS</u>

1. Increased management costs.
2. Habitat degradation will still occur in unmanaged areas.
3. May require more extensive restoration of degraded habitats.
4. Suitable habitat may not be available in each segment.
5. Increased administrative costs.
6. Acquisition difficulties could arise from dealing with increased numbers of landowners.

E. <u>Maintain the Status Quo</u>

1. Conditions that are the goal of this alternative -- Maintain the available habitat at existing acreages and reasonably foreseeable projects.

2. Describe the configuration of managed areas -- This plan provides for no new lands to be acquired or managed in the Platte River valley other than those currently planned.

3. Describe the river reaches to be included in this alternative --This plan would involve the entire Big Bend reach from the J-2 river return near Lexington, downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

a. <u>In-Channel Habitat Management</u>

1. Mechanical clearing
2. Scouring flows
3. Chemical control
4. Fire management
5. Regulated grazing
6. Sediment supply and transport
7. Remove woody vegetation to reduce seed sources

b. Wet Meadow Management

1. Fire management
2. Regulated grazing
3. In-meadow water control structures
4. Closing drainage ditches
5. Conversion of agricultural lands to wet meadows
6. Change bank elevation
7. Chemical treatment
8. Water quality improvement
9. Haying
10. Pumping

c. On-Site Species Management

1. Predator control
2. Regulation of human activities
3. Law enforcement
4. Site-specific management

5. List the habitat protection techniques that are applicable to this alternative --

a. Methods

1. Fee title ownership
2. Conservation easements
3. Technical assistance by agencies
4. Leasing
5. Education

b. Habitat Impacts

1. Regulate existing and future surface water development
2. Regulate groundwater development
3. Bank stabilization/channel stabilization activities
4. Road and bridge construction
5. Airport development
6. Adequate marking and routing of overhead wires
7. Regulate residential development
8. Sand and gravel development
9. Regulate agricultural development

10. Pesticides
11. Hazardous substance control
12. Airspace restrictions

6. Discuss the pros and cons of this alternative:

<u>PROS</u>

1. No increase in public expense.
2. No future water development.
3. Existing management areas would be maintained.

<u>CONS</u>

1. High per-acre management costs due to increased vegetation removal requirements on managed areas.
2. No improvement in flow conditions.
3. No commitment to management by Federal agencies.
4. No additional management opportunities.
5. No future water development.
6. Habitat degradation will still occur in unmanaged areas.
7. Reduced opportunities to effect endangered and threatened species recovery.
8. Nesting, roosting, and foraging opportunities are less frequently distributed.
9. No opportunity to obtain a contiguous tract of desireable habitat.
10. Less increase in opportunities for public access to the river.
11. Reduced likelihood of coordinated management of Platte River habitats.

F. <u>The 89-Mile Plan</u>

1. Conditions that are the goal of this alternative -- Maximize habitat management opportunities over the entire reach from Lexington to Chapman, Nebraska, under the best possible conditions.

2. Describe the configuration of the managed areas -- This alternative would involve all the land within one mile of the river channel.

3. Describe the river reaches that would be included in this alternative -- This plan would include the entire Big Bend reach from the J-2 river return near Lexington, downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

   a. <u>In-Channel Vegetation Management</u>

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing
      6. Sediment supply and transport
      7. Instream structures
      8. Inundation flows
      9. Remove woody vegetation to reduce seed sources

   b. <u>Wet Meadow Management</u>

      1. Fire management
      2. Regulated grazing
      3. In-channel water control structures
      4. Closing drainage ditches
      5. Conversion of agricultural lands to wet meadows
      6. Change bank elevation
      7. Groundwater regulation
      8. Quantity and timing of flows
      9. Chemical treatment
      10. Water quality improvement
      11. Haying
      12. In-channel water control structures
      13. Pumping

   c. <u>On-Site Species Management</u>

      1. Predator control
      2. Regulation of human activities
      3. Law enforcement
      4. Site-specific management

5. List the habitat protection techniques applicable to this alternative --

   a. <u>Methods</u>

      1. Fee title ownership
      2. Cooperative agreements with private landowners
      3. Conservation easements
      4. Tax incentives for habitat maintenance by private landowners
      5. Technical assistance by agencies
      6. Land registry programs

