Interior Population of the Least Tern

Sterna Antillarum

Recovery Plan

DEPARTMENT OF THE INTERIOR • U.S. FISH AND WILDLIFE SERVICE

RECOVERY PLAN FOR THE INTERIOR POPULATION OF THE

LEAST TERN (*Sterna antillarum*)

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR THE LEAST TERN

CURRENT STATUS: The interior population of the least tern (*Sterna antillarum*), a breeding migratory bird in mid-America, was listed as endangered on June 27, 1985 (50 *Federal Register* 21,784-21,792). Census data currently indicate about 5,000 interior least terns.

Habitat Requirements and Limiting Factors: Interior least terns breed in the Mississippi and Rio Grande River Basins from Montana to Texas and from eastern New Mexico and Colorado to Indiana and Louisiana. From late April to August they occur primarily on barren to sparsely vegetated riverine sandbars, dike field sandbar islands, sand and gravel pits, and lake and reservoir shorelines. Threats to the survival of the species include the actual and functional loss of riverine sandbar habitat. Channelization and impoundment of rivers have directly eliminated nesting habitat. This recovery plan outlines recovery strategies to increase the interior population of the least tern to approximately 7,000 birds throughout its range.

Recovery Objective: Delisting

Recovery Criteria: Assure the protection of essential habitat by removal of current threats and habitat enhancement, establish agreed upon management plans, and attain a population of 7,000 birds at the levels listed below.

1. Adult birds in the Missouri River system will increase to 2,100 and remain stable for 10 years.
2. Current numbers of adult birds (2,200-2,500) on the Lower Mississippi River will remain stable for 10 years.
3. Adult birds in the Arkansas River system will increase to 1,600 and remain stable for 10 years.
4. Adult birds in the Red River system will increase to 300 and remain stable for 10 years.
5. Current number of adult birds in the Rio Grande River system (500) will remain stable for 10 years.

Actions Needed:

1. Determine population trends and habitat requirements.
2. Protect, enhance and increase populations during breeding.
3. Manage reservoir and river water levels to the benefit of the species.
4. Develop public awareness and implement educational programs about the interior least tern.
5. Implement law enforcement actions at nesting areas in conflict with high public use.

Cost of Recovery: Estimated to be $1,720,000 - $2,000,000, to reach recovery criteria set out above, and complete subsequent monitoring for 10 years.

Date of Recovery: Delisting should be initiated in 2005, if recovery criteria have been met.

DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the U.S. Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U. S. Fish and Wildlife Service **only** after they have been signed by the Regional Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

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I. INTRODUCTION

The interior population of the least tern (Sterna antillarum) (hereafter referred to as the interior least tern) has been a species of concern for many years because of its perceived low numbers and the vast transformation of its riverine habitat. Barren sandbars, the interior least tern's most common nesting habitat, were once a common feature of the Mississippi, Missouri, Arkansas, Ohio, Red, Rio Grande, Platte, and other river systems in the central United States. Sandbars are still common at normal river stages on the Lower Mississippi River and on portions of other river systems. Sandbars generally are not stable features of the natural river landscape, but are formed or enlarged, disappear or migrate depending on the dynamic forces of the river. However, stabilization of major rivers to achieve objectives for navigation, hydropower, irrigation, and flood control has destroyed the dynamic nature of these processes (Smith and Stucky 1988). Many of the remaining sandbars are unsuitable for nesting because of vegetation encroachment or are too low and subject to frequent inundation. The number and distribution of interior least terns probably have declined accordingly.

The interior least tern was listed as an endangered species on June 27, 1985 (50 Federal Register 21,784-21,792) in the following States: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana (Mississippi River and it's tributaries north of Baton Rouge), Mississippi (Mississippi River), Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas (except within 80 km of Gulf Coast). The States of Arkansas, Illinois, Indiana, Iowa, Missouri, Nebraska, Tennessee, Texas, Kansas, Kentucky, New Mexico, Oklahoma, and South Dakota list the interior least tern as endangered under State laws. Although not legislatively designated as endangered in North Dakota, the interior least tern is regarded as endangered by the North Dakota Game and Fish Department and conservation organizations within the State.

Section 4 of the Endangered Species Act directs the Secretary of the Interior to develop and implement recovery plans for the conservation and survival of endangered and threatened species listed pursuant to Section 4 unless he finds that such a plan will not promote the conservation of the species. The Secretary, in developing and implementing recovery plans (1) shall, to the maximum extent practicable, give priority to those endangered species or threatened species most likely to benefit from such plans, particularly those species that are, or may be, in conflict with construction or other developmental projects or other forms of economic activity. The interior least tern occurs along rivers which are heavily regulated by numerous dam and irrigation projects.

The goal of this recovery plan is to describe actions for the conservation and survival of the interior least tern and to return the species to non-endangered status throughout its range. This plan summarizes available biological data, details various actions to stabilize and/or restore the interior least tern, and establishes criteria to remove it from the federal list of endangered species.

Description

Least terns (all currently recognized subspecies and populations) are the smallest members of the subfamily Sterninae and family Laridae of the order Charadriiformes, measuring about 21-24 cm long with a 51 cm wingspread. Sexes are alike, characterized by a black-capped crown, white forehead, grayish back and dorsal wing surfaces, snowy white undersurfaces, legs of various orange and yellow colors depending on the sex, and a black-tipped bill whose color also varies depending on sex (Watson 1966, Davis 1968, Boyd and Thompson 1985). Boyd and Thompson (1985) developed the following criteria to distinguish the sexes in the field based upon their work in Kansas:

1) Females usually have a wing chord less than 171 mm long while males usually have a wing chord greater than 174 mm.
2) A male's feet are brighter than its mate's feet; the male's are bright orange, while the female's feet are bright to pale yellow, or rarely grey.
3) A male's bill is larger than the female's; the female's bill depth at its widest point is 4.5 mm to 5.5 mm, while the male's is 6.0 mm or greater.
4) A male's bill is orange to bright yellow, whereas the female's bill is light or dull yellow, or straw-colored.

Immature birds have darker plumage than adults, a dark bill, and dark eye stripes on their white foreheads. Jackson (1976) described the developmental stages of least tern chicks. Further details on plumage development and variation were presented by Massey and Atwood (1978) and Thompson and Slack (1983).

Taxonomy

The least tern (*Sterna antillarum*) in North America was described by Lesson in 1847 (Ridgway 1895, American Ornithologists' Union 1957, 1983). The least tern in interior North America was described later as a race (*Sterna albifrons athalassos*) of the Old World little tern (*Sterna albifrons*) (Burleigh and Lowery 1942). Two other described New World races were the eastern or coastal least tern (*Sterna albifrons antillarum*), and the California least tern (*Sterna albifrons browni*). The coastal least tern breeds along the Atlantic and Gulf coasts and the California least tern breeds along the California coast.

As a result of studies on vocalizations and behavior of this group of terns in the Old and New Worlds, the American Ornithologists' Union (1983) now treats the New World least terns as a distinct species, *Sterna antillarum*. Subspecies of New World least terns recognized by the American Ornithologists' Union (1957, 1983) are the interior least tern (now *Sterna antillarum athalassos*), the eastern or coastal least tern (now *Sterna antillarum antillarum*), and the California least tern (now *Sterna antillarum browni*).

However, the validity of least tern subspecies has been questioned by several authors in recent years. Massey (1976) reported no consistent morphological, behavioral, or vocal differences between S. a. antillarum and S. a. browni. In Texas, where both S. a. antillarum and S. a. athalassos occur, electrophoretic analyses indicate little genetic differentiation between least terns produced on the Texas coast and Texas Panhandle rivers (McCament and Thompson 1987, McCament-Locknane 1988). Coastal least terns have populated interior breeding sites. Boyd and Thompson (1985) reported an incubating least tern at Quivira National Wildlife Refuge, Kansas, that originally had been banded as a chick on the Texas coast. The most recent morphometric and biochemical assessment of North American least terns could not distinguish subspecies (Thompson et al. In prep)

Originally, S. a. athalassos was proposed for endangered status. Because of the taxonomic uncertainty of least tern subspecies in North America, the U. S. Fish and Wildlife Service did not list the subspecies and instead designated as endangered those least terns occurring in interior North America. The California least tern has been listed as endangered since 1970 (U. S. Fish and Wildlife Service 1980).

Distribution

The interior least tern is migratory and historically bred along the Mississippi, Red and Rio Grande River systems and rivers of central Texas. The breeding range extended from Texas to Montana and from eastern Colorado and New Mexico to southern Indiana. It included the Red, Missouri, Arkansas, Mississippi, Ohio and Rio Grande River systems (American Ornithologists' Union 1957, Anderson 1971, Coues 1874, Burroughs 1961, Hardy 1957, Youngworth 1930, 1931, Ducey 1981). Incidental occurrences of least terns in Michigan, Minnesota, Wisconsin, Ohio and Arizona have been reported (Campbell 1935, Janssen 1986, Jung 1935, Mayfield 1943, Monson and Phillips 1981, Phillips et al. 1964).

Current Distribution

The interior least tern continues to breed in most of the aforementioned river systems, although its distribution generally is restricted to less altered river segments (Figure 1) (Tables 1-5).

Missouri River System: The explorers, Lewis and Clark, observed the least terns along the Missouri River frequently and believed them to be "a native of this country and probably a constant resident" (Burroughs 1961). In the Dakotas, most interior least terns occur on those segments of the Missouri River and its tributaries that are not affected by impoundments or channelization. In South Dakota, the interior least tern nests primarily on flowing segments of the Missouri River and Cheyenne River (Nebraska Game and Parks Commission, Schwalbach 1988, Schwalbach et al. 1986, 1988). Breeding areas in North Dakota constitute about 192 km of the Missouri River from Garrison Dam to the mouth of the Cannonball River

south of Bismarck (Dryer and Dryer 1985, Mayer and Dryer 1988), and about 29 km of the Yellowstone River in North Dakota from the Montana border to the river's confluence with the Missouri River (Kreil and Dryer 1987). A few interior least terns nest on islands, shorelines and sandbars along the reservoir, Lake Oahe, an impoundment on the Missouri River in North and South Dakota (Schwalbach 1988, Mayer and Dryer 1988). In Montana, breeding interior least terns recently have been recorded on the Yellowstone River, and on the Missouri River between Fort Peck Reservoir and North Dakota. A few interior least terns have been recorded on islands and shoreline within the Fort Peck Reservoir (Charles M. Russell National Wildlife Refuge). These locations are the western most nesting sites of the interior least tern.