7. Agricultural land management
8. Leasing
9. Zoning
10. Special designations
11. Floodplain management
12. Education

b. <u>Habitat Impacts</u>

1. Regulate industrial development
2. Regulate existing and future surface water development
3. Regulate groundwater development
4. Bank stabilization/channel stabilization activities
5. Road and bridge construction
6. Airport development
7. Adequate marking and routing of overhead wires
8. Regulate residential development
9. Sand and gravel development
10. Regulate agricultural development
11. Pesticides
12. Hazardous substance control
13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

<u>PROS</u>

1. Maximization of habitat management opportunities throughout the Big Bend reach.
2. Widespread availability of endangered species habitats.
3. Existing management areas would be maintained and possibly expanded.
4. Increased likelihood of large contiguous tracts of managed habitat.
5. Greater flexibility of management opportunities.
6. Expanded opportunities for preservation and management of habitat.
7. Increased opportunities for public access to the river.

<u>CONS</u>

1. Very expensive to implement.
2. Very complex land acquisition program.
3. Greater management difficulty.
4. Increased logistical difficulties.
5. Very high management costs.
6. May require more extensive restoration of degraded habitat.

G. Platte River System Management Plan

1. Conditions that are the goal of this alternative -- Maximize habitat management opportunities on the entire Platte River system in Nebraska including the North Platte and South Platte rivers upstream to the Colorado and Wyoming borders.

2. Describe the configuration of the managed areas -- This plan would involve the river channel and all land for one mile on either side of the high banks of the rivers.

3. Describe the river reaches that would be included in this alternative -- The System Management Plan would involve maximizing management possibilities throughout the river system from the Colorado and Wyoming borders east along the mainstem stem Platte River to its confluence with the Missouri River.

4. List the habitat management techniques that are applicable:

   a. In-Channel Vegetation Management

      1. Mechanical clearing
      2. Scouring flows
      3. Chemical control
      4. Fire management
      5. Regulated grazing
      6. Sediment supply and transport
      7. Instream structures
      8. Inundation flows
      9. Remove woody vegetation to reduce seed sources

   b. Wet Meadow Management

      1. Fire management
      2. Regulated grazing
      3. In-channel water control structures
      4. Closing drainage ditches
      5. Conversion of agricultural lands to wet meadows
      6. Change bank elevation
      7. Groundwater regulation
      8. Quantity and timing of flows
      9. Chemical treatment
      10. Water quality improvement
      11. Haying
      12. In-channel water control structures
      13. Pumping

c. <u>On-Site Species Management</u>

1. Predator control
2. Regulation of human activities
3. Law enforcement
4. Site-specific management

5. List the habitat protection techniques applicable to this alternative --

a. <u>Methods</u>

1. Fee title ownership
2. Cooperative agreements with private landowners
3. Conservation easements
4. Tax incentives for habitat maintenance by private landowners
5. Technical assistance by agencies
6. Land registry programs
7. Agricultural land management
8. Leasing
9. Zoning
10. Special designations
11. Floodplain management
12. Education

b. <u>Habitat Impacts</u>

1. Regulate industrial development
2. Regulate existing and future surface water development
3. Regulate groundwater development
4. Bank stabilization/channel stabilization activities
5. Road and bridge construction
6. Airport development
7. Adequate marking and routing of overhead wires
8. Regulate residential development
9. Sand and gravel development
10. Regulate agricultural development
11. Pesticides
12. Hazardous substance control
13. Airspace restrictions

6. Discuss the pros and cons of this alternative:

The advantages and disadvantages of this alternative listed below are the same as those of the 89-Mile Plan. Because the plan involves the entire river system from the Colorado and Wyoming borders downstream through Nebraska, management opportunities are the greatest of any of the plans described. However, the magnitude of the negatives is increased considerably by the greater management costs and increased logistical difficulties.