Interior least terns breed along the lower section of the Niobrara River, Nebraska, from Keya Paha and Rock Counties to the Missouri River (Nebraska Game and Parks Commission 1985a). Current distribution probably is similar to the historic distribution because the Niobrara River has been little changed by man (Ducey 1985). On the Platte River, Nebraska, interior least terns nest on sandbars and at sand and gravel pits from the Missouri River to North Platte (Nebraska Game and Parks Commission 1987) and along the South Platte River as far west as Ogallala. On the Loup River, a tributary of the Platte River, interior least terns breed as far west as Arcadia but are most common between Saint Paul, Nebraska and the Loup's confluence with the Platte River at Columbus, Nebraska. A few interior least terns also occur along the Elkhorn River, another tributary of the Platte River.

The interior least tern no longer nests in the Missouri reaches of the Missouri River (Smith 1985, Sidle et al. 1988, Smith and Renken 1990). The hydrology of the River in Missouri has been drastically altered by channelization, and studies show that river levels are typically too high during the breeding season to expose suitable nesting habitat (Smith and Renken 1990).

Arkansas River System: Breeding interior least terns occur along the Arkansas River system in Colorado, Kansas, Oklahoma, Arkansas and Texas (Table 2). In Colorado, interior least terns nest at Adobe Creek reservoir (Blue Lake) and have been observed at Nee Noshe reservoir (Carter 1989). Both reservoirs are located on small tributaries of the Arkansas River.

In Kansas, interior least terns nest on the Cimarron River in Meade, Comanche and Clark Counties, and Quivira National Wildlife Refuge, and in the recent past at Cheyenne Bottoms Wildlife Management Area (Boyd 1983, 1986, 1987; Schulenberg and Ptacek 1984).

The interior least tern occurs on several tributaries of the Arkansas River in Oklahoma. It breeds along the Salt Fork of the Arkansas River at the Salt Plains National Wildlife Refuge (Hill 1985, Grover and Knopf 1982); Optima Reservoir at the fork of the Coldwater Creek and Beaver River in the Oklahoma Panhandle; and on the Cimarron River in Beaver,

Harper, Woods, Woodward, Major, Blaine, Kingfisher, Logan, and Payne Counties (Boyd 1987, L. Hill personal communication).

Along the Arkansas River in Oklahoma, the interior least tern breeds in Kay, Osage, Pawnee, Creek, Tulsa, Wagoner, Muskogee, and Sequoyah Counties (Hoffman 1986, L. Hill personal communication). In Arkansas, the breeding range on the Arkansas River is above Little Rock (Smith and Shepherd 1985, Smith et al. 1987, K. Smith 1986).

Along the Canadian River, interior least terns breed in Ellis, Roger Mills, Dewey, Cleveland, McClain, Haskell, and Sequoyah Counties, Oklahoma and in Hemphill, Roberts and Hutchinson Counties, Texas (McCament and Thompson 1985, 1987; U. S. Fish and Wildlife Service, unpublished data).

Mississippi and Ohio Rivers: On the Mississippi River, interior least terns occur almost entirely in the lower valley south of Cairo, Illinois to Vicksburg, Mississippi (Sidle et al. 1988) (Table 3). Surveys by the U. S. Army Corps of Engineers (Rumancik 1985, 1986, 1987, and 1988; M. Smith 1986) and Missouri Department of Conservation (J. Smith 1985, 1986, 1987, and 1988, Smith and Renken 1990) indicate that about one-half of all interior least terns occur along 1100 km of the Lower Mississippi River.

On the Ohio River system, the interior least tern occurs just above the confluence of the Tennessee and Ohio Rivers and at one artificial site on the Wabash River in Indiana.

Red River System: Interior least terns are known to occur on the Prairie Dog Town Fork of the Red River in the eastern Texas Panhandle and along the Texas/Oklahoma boundary as far east as Burkburnett, Texas (McCament and Thompson 1985, 1987) (Table 4).

Rio Grande River System: Interior least terns occur at three reservoirs along the Rio Grande River and along the Pecos River at the Bitter Lake National Wildlife Refuge, New Mexico (McCament and Thompson 1985, 1987; Neck and Riskind 1981, Seibert 1951, Marlatt 1984, 1987) (Table 5).

Wintering Areas: The wintering area of interior least terns is unknown. However, least terns of unknown populations or subspecies are found during the winter along the Central American coast and the northern coast of South America from Venezuela to northeastern Brazil. Roger Boyd (personal communication 1986) reports that about 35 least terns have been recaptured in South America, mostly in Guyana. One interior least tern banded by Boyd, was captured in El Salvador two years later. Also, a banded California least tern was recaptured in Guatemala.

Table 1. Known breeding areas for interior least terns along the Missouri River system in 1985-1988.

State	County	Locations
Montana	Valley	Fort Peck Reservoir, Charles M. Russell National Wildlife Refuge
	Garfield	Fort Peck Reservoir, Charles M. Russell National Wildlife Refuge
	Prairie	Yellowstone River sandbars
	McCone	Missouri River sandbars
	Richland	Missouri River sandbars
North Dakota	McLean	Missouri River sandbars
	Burleigh	Missouri River sandbars
	Oliver	Missouri River sandbars
	Morton	Missouri River sandbars
	Emmons	Lake Oahe
	Mercer	Missouri River sandbars
	Sioux	Missouri River sandbars
	McKenzie	Yellowstone River sandbars
South Dakota	Charles Mi	Missouri River sandbars
	Bon Homme	Missouri River sandbars
	Yankton	Missouri River sandbars
	Clay	Missouri River sandbars
	Union	Missouri River sandbars
	Sully	Lake Oahe
	Hughes	Lake Oahe
	Stanley	Lake Oahe
	Walworth	Lake Oahe
	Campbell	Lake Oahe
	Corson	Lake Oahe
	Potter	Lake Oahe
	Dewey	Lake Oahe
	Ziebach	Cheyenne River sandbars
	Haakon	Cheyenne River sandbars
Nebraska	Dixon	Missouri River sandbars
	Cedar	Missouri River sandbars
	Knox	Missouri River sandbars
	Howard	Loup River sandbars and sand/gravel pits
	Nance	Loup River sandbars and sand/gravel pits
	Sherman	Loup River sandbars and sand/gravel pits
	Platte	Loup River sandbars and sand/gravel pits
	Valley	Loup River sandbars and sand/gravel pits
	Douglas	Elkhorn River sandbars and sand/gravel pits
	Cumming	Elkhorn River sandbars and sand/gravel pits
	Stanton	Elkhorn River sandbars and sand/gravel pits
	Boyd	Niobrara River sandbars

	Holt	Niobrara River sandbars
	Keya Paha	Niobrara River sandbars
	Brown	Niobrara River sandbars
	Knox	Niobrara River sandbars
	Rock	Niobrara River sandbars
	Cass	Platte River sandbars and sand/gravel pits
	Sarpy	Platte River sandbars and sand/gravel pits
	Saunders	Platte River sandbars and sand/gravel pits
	Douglas	Platte River sandbars and sand/gravel pits
	Dodge	Platte River sandbars and sand/gravel pits
	Colfax	Platte River sandbars and sand/gravel pits
	Butler	Platte River sandbars and sand/gravel pits
	Platte	River sandbars and sand/gravel pits
	Polk	Platte River sandbars and sand/gravel pits
	Hall	Platte River sandbars and sand/gravel pits
	Buffalo	Platte River sandbars and sand/gravel pits
	Kearney	Platte River sandbars and sand/gravel pits
	Phelps	Platte River sandbars and sand/gravel pits
	Dawson	Platte River sandbars and sand/gravel pits
	Hamilton	Platte River sandbars and sand/gravel pits
	Merrick	Platte River sandbars and sand/gravel pits
	Lincoln	Platte River sandbars and sand/gravel pits
	Lincoln	So. Platte River sandbars/sand/gravel pits
	Keith	So. Platte River sandbars/sand/gravel pits
Iowa	Woodbury	Iowa Public Service ash ponds
	Pottawattamie	Iowa Power and Light ash ponds

Table 2. Known breeding areas for interior least terns along the Mississippi and Ohio Rivers, 1985-1988.

State	County or Parish	Location
Missouri	Pemiscott	Mississippi River sandbars and dike fields
	New Madrid	Mississippi River sandbars and dike fields
	Mississippi	Mississippi River sandbars and dike fields
	Scott	Mississippi River sandbars and dike fields
Kentucky	Fulton	Mississippi River sandbars and dike fields
	Hickman	Mississippi River sandbars and dike fields
	Carlisle	Mississippi River sandbars and dike fields
Tennessee	Dyer	Mississippi River sandbars and dike fields
	Lake	Mississippi River sandbars and dike fields
	Lauderdale	Mississippi River sandbars and dike fields
	Tipton	Mississippi River sandbars and dike fields
	Shelby	Mississippi River sandbars and dike fields
Arkansas	Mississippi	Mississippi River sandbars and dike fields
	Crittenden	Mississippi River sandbars and dike fields
	Lee	Mississippi River sandbars and dike fields
	Phillips	Mississippi River sandbars and dike fields
	Deska	Mississippi River sandbars and dike fields
	Chicot	Mississippi River sandbars and dike fields
Mississippi	Desoto	Mississippi River sandbars and dike fields
	Tunica	Mississippi River sandbars and dike fields
	Coahoma	Mississippi River sandbars and dike fields
	Bolivar	Mississippi River sandbars and dike fields
	Washington	Mississippi River sandbars and dike fields
	Issaguena	Mississippi River sandbars and dike fields
	Warren	Mississippi River sandbars and dike fields
Louisiana	East Carroll	Mississippi River sandbars and dike fields
	Madison	Mississippi River sandbars and dike fields
Illinois	Alexander	Mississippi River sandbars and dike fields
	Pulaski	Ohio River sandbars and dike fields
Indiana	Gibson	Public Power plant along Wabash River at East Mt. Carmel

Table 3. Known breeding areas for interior least terns along the Arkansas River system, 1985-1988.

State	County	Location
Arkansas	Pulaski	Arkansas River sandbars and dike fields
	Faulkner	Arkansas River sandbars and dike fields
	Conway	Arkansas River sandbars and dike fields
	Perry	Arkansas River sandbars and dike fields
	Pope	Arkansas River sandbars and dike fields
	Logan	Arkansas River sandbars and dike fields
	Johnson	Arkansas River sandbars and dike fields
	Sabastian	Arkansas River sandbars and dike fields
	Crawford	Arkansas River sandbars and dike fields
Oklahoma	Osage	Arkansas River sandbars
	Kay	Arkansas River sandbars
	Pawnee	Arkansas River sandbars
	Creek	Arkansas River sandbars
	Tulsa	Arkansas River sandbars
	Wagoner	Arkansas River sandbars
	Muskogee	Arkansas River sandbars
	Beaver	Cimarron River sandbars
	Harper	Cimarron River sandbars
	Woods	Cimarron River sandbars
	Woodward	Cimarron River sandbars
	Major	Cimarron River sandbars
	Blaine	Cimarron River sandbars
	Kingfisher	Cimarron River sandbars
	Logan	Cimarron River sandbars
	Payne	Cimarron River sandbars
	Alfalfa	Salt Plains National Wildlife Refuge
	Texas	Optima Reservoir
	Ellis	Canadian River sandbars
	Roger Mills	Canadian River sandbars
	Dewey	Canadian River sandbars
	Haskell	Sequoyah National Wildlife Refuge
	Sequoyah	Sequoyah National Wildlife Refuge
	Cleveland	Canadian River sandbars
	McClain	Canadian River sandbars
Texas	Hemphill	Canadian River sandbars
	Roberts	Canadian River sandbars
	Hutchinson	Canadian River sandbars

Kansas	Barton	Cheyenne Bottoms
	Comanche	Cimarron River sandbars
	Clark	Cimarron River sandbars
	Meade	Cimarron River sandbars
	Stafford	Quivira National Wildlife Refuge
Colorado	Kiowa	Adobe Creek Reservoir
		Nee Noshe Reservoir
	Bent	Adobe Creek Reservoir

Table 4. Known breeding areas for interior least terns along the Red River system, 1985-1988.

State	County	Location
Texas	Childress	Prairie Dog Town Fork sandbars
	Hall	Prairie Dog Town Fork sandbars
	Briscoe	Prairie Dog Town Fork sandbars

Table 5. Known breeding areas for interior least terns along the Rio Grande system, 1985-1988.

State	County	Location
Texas	Zapata	Falcon Reservoir
	Webb	Lake Casa Blanca
	Val Verde	Amistad Reservoir
New Mexico	Chaves	Bitter Lake National Wildlife Refuge

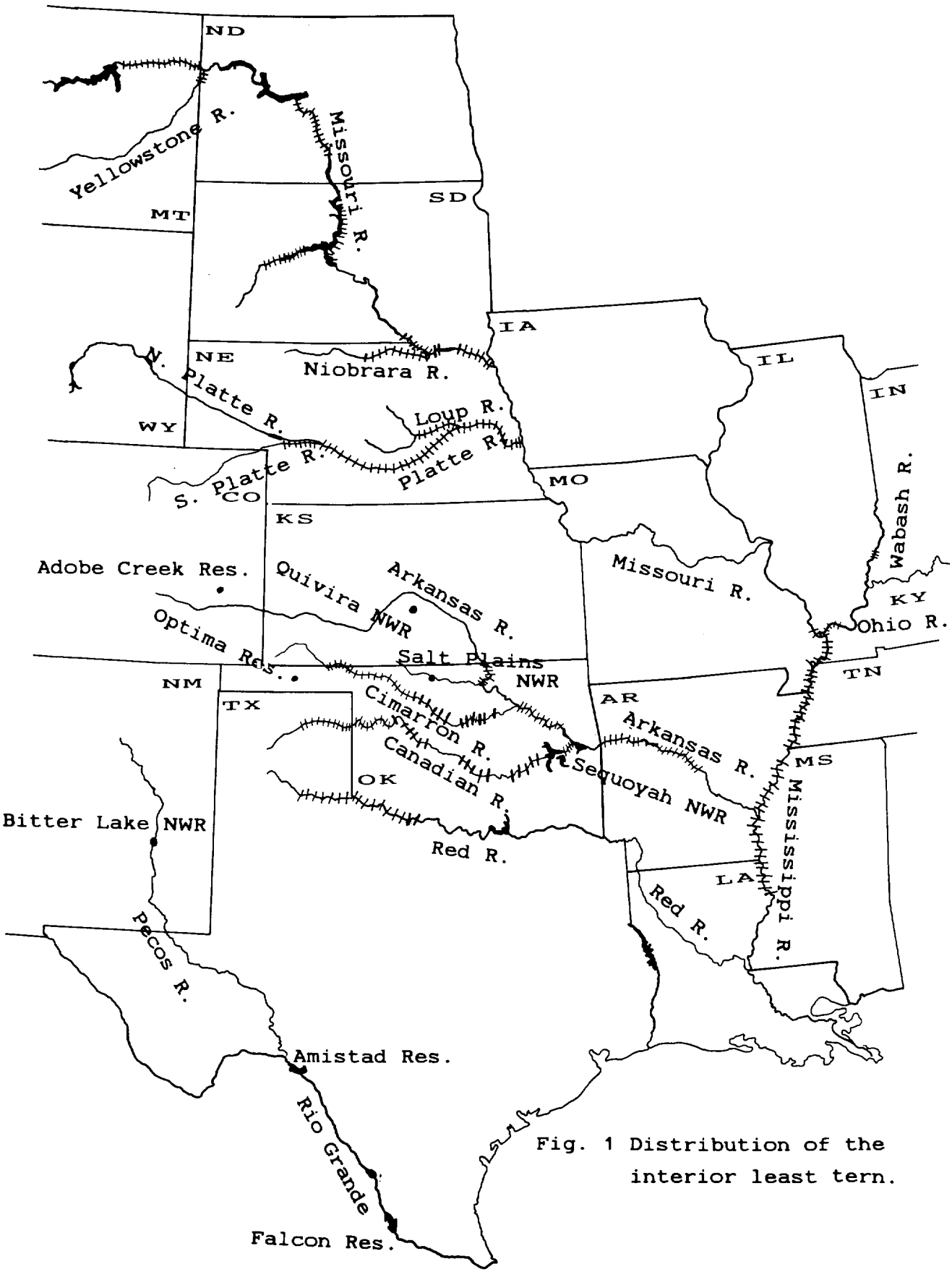


Fig. 1 Distribution of the interior least tern.

Life History

Breeding Behavior: Interior least terns spend about 4-5 months at their breeding sites. They arrive at breeding areas from late April to early June (Faanes 1983, Hardy 1957, U. S. Fish and Wildlife Service 1987a, Wilson 1984, Wycoff 1960, Youngworth 1930). Courtship behavior of least terns is similar throughout North America. Courtship occurs at the nesting site or at some distance from the nest site (Tomkins 1959). It includes the fish flight, an aerial display involving pursuit and maneuvers culminating in a fish transfer on the ground between two displaying birds. Other courtship behaviors include nest scraping, copulation and a variety of postures, and vocalizations (Ducey 1981, Hardy 1957, Wolk 1974).

The nest is a shallow and inconspicuous depression in an open, sandy area, gravelly patch, or exposed flat. Small stones, twigs, pieces of wood and debris usually lie near the nest. Least terns nest in colonies or terneries, and nests can be as close as just a few meters apart or widely scattered up to hundreds of meters (Ducey 1988, Anderson 1983, Hardy 1957, Kirsch 1990, Smith and Renken 1990, Stiles 1939). The benefit of semi-colonial nesting in least terns may be related to anti-predator behavior and social facilitation (Burger 1988).

Interior least tern eggs are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-grey markings (Hardy 1957, Whitman 1988). Occasionally, eggs are pink instead of pale to olive buff (P. Mayer and M. Schwalbach, personal communication), The birds usually lay two or three eggs (Anderson 1983, Faanes 1983, Hardy 1957, Kirsch 1987-89, Sweet 1985, Smith 1985). The average clutch size for interior least terns nesting on the Mississippi River during 1986-1989 was 2.4 eggs (Smith and Renken 1990). Egg-laying begins by late May. Both sexes share incubation which generally lasts 20-25 days but has ranged from 17 to 28 days (Faanes 1983, Hardy 1957, Moser 1940, Schwalbach 1988, G.R. Lingle, personal communication).

The precocial behavior of interior least tern chicks is similar to that of other least terns. They hatch within one day of each other, are brooded for about one week, and usually remain within the nesting territory but as they mature, wander further. Fledging occurs after three weeks, although parental attention continues until migration (Hardy 1957, Massey 1972, 1974; Tomkins 1959). Departure from colonies by both adults and fledglings varies but is usually complete by early September (Bent 1921, Hardy 1957, Stiles 1939). Thompson (1982) presented the following longevity data for coastal least terns revealed by band recoveries:

Age (years)	Percentage of Recoveries Known and Assumed Dead (N)
0-5	74 percent (58)
5-10	9 percent (7)
10-15	10 percent (8)
15-20	4 percent (3)
>20	3 percent

Population Biology: The interior least tern's annual reproductive success varies greatly along a given river or shoreline (Table 6). Because tern's use ephemeral habitats, they are susceptible to frequent nest and chick loss. Consequently there are great local differences in productivity. In 1987, total number of interior least terns reached 4,800 (Table 7). This is considerably higher than the 1,200 interior least terns estimated by a partial survey in 1975 by Downing (1980). There are no comprehensive historic numbers to compare with these figures, although early qualitative descriptions indicate that the interior least tern was rather common (Burroughs 1961, Hardy 1957). Increased censusing efforts during the past few years probably account for the differences among recent census figures and earlier surveys.

Table 6. Some examples of the productivity of interior least terns.