PROS

1. Maximization of habitat management opportunities throughout the Platte River system.
2. Widespread availability of endangered species habitats.
3. Existing management areas would be maintained and possibly expanded.
4. Increased likelihood of large contiguous tracts of managed habitat.
5. Greater flexibility of management opportunities.
6. Expanded opportunities for preservation and management of habitat.
7. Increased opportunities for public access to the river.

CONS

1. Very expensive to implement.
2. Very complex land acquisition program.
3. Greater management difficulty.
4. Increased logistical difficulties.
5. Very high management costs.
6. May require more extensive restoration of degraded habitat.

H. No Action Plan

1. Conditions that are the goal of this plan -- No management of existing habitats by any organization.

2. Describe the configuration of the managed areas -- No specific management areas are defined as a part of this alternative. Future availability of habitat for endangered species would result from reliance on private landowner initiative.

3. Describe the river reaches that would be included in this alternative -- This alternative is applicable to the entire Big Bend reach from the J-2 river return near Lexington, downstream to near Chapman, Nebraska.

4. List the habitat management techniques that are applicable to this alternative --

   a. In-Channel Vegetation Management

1. Mechanical clearing (by waterfowl hunters)

b. Wet Meadow Management

None

c. On-Site Species Management

1. Law enforcement

5. List the habitat protection techniques applicable to this alternative --

a. Methods

None

b. Habitat Impacts

None

6. Discuss the pros and cons of this alternative:

PROS

1. No management costs.

CONS

1. Habitat degradation will continue to occur.
2. Greater likelihood of disturbance to endangered species occupying the river.
3. Increased likelihood of population declines among whooping cranes due to stochastic events.
4. Nesting, roosting, and foraging opportunities would be greatly reduced.
5. No improvement in flow conditions.
6. No commitment to management by Federal agencies.
7. No additional management opportunities.
8. Loss of opportunities to effect endangered and threatened species recovery.
9. No opportunity to obtain a contiguous tract of desireable habitat.
10. No increase in opportunities for public access to the river.
11. No opportunity for coordinated management of Platte River habitats.

ALTERNATIVE IMPLEMENTATION METHODS

Below we provide a brief narrative of the components of each of the implementation techniques that can be used with the management alternatives.

I. Water Management

1. Change Bureau of Reclamation operations on the North Platte River system to benefit instream flows -- Possible changes in Bureau operations may provide water sources to benefit instream flows.

2. Operation of Federal Energy Regulatory Commission projects -- Changes in the operation of FERC licensed projects may provide water sources to benefit instream flows.

3. Allocation of unappropriated water for instream flows -- Seek an allocation of unappropriated water for instream flows from the Nebraska Department of Water Resources.

4. Buy out of consumptive water rights and convert to instream flows -- Acquisition of existing water rights and transfer of those rights to assure flows during crucial time periods each year.

5. Federal water rights -- The United States government could acquire an instream flow right in the Platte River.

6. Development of new storage to augment flows -- Construction of streamside reservoirs designed for releases to augment flows during crucial time periods each year. This would require a storage use right for instream flow purposes.

7. No further development of some water resource projects -- Relinquishment of State, Federal, or local water development projects planned in the Platte River system in Colorado, Nebraska, and Wyoming.

8. Regulate groundwater withdrawals -- The Nebraska State legislature could enact laws to regulate groundwater pumping during crucial time periods each year to prevent depletion of instream flows.

9. On-farm water conservation measures and conveyance facilities -- Upgrading diversion canals and other irrigation facilities to improve their efficiency of water delivery.