Locations	Year	Nest Success	Fledgings per Pair	Frequency of Visits	% Population Monitored	Source
Missouri River North Dakota	1988 1989	0.62 0.56	0.42 0.21	7-10 days "	100% "	Mayer and Dryer 1989
Missouri River South Dakota	1986 1987		0.20 0.64	7-10 days "	100% "	Schwalbach 1988
Missouri River South Dakota	1988 1989	0.36 0.51	0.44 0.55	7-10 days "	100% "	Dirks 1990
Lower Platte River River Nebraska	1987 1988 1989	0.57 0.67 0.43	0.29 0.71 0.47	2-3 days " "	39% 44% 42%	Kirsch 1987-89
Cimarron River Kansas	1982-83	0.18	1.09-0.56	--	--	Schulenberg and Ptacek 1984
Salt Plains NWR, Oklahoma	1987	0.44-0.33	0.44-0.15	1-3 days		Hill 1987

Dispersal Patterns: Breeding site fidelity of coastal and California least terns is very high (Atwood et al. 1984, Burger 1984). This may also be true for the interior least tern in its riverine environment. An interior least tern banded in 1988 as a breeding adult on the Missouri River in North Dakota returned in 1989 to breed on a Missouri River sandbar in North Dakota (Mayer and Dryer 1990). In the Mississippi River valley, a bird banded as a breeding adult in 1987 was observed nesting at the same site in 1989, and three others banded as breeding adults in 1988 returned to nest within the same stretch of the Mississippi River in 1989 (Smith and Renken 1990). Two of those birds had returned to within 4.8 km of their former nesting site. Along the Platte River in Nebraska, interior least terns demonstrate a strong return pattern to previous nesting sites on the river and at sand and gravel pits regardless of reproductive success (E.Kirsch, G. Lingle, personal communication). One interior least tern captured in 1987 as a breeding adult at a Mississippi River ternery in Missouri had been banded as a chick in 1980 by Marsha Waldron; this bird was nesting at a site 131 km upriver from its natal Tennessee colony (Smith 1987, Smith and Renken 1990). Chick dispersal may be as far as that reported by Boyd and Thompson (1985) for a breeding Kansas bird that had been banded as a chick on the Texas coast.

Home Range and Territoriality: The interior least tern's home range during the breeding season usually is limited to a reach of river near the sandbar nesting site. At Salt Plains National Wildlife Refuge, home ranges were highly variable, ranging from 11 to 1,015 ha (Talent and Hill 1985). Variation likely was due to food limitations and chick loss. The home range may change if renesting birds select a different breeding site. At sand and gravel pits along the central Platte River in Nebraska, nesting interior least terns utilize the pit area as well as an adjacent stretch of river. Nesting territories are defended and birds defend any nest in the colony. In defending the territory, the incubating bird will fly up and give an obvious alarm call followed by repeated dives at the intruder (Hardy 1957). The strong defense of territories facilitates locating terneries during census surveys.

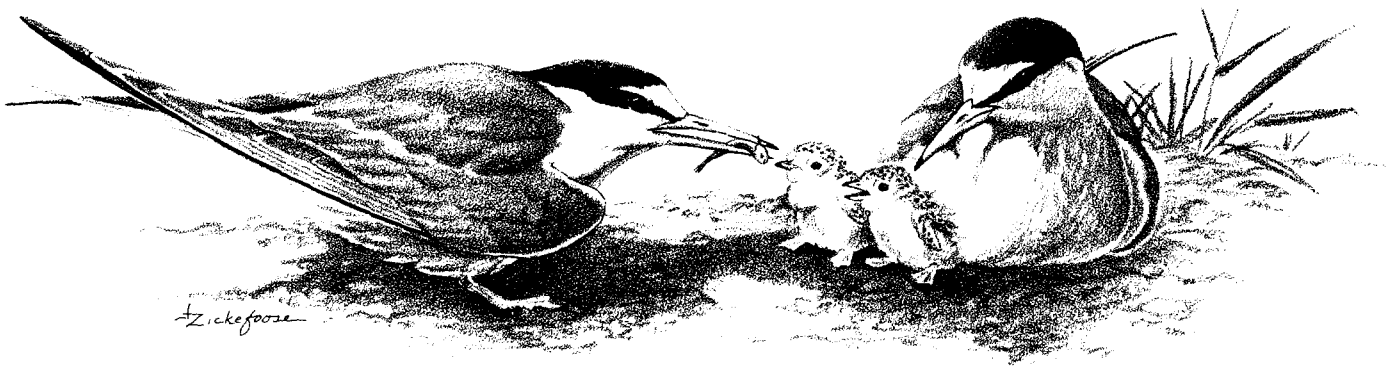


Table 7. Census data on the interior population of the least tern, 1985-1988[1].

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
Mississippi River Basin						
1. Ft. Peck Reservoir, Missouri River, Montana	-*	--**	4	2	-	(Alfonso, unpublished data, Montana Piping Plover Recovery Committee 1988)
2. Below Ft. Peck Reservoir, Missouri River, Montana	-	--	--	18	22	(D. Christopherson, unpublished data)
3. Yellowstone River, Montana	-	--	--	12	-	(Gorges, unpublished data)
4. Below Garrison Dam, Missouri River, North Dakota	114	169	175	142	192	(Dryer and Dryer 1985, Mayer and Dryer 1988)
5. Lake Sakakawea, Missouri River, North Dakota	-	-	-	7	-	(Mayer and Dryer 1988)
6. Lake Oahe, Missouri River	-	-	-	7	-	(Mayer and Dryer 1988)
7. Yellowstone River, North Dakota	-	22	20	24	30	(Kreil and Dryer 1987, Mayer and Dryer 1988)
8. Cheyenne River, South Dakota	-	31	54	27	26	(Schwalbach et al. 1986, 1988; Schwalbach 1988)

Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
9. Lake Oahe, Missouri River, South Dakota	-	16	21	61	-	(Schwalbach et al. 1986, 1988; Schwalbach 1988)
10. Below Fort Randall and Gavins Point Dam, MO River, South Dakota to Ponca, NE	202	206	292	297	140	(Schwalbach et al. 1986, 1988; Schwalbach 1988)
11. Power plant ash lagoons near Council Bluffs, Iowa	18	28	22	22		(Dinsmore and Dinsmore 1989, Wilson 1984)
12. Niobrara R., Nebraska	174	-	143	200	190	(Nebraska Game and Parks Commission 1985a)
13. Platte River, Nebraska	256	438	606	635	502	(Nebraska Game and Parks Commission 1988; G. R. Lingle, personal communication)
14. Loup River, Nebraska	-	-	100	155	70	(S. Gauthreaux and Nebraska Game and Parks Commission, unpublished data)
15. Elkhorn River, Nebraska	2	8	4	-	-	(J. Dinan, Nebraska Game and Parks Commission, personal communication)
16. Mississippi R., Cape Girardeau, Missouri to Vicksburg, Mississippi	1264	2244	2488	2356	1100	(Rumancik 1985, 1986; J.W. Smith 1985, 1986, 1987, 1988; M. Smith 1986; W. King personal communication; Smith and Renken 1990)
17. Power plant, Wabash River, E. Mt. Carmel, IN	2	4	4	-	-	(Johnson 1987, Mills 1987)

Table 7 (continued)

	Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
18.	Arkansas River, Arkansas (above Little Rock)	50	80	130	119	256	(Smith and Shepherd 1985, K. Smith 1986, Smith et al. 1987)
19.	Arkansas River, Oklahoma	-	78	200	200	119	(Hoffman 1986, L. Hill personal communication)
20.	Quivira National Wildlife Refuge, Kansas (Rattlesnake Creek of Arkansas River)	48	48	54		-	(Boyd 1986, 1987)
21.	Adobe Creek Reservoir Colorado	-	-	6	10	-	(Barbara Campbell, personal communication)
22.	Salt Plains National Wildlife Refuge, Oklahoma (Salt Fork of the Arkansas River)	-	140	210	-	-	(Boyd 1986, 1987)
23.	Cimarron River, Kansas and Oklahoma	82	150	132	-	121	(Boyd 1986, 1987)
24.	Optima Reservoir, Oklahoma (Beaver River)	46	52	60	38	-	(Boyd 1986, 1987; L. Hill)
25.	Canadian River, western Oklahoma and Texas	127	182	20	16	253	(McCament and Thompson 1985, 1987; U. S. Fish and Wildlife Service, unpublished data)

Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
26. Canadian River, Eufaula Dam to Arkansas River, including Sequoyah National Wildlife Refuge	-	-	105	34	43	(L. Hill personal communication)
27. Canadian River at Norman, Oklahoma	-	-	-	12	3	(L. Hill, personal communication)
28. Prairie Dog Town Fork of Red River, Texas	44	50	12	16	241	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
Rio Grande River Basin						
29. Falcon Reservoir, Rio Grande River	500	150	50	222	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
30. Lake Casa Blanca	5	-	14	50	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)
31. Amistad Reservoir, Rio Grande River	20	9	-	14	-	(McCament and Thompson 1985, 1987; B. Thompson, pers. commun.)

Table 7 (continued)

Location	Number of adult least terns 1985	1986	1987	1988	Approximate length of river stretch (km) where nesting least terns intermittently occur	Source
32. Bitter Lake National Wildlife Refuge, New Mexico (Pecos River)	-	8	6	6	-	(Shomo, 1988 and S. Williams, New Mexico Game and Fish Department, unpublished report)
Total	2952	4113	4932	4702	3308	

[1]The census results should be viewed in light of the extent and frequency of census efforts. Increases or decreases from year to year may not be related to reproductive performance.
* no census conducted in that year.
** area surveyed but no birds found

Diet: The interior least tern is piscivorous, feeding in shallow waters of rivers, streams and lakes. Other least terns also feed on crustaceans, insects, mollusks and annelids (Whitman 1988). The terns usually feed close to their nesting sites. Fish prey is small sized and important genera include *Fundulus*, *Notropis*, *Campostoma*, *Pimephales*, *Gambusia*, *Blonesox*, *Morone*, *Dorosoma*, *Lepomis* and *Carpiodes* (Grover 1979, Hardy 1957, Rumancik 1988, 1989; Schulenberg et al. 1980, Smith and Renken 1990, Wilson et al. 1989). Moseley (1976) believed least terns to be opportunistic feeders, exploiting any fish within a certain size range. Fishing occurs close to the riverine colony. Terns nesting at sand and gravel pits and other artificial habitats may fly up to 3.2 km to fish. Radio-tagged terns at Salt Plains National Wildlife Refuge often traveled 3.2-6.4 km to fish (Talent and Hill 1985). Fishing behavior involves hovering and diving over standing or flowing water.

Interspecific Interactions: Interior least terns are breeding associates of the piping plover (*Charadrius melodus*) in the Missouri River system (Dryer and Dryer 1985, Faanes 1983, Nebraska Game and Parks Commission 1987, Schwalbach 1988) and the snowy plover (*Charadrius alexandrius*) and American avocet (*Recurvirostra americana*) in the Arkansas River system (Grover and Knopf 1982, Hill 1985). Nesting piping plovers usually can be found within or near nesting interior least terns at sand and gravel pits and on riverine sandbars.

Habitat Requirements

Least terns throughout North America nest in areas with similar habitat attributes.

Coastal Areas: Coastal and California least terns usually nest on elevated portions of level, unvegetated substrates near foraging areas (Carreker 1985). Beaches, sand pits, sandbars, islands and peninsulas are the principal breeding habitats (Moseley 1976). Nesting can be close to water but is usually between the dune environment and the high tide line (Akers 1975, Blodget 1978). Unconsolidated substrate such as small stones, gravel, sand, debris and shells comprise the nesting substrate. A mixture of coarse sand, shells and other fragments may be preferred over fine-grained substrates because of better cryptic qualities, stability in wind, and water permeability (Burroughs 1966, Craig 1971, Gochfeld 1983, Jernigan et al. 1978, Soots and Parnell 1975, Swickard 1972, Thompson and Slack 1982).

Vegetation at California and coastal least tern nesting sites is sparse, scattered and short. Vegetation cover is usually less than 20% at the time of nesting (Craig 1971, Thompson and Slack 1982, Gochfeld 1983). Least tern colonies in denser vegetation may be a response to habitat loss or a function of strong site tenacity.

Rivers: The riverine nesting areas of interior least terns are sparsely vegetated sand and gravel bars within a wide unobstructed river channel, or salt flats along lake shorelines. Nesting locations usually are at the higher elevations and away from the water's edge because

nesting starts when the river flows are high and small amounts of sand are exposed. The size of nesting areas depends on water levels and the extent of associated sandbars. An examination of the interior least tern's nesting ecology on the Missouri River (Schwalbach et al. 1988) illustrates the changes caused by varying river flows. Along one stretch of the Missouri River in South Dakota the average size of nesting sandbars was 12 and 31 ha in 1986 and 1987, respectively; nest elevation and nest to water distance differed by a factor of three in both years.

The Lower Mississippi River is very wide and carries a tremendous volume of water and sand. Sandbars form annually, are washed away, and shift position. Many sandbars are over 3.2 km long and 1.2 km wide. Nest sites are often several hundred meters from the water (Rumancik 1987, 1988). Thus, nesting areas usually are several hundred hectares in size. Mississippi River levels at the onset of nesting also influences the number of nests at a colony. Smith and Renken (1990) observed Mississippi River colonies that averaged 100 nests/colony when habitat was restricted by high water early in the nesting period, but which averaged only 19.3 nests/colony during a year of more moderate river levels.

Artificial Nesting Habitat: Least terns nest on artificial habitats such as sand and gravel pits and dredge islands (Dryer and Dryer 1985, Haddon and Knight 1983, Kirsch 1987-89, Larkins 1984, Morris 1980). In North America the coastal and California least terns commonly nest on a variety of artificial nesting habitats, even roof-tops (Altman and Gano 1984, Atwood et al. 1979, Fisk 1975, 1978; Jernigan 1977, Massey and Atwood 1980, 1983; Swickard 1974).

The interior least tern nests on dike fields along the Mississippi River (Smith and Stucky 1988; Smith and Renken 1990), at sand and gravel pits (Kirsch 1987-89), ash disposal areas of power plants (Dinsmore and Dinsmore 1988, Johnson 1987, Wilson 1984), along the shores of reservoirs (Boyd 1987, Chase and Loeffler 1978, Neck and Riskind 1981, Schwalbach 1988) and at other manmade sites (Shomo 1988). The percentage of interior least terns nesting on pits adjacent to the lower reach (Columbus to Plattsmouth) of the Platte River varies depending on the flow and amount of exposed sandbar habitat (Kirsch 1987-89). Suitable nesting habitat in the upper Platte River channel has been severely reduced (Sidle et al. 1989) and in many stretches of the river, sand and gravel pits annually provide the only nesting habitat (Lingle 1989). It is unknown to what extent sand and gravel pits, dike fields, reservoir shorelines and other artificial habitats have replaced natural habitat. In the lower Mississippi River alone, 7,518 ha of bar and island habitat were lost in diked reaches between 1962 and 1976 (Nunnally and Beverly 1986, Smith and Stucky 1988).

Reasons For Current Status

Habitat alteration and destruction: Channelization, irrigation, and the construction of reservoirs and pools have contributed to the elimination of much of the tern's sandbar nesting habitat in the Missouri, Arkansas, and Red River systems (Funk and Robinson 1974, Hallber et al 1979, Sandheinrich and Atchison 1986). Ducey (1985), for example, describes the changes in the channel characteristics of the Missouri River since the early 1900s under the Missouri River Bank Stabilization and Navigation Project. The wide and braided character of the Missouri River was engineered into a single narrow navigation channel. Most sandbars virtually disappeared between Sioux City, Iowa and Saint Louis, Missouri (Sandheinrich and Atchison 1986, Smith and Stucky 1988).

Where sandbars still occur along the Nebraska-South Dakota boundary (Missouri River), approximately 3,156 ha of sandbar habitat have been lost between 1956 and 1975 (Schmulbach et al. 1981). Sandbars along the Nebraska-Iowa Missouri River boundary have been virtually eliminated with the exception of 890 ha inventoried along the 80-km Missouri National Recreation Area (Schmulbach et al. 1981).

Current regulation of Missouri River dam discharges pose additional problems for interior least terns nesting in remaining habitats (Nebraska Game and Parks Commission 1985c, Schwalbach et al. 1988). Before regulation of river flows, summer flow patterns were more predictable. Peak flows occurred in March from local runoff and then again in May and June when mountain snowmelt occurs. Flows then declined during the rest of the summer allowing interior least terns to nest as water levels dropped and sandbars became available (Stiles 1939, Hardy 1957). Currently, the main stem system is supposed to be regulated for hydropower, navigation, water quality and supply, flood evacuation, irrigation, fish and wildlife conservation, and public recreation. However, system releases are designed to provide equitable service to power and navigation demands, except when they conflict with flood control functions of the system.

The demands are unpredictable and flows can fluctuate greatly. Flow regimes differ greatly from historic regimes. High flow periods may now extend into the normal nesting period, thereby reducing the quality of existing nest sites and forcing interior least terns to initiate nests in poor quality locations. Extreme fluctuations can flood existing nests, inundate potential nesting areas, or dewater feeding areas. Interior least terns along the Arkansas River in Oklahoma and Arkansas contend with dam discharge problems similar to those on the Missouri River.

Along the Lower Mississippi River, and elsewhere, natural river discharge may exert considerable influence on reproductive success. A wet spring may delay river fall and habitat may not be available until later. Rises in the river during the spring and summer may inundate nests and wash away chicks (Rumancik 1986, 1989, Smith and Renken 1990). Renesting, however, does occur and may be an adaptation to river fluctuations. Dike

construction has created many sandbars between the dikes and many nesting colonies are located on these sandbars (Landin et al. 1985, Rumancik 1986, 1987, 1988, 1989; J. Smith 1985, 1986, 1987). The extent to which these sandbars are attaching to the riverbank and reducing tern habitat is not known but according to Smith and Stucky (1988) the processes of dike field terrestrialization are well underway at several least tern colony sites in the lower Mississippi River.

Reservoir storage of flows responsible for scouring sandbars has resulted in the encroachment of vegetation along many rivers such as the Platte River, Nebraska and greatly reduced channel width (Currier et al. 1985, O'Brien and Currier 1987, Eschner et al. 1981, Lyons and Randle 1988, Sidle et al. 1989, Stinnett et al. 1987). In addition, river main stem reservoirs now trap much of the sediment load resulting in less aggradation and more degradation of the river bed and subsequently less formation of suitable sandbar nesting habitat. Riverine habitat along the central Platte River may require extensive vegetation clearing and other intensive management. In contrast, the lower Platte River (Columbus, Nebraska to the Missouri River confluence) has not undergone as extensive habitat changes as the central Platte. During 1987-1989, riverine sandbar habitat hosted 72% of the nests on the lower Platte and only 12% of the nests on the central Platte (Kirsch 1989, Lingle 1989).

Human disturbance: Many rivers have become the focus of recreational activities. Human presence reduces reproductive success (Mayer and Dryer 1988, Smith and Renken 1990). In mid-America, sandbars are fast becoming the recreational counterpart of coastal beaches. Even sand and gravel pits and other artificial nesting sites receive a high level of human disturbance.

Conservation Efforts

During the past few years there has been a great increase in the number of interior least tern surveys, research projects and public relations endeavors to protect the birds on the part of both public and private conservation organizations. Proposed federal listing of the interior least tern prompted much of the interest in the northern Great Plains and elsewhere. Today, many state, federal and private organizations are collaborating to census the birds, curtail human disturbance and conduct research.

Under authority of Section 7 of the Endangered Species Act, the U. S. Fish and Wildlife Service is consulting with the U. S. Army Corps of Engineers on whether dam operations on the Missouri and Arkansas Rivers jeopardize the continued existence of the interior least tern (U.S Fish and Wildlife Service 1989, 1990). The outcome of these formal consultations is crucial to the recovery of the interior least tern. Areas of habitat along the Missouri River, for example, continue to degrade due to physical controls on the river and present water management schemes. Changes in the water release regime and physical manipulation of habitat will be necessary.