10. Buy out and convert existing water projects/rights -- Water stored in some upstream water project reservoirs that is not being used for irrigation purposes could be acquired by a

Federal or State agency. Acquisition would allow for release of those waters to augment depleted flows in the system.

11. Purchase storage rights -- Federal or State government agencies could purchase rights to water that would be stored in existing storage facilities. The stored water would be released at crucial time periods to augment instream flows.

12. Change Bureau of Reclamation operations on the South Platte River to augment instream flows -- Alteration of Bureau operations on the South Platte River system could improve the efficiency of managing water storage and timing water releases in the system in Colorado.

13. Buy out and convert existing water rights on the South Platte River -- Some water rights existing in the south Platte River system could be purchased and converted to instream flows.

14. Water transfers -- Cooperative agreements, memoranda of understanding, and other avenues may be used to affect inter-basin water transfers.

15. Corps of Engineers flood control operations on the South Platte River -- Modification of operation of COE flood control projects to benefit instream flows.

16. Improve efficiency of industrial water use -- Federal, State, or local incentives could be developed to encourage better management of industrial water use in the Platte River basin.

17. Improve efficiency of municipal water use -- Federal, State, or local incentives could be developed to encourage better management of municipal water use in the Platte River basin. Communities could be required to install water meters on homes to curtail unregulated water use.

18. Conversion of existing water uses -- New water projects could obtain their water from previously developed sources.

19. Control high flows -- Provide a mechanism to prevent flows that would inundate least tern and piping plover nests.

II. <u>In-Channel Vegetation Management</u>

1. Mechanical clearing -- Several types of machines and hand tools are available to remove encroached woody vegetation from riverine sandbars and from adjacent streamside areas.

Clearing can be used to enhance some areas to provide roosting and nesting habitat.

2. Scouring flows -- High flows of sufficient magnitude and duration could be used to remove some encroached annual and perennial vegetation from riverine areas. Scouring flows rework bottom sediments.

3. Chemical control -- Properly labeled herbicides could be used in some areas to retard encroached woody vegetation. Widespread use of chemicals could produce detrimental impacts to non-target areas.

4. Fire management -- Repeated (annual) controlled burns could be used on riverine and streamside areas sandbars to retard encroaching woody and herbaceous vegetation.

5. Regulated grazing -- Under some circumstances, grazing by ungulates could be used to retard encroaching woody and herbaceous vegetation.

6. Sediment supply and transport -- Adequate supplies of sediments transported by flows of sufficient volume could remove some annual and perennial vegetation from riverine areas.

7. Instream structures -- Temporary low-head dams could be constructed to drown in-channel vegetation. Channel blocks and other structures could be constructed to redirect flows to encourage erosion of sandbars and islands.

8. Inundation flows -- Properly timed flows of sufficient volume and duration could be used to drown seeds or seedlings of encroaching vegetation.

9. Remove woody vegetation to reduce seed sources -- Cottonwood and other tree species in streamside areas could be cut down to reduce seed sources.

10. No vegetation management -- The absence of manipulative management would allow succession of woody and herbaceous continue until equilibrium is reached.

III. <u>Wet Meadow Management</u>

1. Fire management -- Repeated (annual) controlled burns could be used to retard encroaching woody vegetation. Fire at the proper time could also be used to stimulate or retard the production of cool-season or warm-season native grasses and forbs. Fire can reduce the height of the vegetation to improve foraging opportunities for whooping cranes.

2. Regulated grazing -- Under some circumstances, grazing by ungulates could be used to retard encroaching woody vegetation. Grazing at the proper time could also be used to stimulate or retard the production of cool-season or warm-season native grasses and forbs. Grazing can reduce the height of the vegetation to improve foraging opportunities for whooping cranes.

3. In-meadow water control structures -- Some structures could be constructed to hold runoff to stimulate the growth of wet meadow vegetation.

4. Closing drainage ditches -- Closing ditches could be used to restore the water supply to wet meadow vegetation.

5. Conversion of agricultural lands to wet meadows -- Low-lying agricultural land could be acquired and managed to restore wet meadow vegetation.

6. Change bank elevation -- Channel banks could be lowered to encourage water infiltration to wet meadows.

7. Groundwater regulation -- Changes in pumping policies could be sought to discourage excessive removal of shallow groundwater supplies.

8. Quantity and timing of flows -- Properly timed high quantity flows could be used to provide a proper water regime for wet meadow vegetation.

9. Chemical treatment -- Properly labeled herbicides could be used in some areas to retard encroaching woody vegetation. Widespread use of chemicals could produce detrimental impacts to non-target areas.

10. Water quality improvement -- Non-point source pollution could be reduced to improve water quality. Improved land management techniques could be encouraged in adjacent areas to manage runoff.

11. Haying -- Haying could be used to retard encroaching woody vegetation. Haying at the proper time could also be used to stimulate or retard the production of cool-season or warm-season native grasses and forbs. Haying can reduce the height of the vegetation to improve foraging opportunities for whooping cranes.

12. In-channel water control structures -- Some structures could be constructed to hold sediment and raise the channel bed. Other structures could be used to divert stream flows.

13. Pumping -- Water could be pumped from the aquifer or from the river channel to provide an additional source of water for wet meadows.

IV. On-Site Species Management

1. Predator control -- Trapping, predator enclosures, and other activities could be used to reduce or eliminate some predators from least tern and piping plover nesting colonies.

2. Regulation of human activities -- Road construction, housing developments, and disruptive recreational activities should be discouraged near nesting, roosting, and foraging areas.

3. Law enforcement -- An aggressive law enforcement effort could be put in place to discourage taking of endangered birds.

4. Site-specific management -- Nesting roosting or foraging habitat could be developed in suitable areas in and adjacent to the river channel.

V. Habitat Protection Methods

1. Fee title ownership -- Ownership by a government agency or conservation organization could be used in some areas to provide permanent protection of habitat.

2. Cooperative agreements with private landowners -- Short-term or long term management agreements could be used to protect nesting or roosting habitat.

3. Conservation easements -- Perpetual easements could be acquired to remove development threats in some areas.

4. Tax incentives for habitat maintenance by private landowners -- State or local governments could enact certain tax incentives to encourage conservation of endangered species habitat by private landowners.

5. Technical assistance by agencies -- The U.S. Fish and Wildlife Service, Nebraska Game and Parks Commission, or the Natural Resource Districts could provide private landowners with assistance in protecting or managing endangered species habitat.

6. Land registry programs -- Registry programs could be developed to recognize important endangered species habitat.

7. Agricultural land management -- Landowners could be encouraged to implement a crop management program to ensure the continued existence of crops as forage items in some areas.

8. Leasing -- Short-term or perpetual lease agreements could be developed to encourage the preservation of endangered species habitat.

9. Zoning -- Zoning ordinances could be enacted or strengthened to encourage the conservation of endangered species habitat on private lands.

10. Special designations -- Wild and Scenic River and similar designations could be used to discourage development and encourage conservation of endangered species habitat.

11. Floodplain management -- Special designations could be sought to plan the future development of lands in the floodplain of the Platte River.

12. Education -- An effective, widespread education program could be implemented to inform the public about endangered species and their habitats in the Platte River valley.

VI. <u>Habitat Impacts</u>

1. Regulate industrial development -- Future construction of industrial facilities that consume large quantities of water or displace or affect endangered species habitats could be restricted.

2. Regulate existing and future surface water development -- Water development could be regulated to maintain an appropriate instream flow regime.

3. Regulate groundwater development -- Regulation of future development could be used to discourage overuse of groundwater resources.

4. Bank stabilization/channel stabilization activities -- The Corps of Engineers could discourage the placement of stabilization structures that disrupt flows or sediment transport. Existing techniques could be altered to improve their efficiency.