Aside from the Section 7 consultation on the Missouri River, the Corps Master Manual for river operations is under review. If upper Missouri River Basin states have their way for holding water in the reservoirs for recreation and fisheries, navigation in the Missouri River could be reduced and maintenance of the commercial navigation project above Omaha could become infeasible. The reach between Sioux City, Iowa and the mouth of the Platte River could once more be available to interior least terns.

Montana: Current efforts include surveys to determine the number and distribution of interior least terns along the Missouri and Yellowstone Rivers and along the shores of the Fort Peck Reservoir.

North Dakota: Censusing has been conducted along the Missouri River since 1982 and along the Yellowstone River since 1986. Habitat requirements are being estimated and recommendations are being made for the management of Missouri River habitat. Research continues on reproductive success and on methods to increase productivity. Resource agencies are involved with a variety of public relations efforts to curtail human disturbance on Missouri River sandbars and islands.

South Dakota: Detailed studies of interior least tern nesting ecology continue at Missouri and Cheyenne River sandbars and along the reservoir shoreline of Lake Oahe. Resource agencies are involved with public relations efforts to curtail human disturbance on the Missouri River. Management activities include the posting of nesting sites and informational signs at boat ramps and elsewhere. This has been complemented with enforcement actions being taken by state and federal officials. Recent amendments to South Dakota law prohibit the harassment of least tern nesting and rearing sites on the Missouri River.

Nebraska: Nebraska supports one of the largest breeding populations of interior least terns. Annual surveys have been carried out since 1979. Efforts are underway to quantify available nesting habitat on the Platte River at various river flows. Research on reproductive success, habitat selection, foraging ecology, predation and the value of sand and gravel pits continues along the Platte River (Kirsch 1987-89, Lingle 1989, Wilson et al. 1989).

A flow management plan has been prepared for the Missouri River (Nebraska Game and Parks Commission 1985c) and certain instream flows have been determined on the Platte River for the interior least tern, its habitat and forage fish, and for other wildlife and resources (Table 8). In 1990 the Federal Energy Regulatory Commission (FERC) ordered the Nebraska Public Power District to maintain the instream flows in Table 8 for interior least terns (50 FERC Report (CCH) 61,180) (Sidle et al. 1990). The District seeks a new license to operate diversion dams and other facilities associated with the Lake McConaughy reservoir on the North Platte River. Lake McConaughy was constructed in the late 1930s and licensed for 50 years. The dam, diversion structures, and other facilities have had a major impact on the downstream habitat of the

interior least tern. When granting a new power license the Federal Power Act requires FERC to give equal consideration to the protection, mitigation of damage to, and enhancement of, fish and wildlife.

Posting, extensive news media efforts, posters, brochures, information signs at river entry points, and law enforcement patrols are some of the additional activities being carried out in Nebraska. The Platte River Whooping Crane Habitat Trust is trying to rehabilitate sandbars in the central Platte River (Lexington to Grand Island) by removing vegetation over extensive areas of the river channel. FERC also ordered the Nebraska Public Power District to construct eight permanent five- to ten-acre sites for interior least tern nesting in the central Platte River where nesting habitat has been severely degraded, in part by the upstream Lake McConaughy and associated water diversion canals and offstream reservoirs.

Finally, Nebraska law requires state agencies to consult with the Nebraska Game and Parks Commission on any action authorized, funded, or carried out by the state agencies. This insures that such actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of habitat. The Commission reviews state sponsored or authorized projects that may impact endangered or threatened species and issues biological opinions to the state agencies.

Colorado: The interior least tern is known to breed at Adobe Creek reservoir and has been observed at Nee Noshe reservoir. Public relation efforts and other endeavors are underway to address fluctuating water levels, human disturbance, vegetation encroachment, and predation.

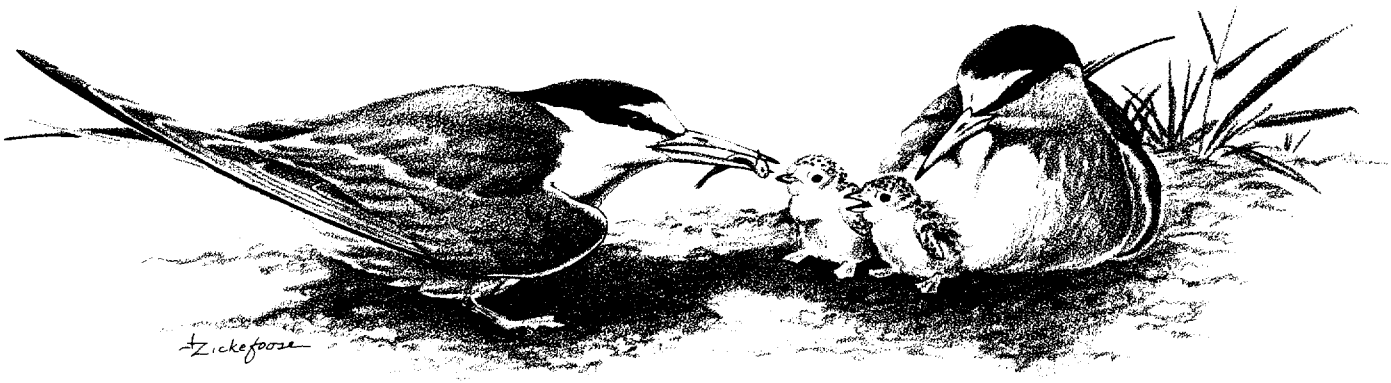
Iowa: Largely devoid of natural interior least tern habitat, Iowa's conservation efforts have focused on monitoring and protecting the few nest sites located on fly-ash disposal sites of two power generating stations along the Missouri River at Council Bluffs and Sioux City. Both sites are monitored to record the number of nesting pairs and reproductive success. The Council Bluffs nesting habitat also is protected by a management plan. The plan specifies that both people and heavy equipment will be kept out of the nesting area during the breeding season.

Interior least tern decoys have been set out at the DeSoto National Wildlife Refuge to attract terns which formerly nested there in the 1970s. Woody vegetation has been cleared and the areas are disked to maintain open habitat.

Table 8. Recommended annual flow regime for Central Platte River, Nebraska[1]

Time Period	Flow(cfs[2])	Species/Resources of Concern	Existing Median Flow(cfs) (1958-1985)
Jan 1-Mar 22	1,100	Bald Eagle, wet meadow sandhill crane, waterfowl, least tern forage fish, sport fish	1,710
Mar 23-May 10	2,000	Whooping crane, sandhill crane, waterfowl, least tern forage fish, sport fish	1,823
May 11-May 14	800	Least tern forage fish, sport fish	1,433
May 15-Sep 15	800	Least tern, piping plover, tern forage fish, sport fish	781
Sep 16-Nov 15	2,000	Whooping crane, sandhill crane, waterfowl, least tern forage fish, sport fish	893
Nov 16-Dec 9	1,000	Waterfowl, least tern forage fish, sport fish	1,186
Dec 10- Dec 31	1,100	Bald eagle, waterfowl, least tern forage fish, sport fish	1,253

[1]As measured at the U. S. Geological Survey gage at Grand Island.
[2]Cubic feet per second



Missouri: The Missouri Department of Conservation maintains an active conservation, management and research program for interior least terns. The Missouri River has been thoroughly surveyed for potential habitat; Mississippi River colonies are closely monitored and under detailed study; and management plans have been developed. Regulations provide special protective status for least tern nesting areas on Department owned islands and sandbars. Public information programs about the interior least tern are widespread.

Kansas: The Kansas Department of Wildlife and Parks has funded research on distribution, reproductive success, banding and inter-colonial movements, foraging ecology, and predation since 1980. Annual surveys along the Cimarron River and at the Quivira National Wildlife Refuge have been conducted since 1980. Successful habitat alteration and management has been on-going since 1985. Studies also have focused on the issue of inadequate instream flows in both the Cimarron and Arkansas rivers in Kansas.

Oklahoma: The largest concentration of least terns in Oklahoma is at Salt Plains National Wildlife Refuge. This area has been studied intermittently since 1977. Research at river nesting sites has been on-going since 1982. The Cimarron and Arkansas rivers have received more survey and distribution effort than the Red and Canadian rivers. Various studies of reproductive success, inter-colonial movements and foraging ecology have been conducted at Salt Plains, Optima Reservoir and the western reaches of the Cimarron River. Posting, fencing and extensive news media efforts have been successful at Optima Reservoir and the western reaches of the Cimarron River. Nesting sites on the Cimarron River continue to be threatened by several river diversion and impoundment proposals. A memorandum of understanding has been developed between The Nature Conservancy, U. S. Army Corps of Engineers, Oklahoma Department of Wildlife Conservation, U. S. Fish and Wildlife Service, Tulsa Audubon Society, River Parks Authority and riverbed landowners for protection and management of essential habitat on the Arkansas River in Tulsa County.

Mississippi River States: The U. S. Army Corps of Engineers has undertaken extensive census work along the Mississippi River between Illinois and Vicksburg, Mississippi, and along the Arkansas River to the Oklahoma border. Their surveys have provided the only information on the tern on the Mississippi River below the State of Missouri. The locations of colonies are monitored and the information is used by regulatory personnel to evaluate permit applications and in planning operations and maintenance activities on the lower Mississippi River.

Texas and New Mexico: The Texas Parks and Wildlife Department has examined the numbers and distribution of interior least terns along the Rio Grande River and rivers in the Texas Panhandle, and investigated genetic characteristics of coastal and interior least terns. The New Mexico Department of Game and Fish has conducted several years of surveys and studies and developed management recommendations for interior least terns at and near the Bitter Lake National Wildlife Refuge along Pecos River (Jungemann 1988).

II. RECOVERY

Recovery objective

The purpose of this plan is to describe actions necessary to achieve recovery of interior least terns. The first step in this approach is to set a quantifiable goal (i. e., recovery objective) that, when reached, will assure populations remain stable. The remainder of this plan outlines steps necessary to achieve the recovery objective. Recovery goals, objectives and tasks may change as we learn more about the interior least terns.