5. Road and bridge construction -- Regulation of highway construction activities could be expanded to conserve terrestrial habitats and minimize impacts to flow regimes.

6. Airport development -- Construction of new airport facilities in the floodplain should be discouraged to protect terrestrial habitats, avoid disturbance of roosting, foraging, or nesting birds, and reduce the likelihood of airplane collisions with birds.

7. Adequate marking and routing of overhead wires -- Future construction of overhead wires should be encouraged to remain within existing occupied corridors. Existing overhead wires that could cause mortality to birds in flight could be marked to increase visibility.

8. Regulate residential development -- Future residential development in the floodplain could be planned to avoid the destruction of existing terrestrial habitats, and to avoid disturbance to roosting, nesting, and foraging endangered species.

9. Sand and gravel development -- Sandpit development could be regulated to minimize negative impacts to existing habitats. Sandpits could be intensively managed to maximize nesting or foraging opportunities for least terns and piping plovers.

10. Regulate agricultural development -- Various programs of the U.S. Department of Agriculture could be used to regulate future agricultural activities to enhance endangered species habitat.

11. Pesticides -- Buffer zones could be established to minimize exposure of endangered birds to potentially lethal chemicals.

12. Hazardous substance control -- Toxic chemicals and other hazardous substances should be discouraged from being used or disposed near areas that might be occupied by endangered species.

13. Airspace restrictions -- The Federal Aviation Administration and Department of Defense could impose stricter airspace restrictions to minimize disturbance of endangered birds, and to reduce the likelihood of collisions with birds in flight.

CHAPTER 7

THE FUTURE

The Coordinating Committee directed the Biology Workgroup to develop a program to monitor a recommended management plan for the Platte River in its Big Bend Reach. Later instructions directed the Workgroup to develop only a series of management alternatives without selecting a recommended plan. Lacking a specific management goal makes development of a goal-specific monitoring plan impossible to develop. As an alternative, the Biology Workgroup adapted the following generic monitoring plan from one developed by Currier et al. (1985). At the conclusion of this plan we present several species-specific efforts that can be used to monitor population and habitat change among individual endangered species occupying the Platte River. A goal-specific management plan will be developed after the Management Alternatives Workgroup has selected a preferred alternative.

Platte River Monitoring Program

The goals of a monitoring program for the Platte River ecosystem include:

1. Establish the quantity and quality of existing endangered species habitat in the Big Bend of the Platte River.

2. Predict trends in the quality and quantity of endangered species habitat.

3. Periodically measure the quantity and quality of endangered species habitat and their populations to assess changes over time.

4. Provide information to assist efforts to plan effective habitat restoration and preservation.

5. Update and refine endangered species models based on new data.

The current status of endangered species habitat along the Platte River is described earlier in this report. A review of historical habitat conditions (prior to settlement) is presented as a perspective for the current habitat status. Subsequent monitoring reports will focus primarily on habitat and population changes. Updated reports will be issued periodically as major changes occur.

In order to monitor habitat for endangered species, an understand the life-history characteristics of the species is required. After these characteristics are known, the environmental data needed to monitor the habitat can be determined. For instance, grasslands of a particular size may be required before a certain species will nest. To assess the status of nesting habitat for this species, environmental data regarding the size and location of grassland tracts would therefore be needed.

Analyzing the juxtaposition of habitat components is a difficult task because they are usually distributed unevenly and occur at different frequencies. Consideration must be given to the relative value of each habitat component to the species, as well as the effective area of each component (accounting for disturbances). Such an analysis is even more complex when one considers the number of endangered species using the Platte River and that different species may be competing for some of the same habitat components.

To monitor the complexity of habitat requirements and habitat distribution, two computer-based analysis techniques will be used. A geographical information management system (GIS) is needed which indicates the location of roads, forests, crop types, and other land features which are entered into a computer based on their geographic locations. These mapped data can be accessed, manipulated, and displayed through the computer. The second technique involves the use of habitat suitability models to measure the relative value of habitat for each species. Based on these needs, mapped geographical information (including the abundance and distribution of habitat components) can be evaluated to determine the habitat suitability for a particular species. Both distance measures (position of different habitat components in relation to one another) and the amount of habitat available are considered in the evaluation.

The first step in the development of a GIS is to classify all the land surface cover types. Cover type classes are determined primarily by the habitat requirements of the species or their responses to particular habitat components. For example, to assess the value of an area for whooping cranes roosting, positive river channel habitat components such as unobstructed width, water width and water depth need to be included. In this report, a separate model was developed for each endangered species except the bald eagle.

Species-specific activities that should be implemented to monitor population and habitat changes among endangered species on the Platte River are listed below.

<u>WHOOPING CRANE</u>

1. Conduct aerial searches of the Platte River to detect the occurrence of whooping cranes during spring and fall each year. Spring surveys should be conducted during 25 March to 20 April. Fall surveys should be conducted during 15 October to 15 November.

2. Stream profiles should be made at each riverine roost site to quantity streambed characteristics and other aspects of nocturnal roost sites.

3. A public education program should be continued to encourage the reporting of whooping cranes not found by aerial searches.

4. Locations of all confirmed sightings should be mapped (to the scale of each 40 acre block) to increase the data base on exact locations used by whooping cranes.

5. Intensive habitat analyses should be conducted at each restored habitat site occupied by whooping cranes (primarily wet meadows) to determine macrohabitat and microhabitat characteristics of non-riverine foraging habitat.

LEAST TERN

1. Yearly monitoring of least tern populations at each nesting colony to assess nesting population and reproductive success changes.

2. Color-mark a minimum of 50 least tern chicks every year to assess survivorship and return rates.

3. Obtain nine-inch aerial color infrared photographs of the Platte River every three years.

4. Use the photographs obtained in number 3 above to conduct a 20% sample of the status of riverine channel and sandpit habitats in the Big Bend reach.

5. Use the habitat models to assess the status of least tern riverine habitat in conjunction with number 4 above.

PIPING PLOVER

1. Yearly monitoring of piping plover populations at each nesting colony to assess nesting population and reproductive success changes.

2. Color-mark a minimum of 50 piping plover chicks yearly to assess survivorship and return rates.

3. Obtain nine-inch aerial color infrared photographs of the Platte River every three years.

4. Use the photographs obtained in number 3 above to conduct a 20% sample of the status of riverine channel and sandpit habitats in the Big Bend reach.

5. Use the habitat models to assess the status of piping plover riverine habitat in conjunction with number 4 above.

BALD EAGLE

1. Continue to cooperate with the National Wildlife Federation's annual mid-winter survey to assess changes in bald eagle populations over time.

2. Develop improved techniques to more accurately describe the spacial distribution of bald eagles in the Big Bend reach.

3. Monitor the frequency of use of known nocturnal bald eagle roost sites in the Big Bend reach each year.

4. Conduct intensive analyses of the habitat components of bald eagle nocturnal roosts at five-year intervals.

5. Monitor factors affecting ice formation in the Big Bend Reach and its influence on the availability of bald eagle foraging habitat.

FORAGE FISH

1. Yearly monitoring of standing crop of sand shiner populations in June near least tern nesting colonies.

CHAPTER 8

SUMMARY

The data contained in this report is a synthesis of the best information available on the endangered species resource in the Big Bend of the Platte River. Included is information on past and current area of habitat, changes (both positive and negative) in endangered species use of the river, a description of criteria used in developing species models, and a list of potential alternatives for the management of Platte River resources in the future.

In presenting this information to the Project Manager, the Biology Workgroup would like to reiterate that the models and management alternatives displayed in this report are not the final answer for the Platte River. If properly applied to the future management of Platte River habitats, the information in this report can be used as one tool in the successful recovery of endangered species using the Platte River.

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