Recognizing that the interior least tern has a broad distribution, the recovery objective was set by taking into account: 1) current data on distribution and abundance of interior least terns in each river system; 2) knowledge of how thoroughly each river system has been surveyed; 3) historic population data, when available; 4) loss of viable habitat; 5) an assessment of the potential to increase breeding pairs at currently occupied sites; 6) assessment of the potential to establish breeding pairs at unoccupied sites. Technical experts and state and federal resource agencies were consulted to determine the status of current populations and habitats, as well as the potential for population increase.

Therefore, in order to be considered for removal from the endangered species list, interior least tern essential habitat will be properly protected and managed and populations will have increased to 7,000 birds:

I. Missouri River System
   A. Number of birds in the Missouri River system will increase to 2,100 adults.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The breeding pairs will be maintained in the following distribution for 10 years (assuming at least four major censuses will have been conducted during this time):
      Montana - 50 adults
      North Dakota - 250 adults
      South Dakota - 680 adults (includes 400 shared with Nebraska on the Missouri River).
      Missouri River below Gavin's Pt. Dam - 400 adults
      Lake Oahe - 100 adults
      Missouri River below Ft. Randall - 80 adults
      Other Missouri River sites - 20 adults
      Cheyenne River - 80 adults
      Nebraska - 1520 adults (includes 400 adults shared with South Dakota on the Missouri River).
      Missouri River - 400 adults
      Niobrara River - 200 adults
      Loup River - 170 adults
      Platte River - 750 adults
      Missouri and Iowa - Opportunities for habitat restoration and reestablishment of breeding pairs will be determined.

II. Mississippi and Ohio Rivers
   A. Current number of adult birds (2,200-2,500) on the Lower Mississippi River will remain stable for the next ten years.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced, and restored.

III. Arkansas River System
   A. Numbers of birds on the Arkansas River system will increase to 1,600 adults.
   B. Essential breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The 1,600 breeding adults will be maintained in the following distribution for 10 years:
      Arkansas River, Arkansas - 150 adults
      Arkansas River, Oklahoma - 250 adults
      Quivira National Wildlife Refuge - 100 adults
      Salt Plains National Wildlife Refuge - 300 adults
      Cimarron River Basin - 400 adults
      Canadian River - 300 adults
      Beaver/ North Canadian River - 100 adults

IV. Red River System
   A. Number of birds in the Red River system will increase to 300 breeding adults.
   B. Essential Breeding habitat (Appendix 4) will be protected, enhanced and restored.
   C. The 300 adults will be distributed along the Prairie Dog Town Fork where interior least terns currently occur and at other essential habitat sites yet to be determined.

V. Rio Grande River System
   A. Current number of adult birds (500) in the Rio Grande River system will remain stable for 10 years.
   B. Essential breeding habitat will be protected, enhanced and restored.
   C. The birds will be distributed along the Rio Grande and Pecos Rivers.

<u>Step-Down Outline</u>

The step-down outline lists tasks necessary to meet the recovery objective. Steps (or tasks) are not presented in order of importance. Some steps are underway, while others may take years before they are begun. An explanation of these steps is presented in the Narrative section of this plan. Following the Narrative, the Implementation Schedule lists and sets priorities to be taken in the next three years. The step-down outline is very similar to the step-down outline in the Great Lakes/Northern Great Plains Piping Plover recovery plan (U. S. Fish and Wildlife Service 1988a) because both species breed in the same habitat areas in the Missouri River system and require similar recovery tasks.

1. Determine current distribution and population trends of the interior least tern.
   11. Assess status and distribution of breeding populations.
      111. Survey sandbars, reservoir shorelines, sand and gravel pits and other suitable habitats to determine breeding

distribution.

112. Develop a method for standardization of census techniques and timing of censuses.
113. Census known and potential breeding sites.
114. Monitor reproductive success.
115. Assess dispersal patterns and genetic diversity.
116. Assess mortality.
117. Further identify life history parameters and develop population models.

12. Assess status and distribution for the migration period.
13. Assess status and distribution during the winter.
    131. Survey beaches and other suitable habitat to determine winter distribution.
    132. Census known wintering areas.
    133. Monitor movement of birds between wintering sites and assess mixing of populations.
    134. Assess mortality on wintering areas.

2. Determine current habitat requirements and status.
   21. Determine breeding habitat requirements and status.
       211. Assess the characteristics, including prey resources, of breeding habitat.
       212. Quantify and evaluate available breeding habitat.
       213. Examine historic aerial photography and hydrographic surveys of river systems to determine the previous extent of potential habitat and vegetational changes.
   22. Determine current migration habitat requirements and status.
       221. Assess the characteristics, including prey resources, of migration habitat.
       222. Quantify and evaluate available migration habitat.
   23. Determine current habitat requirements and status on wintering areas.
       231. Assess the characteristics, including prey resources, of winter habitat.
       232. Quantify and evaluate winter habitat.
3. Protect, enhance, and increase interior least tern populations.
   31. Protect, enhance, and increase populations during the breeding season.
       311. Increase reproduction and survival at occupied breeding sites.
           3111. Evaluate predator impacts on eggs and chicks and identify species responsible for the predation.
           3112. Evaluate techniques for predator management and implement where appropriate.
           3113. Restrict public use within nesting areas and investigate enforcement options.
           3114. Manage water levels and river flows to reduce nest and chick loss.
           3115. Modify or eliminate construction activities that adversely impact reproductive success.

3116. Investigate the effects of environmental contaminants at breeding areas.

32. Protect and enhance populations during migration and winter.
    321. Manage areas to maximize survival of birds during migration.
    322. Manage winter areas to maximize survival of birds during winter.
        3221. Investigate the effects of human activities on winter survival.
        3222. Investigate the effects of environmental contaminants.

4. Preserve and enhance habitat.
    41. Provide protection and management of breeding habitat.
        411. Identify areas of essential breeding habitat.
        412. Continue to evaluate areas for consideration as essential breeding habitat.
        413. Establish liaison with agencies and organizations with land and water management responsibilities.
        414. Revise, establish, or utilize land and water laws and regulations to provide protection along rivers and lakes.
        415. Develop criteria and priorities for breeding habitat protection.
        416. Develop management plans for breeding habitat.
            4161. Determine direct, indirect and cumulative effects of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.
            4162. Identify river flow regimes that will protect and enhance breeding and foraging habitat.
            4163. Determine the relationship of existing artificial breeding sites to river sites.
            4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.
            4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.
            4166. Develop lake and reservoir control policies where existing and potential interior least tern habitat is threatened.
            4167. Identify needs and techniques for managing water levels.
        417. Evaluate success of protection and management techniques.
    42. Provide protection and management of migration habitat.
    43. Provide protection and management of winter habitat.
        431. Identify areas of essential winter habitat.
        432. Develop criteria and priorities for winter habitat protection.
        433. Develop management techniques.
        434. Modify construction activities that may reduce or negatively alter winter habitat.
        435. Evaluate success of protection and management techniques.

5. Develop and implement an education program that publicizes information on the interior least tern, including its life history, reasons for

current status, and options for recovery.

51. Inform and educate the public on the bird's plight and recovery efforts.
    - 511. Identify target audiences among the general public.
    - 512. Develop and distribute educational materials appropriate to various audiences.
    - 513. Develop materials for newspapers, radio, and television that highlight specific interior least tern projects.
    - 514. Provide controlled viewing opportunities if and when appropriate.
52. Inform and educate public resource management agencies.
    - 521. Identify critical resource agency constituents.
    - 522. Develop educational materials appropriate to respective agencies and their management authority.
    - 523. Provide public resource agencies with periodic updates on the interior least tern's status and progress of recovery efforts.

6. Coordinate recovery efforts.
    - 61. Designate a recovery plan coordinator.
        - 611. Coordinate research and management activities with federal,state, local and private organizations.
        - 612. Coordinate international research and management activities.
        - 613. Coordinate development of a public information program at the national and international level.

Narrative

The Narrative gives further details and justification for each task in the Step-Down Outline. The steps critical for recovery in the next three years are outlined and given priority in the Implementation Schedule.

1. <u>Determine current distribution and population trends of the interior least tern.</u>

   The effectiveness of current conservation efforts will not be well-understood until comprehensive distribution and census data have been collected. Future plans for recovery also will be curtailed until a more accurate picture of the species status is defined.

   11. <u>Assess status and distribution of breeding populations</u>.

   Most interior least tern censusing has been carried out during the breeding season. Results indicate interior least terns are widely distributed, as scattered pairs or in concentrations at breeding areas. The terns probably disperse great distances as suggested by Boyd and Thompson (1985). Continued search for new breeding areas and evaluation of known areas are necessary to complete our knowledge of the birds' status.

111. Survey sandbars, reservoir shorelines, sand and gravel pits and other suitable habitats to determine breeding distribution.

Currently, the distribution of the interior least tern on most of the Missouri River system is well-known and monitored, although reservoir shorelines in the Dakotas and Montana should be further surveyed for accurate population estimates especially during drought years when reservoir levels are low. Additional survey work is needed on the Loup River in Nebraska and elsewhere in the Platte River system. The Arkansas River system needs further survey work in Arkansas, Kansas, Oklahoma and Texas. The length of the Red River requires a thorough survey as does the Rio Grande River system and rivers in central Texas. Additional survey work is needed on the Lower Mississippi River to determine distribution when the river rises and floods nesting colonies. The Missouri Department of Conservation has a study in progress to address this need. The status of potential sites should be monitored and updated at least once every five years.

112. Develop a method for standardization of census techniques and timing.

The exposure of sandbars in the spring follows the reduction of river flows. The breeding cycle may commence at different times throughout the interior least tern's range. Differences in breeding chronology from south to north must be determined. Because of the length of time involved in surveying long stretches of rivers, surveys should be correlated with reported river levels and the exposure of sandbars. Surveys should account for renesting birds and later nesting by younger adults (Massey and Atwood 1981, Smith and Renken 1990).

113. Census known and potential breeding sites.

Once sites are identified as containing breeding pairs, annual censuses of breeding and non-breeding adults should be carried out at essential breeding habitat (Appendix 4) for several years. If the birds are established for several years, censusing should continue at least once every year.

114. Monitor reproductive success.

Census data provide an indication of an area's population size, but estimates of reproductive success are also necessary. More adults may be present in nesting areas than actually breed. Frequent nest destruction further lowers productivity of a site, rendering simple counts of breeding pairs less meaningful than censuses of adults and fledged chicks. Reproductive success or recruitment (measured in terms of number of chicks fledged per pair) should be monitored annually at essential sites and at least every three years, on a rotating basis, at other sites. Causes of reproductive failure should be identified whenever possible. Because of possible early fledgling departure from colonies, multiple counts of fledglings should be made for

determination of the fledging rate (Thompson 1982, Thompson and Slack 1983).

115. Assess dispersal patterns and genetic diversity.
Little is known about the interaction between coastal least terns and the interior least tern. Boyd and Thompson (1985) found a nesting least tern in Kansas which had been banded as a chick on the Texas coast. It would be useful to know if coastal least terns serve as a reservoir to replenish the interior least tern population; and if the status of the coastal least tern population determines the numbers and distribution of interior least terns. Monitoring movements of marked birds in major breeding areas will fill the gap in our understanding of dispersal. Knowledge of how new nest sites are colonized, and where new birds originated will be useful in developing population management plans and models.

116. Assess mortality.
Factors such as human disturbance, predation, and water level regulation have reduced success of interior least tern eggs and chicks (Mayer and Dryer 1990). Factors affecting adult mortality, however, have never been fully addressed for any part of the annual cycle. Predation is a problem for some California and coastal least terns (Burger 1984, Minsky 1980, Massey 1981) and the closely allied little tern in Europe (Haddon and Knight 1983). During the breeding season, predation on interior least terns by coyote (*Canis latrans*), crow (*Corvus brachyrhynchos*), and raptors has been reported (G. R. Lingle, personal communication, Hill 1985, Kirsch 1990, Mayer and Dryer 1990) and predation on nesting adults by barred owls (*Strix varia*) has been recorded (Smith and Renken 1990). Predation is significant on the Missouri National Recreational River (U. S. Fish and Wildlife Service, unpublished data). It is important to determine the extent and cause of adult and juvenile mortality during the breeding season.

117. Further identify life history parameters and develop population models.
Field studies of interior least terns should be carried out without reducing reproductive success or site tenacity. Future breeding studies only should be undertaken after researchers have identified specific critical factors that require resolution in order to rehabilitate the species. It would be useful to compile all available life history data and develop a model to estimate potential population trends.

12. Assess status and distribution for the migration period.
Less is known about the migratory ecology for the interior least tern than for any other phase of the annual cycle. Migratory routes have not been adequately described for spring or fall. It is not known if interior least terns follow major river systems during migration or if they migrate directly north and south. Further, it is unknown if interior least terns join coastal least terns prior to coastal least tern migration to Latin America or if interior least terns have their own migration route. Before

intensive individual field studies are undertaken, it may be beneficial to coordinate surveys of potential sites with natural resource employees or local birders to determine if interior least terns are stopping en route to wintering sites.

13. Assess status and distribution during the winter.
Interior least terns spend 6-7 months at wintering sites. Most field research, however, has been carried out on breeding birds. Factors limiting non-breeding birds may be as severe or worse than threats encountered during other times of the year. Field studies should begin to at least locate wintering sites.

131. Survey beaches and other suitable habitat to determine winter distribution.
Biologists familiar with the avifauna of Atlantic and Caribbean coastal Latin America should be contacted to assist in determining the winter distribution of least terns. A survey of the north coast of South America should be carried out to identify those habitat types used by least terns. However, the surveys may be difficult. Accessibility of coastal areas along central America and the northern coast of South America may be problematic for geographical and political reasons. Color-banded individuals would provide the means to distinguish interior least terns from other races or populations.

132. Census known wintering areas.
Once winter sites are known, censuses of important areas will provide an indication of their continuing importance and status as post-breeding sites.

133. Monitor movement of birds between wintering sites and assess mixing of populations.
It is not known if post-breeding interior least terns mix with coastal least terns at wintering sites. Once the habitat types of interior least terns are known, habitat protection can begin. Monitoring movements of birds between different sites will provide this information, as well as indicate the degree to which individuals from various breeding populations mix during the winter.

134. Assess mortality on wintering areas.
The extent and cause of mortality to post-breeding interior least terns has not been addressed. It is not clear if adults and juveniles suffer differential mortality, or if post-breeding birds face greater threats than do breeding birds. Any information leading to further delineation of threats to the species during this time will be important.

2. Determine current habitat requirements and status.

Habitat alteration has been identified as one of the principal causes of the current status of the interior least tern (U. S. Fish and Wildlife Service 1985, Whitman 1988). Recovery of the species will be affected substantially by the ability to identify and protect essential breeding habitat and to intensively manage that habitat to maximize productivity and survival. Setting priorities for protection of remaining sites and determining habitat management actions will require detailed knowledge of interior least tern habitat requirements and the availability and quality of existing sites.

21. Determine breeding habitat requirements and status.

Our knowledge of interior least tern breeding habitat requirements has increased greatly during the past five years. Data on seemingly adequate but unoccupied habitat is needed. Comparison of habitat conditions among used sites along with data on reproductive success will provide the information necessary to set priorities for protection, and determine site-specific management actions to enhance breeding habitat.

211. Assess the characteristics, including prey resources, of breeding habitat.

The characteristics of breeding habitat must be investigated across the entire range of the interior least tern. At riverine sites, habitat variables to be measured should include: nesting area and height above water level, vegetative cover and distribution, substrate type, and river level fluctuations. Other variables may be of particular interest at local breeding areas. Measurements taken and methods employed at various breeding sites should be standardized to allow comparisons among areas. Few data are available on food resources at interior least tern breeding areas. Information on prey species occurrence and abundance are needed, as are estimates of the likelihood of food being a limiting habitat factor. The goals of these investigations should be identification of the range of habitat conditions tolerated by interior least terns, determination of habitat factors that affect nest densities, and elucidation of habitat conditions that may be related to maximum reproductive success rates.

212. Quantify and evaluate available breeding habitat.

As habitat assessment is undertaken, efforts to quantify existing interior least tern habitat should be initiated. The first task should be quantification of known and potential breeding habitat. As habitat quality data become available, existing sites should be evaluated with respect to habitat adequacy and deficiencies. Based on this information, recommendations for site protection or management actions should be given priorities. Remote sensing techniques such as aerial videography (Sidle and Ziewitz 1990) can be useful to quantify and, if possible, rate interior least tern breeding habitat. Sandbars are easily visible on satellite imagery of the Mississippi and Missouri Rivers. A catalog or compendium of interior least

tern nesting areas should be developed.

213. Examine historic aerial photography and hydrographic surveys of river systems to determine the previous extent of potential habitat and vegetational changes.
For many rivers periodic aerial photographs and hydrographic surveys are available. It would be useful for predictive purposes to measure the change, if any, in the quantity and quality of sandbar habitat since photo and hydrographic coverage began (Hamel et al. in press, Rodekohr and Engelbrecht 1988, Sidle et al. 1989). Such an endeavor would allow an accurate forecast of habitat trends.

22. Determine current migration habitat requirements and status.
Because migration patterns of interior least terns are not understood, no information on habitat requirements or status is available. Once stop-over sites, if they exist, are determined, evaluation of habitat requirements should be undertaken.

221. Assess the characteristics, including prey resources, of migration habitat.
If stop-over sites are identified, the habitats used should be described and variables characterizing those habitats quantified. Quantification (time activity budgets) of how interior least terns use the available habitats and their length of stay at stop-over sites also should be determined.

222. Quantify and evaluate available migration habitat.
Once migratory habitats are identified and characterized, the availability of such habitats should be determined. Initially, habitat availability in the vicinity of known stop-over sites should be quantified and its quality assessed. If migratory habitat in the vicinity of current stop-over sites is limited, a large scale survey of available habitat along suspected migratory corridors should be made.

23. Determine current habitat requirements and status on wintering areas.
No data are available on interior least tern winter habitat requirements. This task should be undertaken followed by a determination of the extent to which wintering habitats are traditionally used. Information on the role of winter habitat abundance, distribution, and quality in interior least tern population dynamics is totally lacking. Data relating winter habitat conditions to population status are needed.

231. Assess the characteristics, including prey resources, of winter habitat.
As primary wintering areas are identified, characteristics of the habitats used by interior least terns must be quantified and variables affecting quality of those habitats elucidated. Winter habitats should be assessed with regard to interior least tern prey abundance and distribution, roost site needs, and location of feeding and roosting habitat. Habitat characteristics near occupied sites, but not currently used by interior least terns, also should be assessed. Quantitative data on interior least tern use of winter habitats also are needed. Information on movements

among wintering areas, movements among habitats, time-activity budgets, the use of pre-migration staging areas, etc., may provide important information on habitat quality. The goal of these studies should be identification of habitat features that affect winter survival of interior least terns, assure adequate pre-breeding condition, and favor mixing among individuals from local breeding populations.

232. Quantify and evaluate winter habitat.
After baseline information on habitat characteristics and quality is available, the amount and distribution of winter habitat should be determined. Additionally, the quality of existing habitat should be rated and deficiencies identified. This effort may involve development of remote sensing techniques to identify and monitor winter habitat. Based on data generated under steps 231 and 232 the likelihood of winter habitat quantity limiting the growth of the interior least tern population should be evaluated. If winter habitat is found to be limited, further recommendations should be developed on the need for habitat protection or management of specific sites.

233. Eliminate current or potential threats to winter habitat.
As winter habitat is identified, current and potential threats to each site should be determined. Priority should be given to sites currently used by interior least terns. It is important to not only identify threats that could destroy winter habitats, but also those that could result in lowering the quality of remaining sites. Habitat ownership will have to be taken into consideration when assessing threats to the species.

3. Protect, enhance, and increase interior least tern populations.
Legal protection is often not enough to ensure perpetuation of breeding populations. Active management actions, including predator management, restricted access, and water level management are critical components of a comprehensive protection plan.

31. Protect, enhance, and increase populations during the breeding season.
To date, breeding activity of interior least terns has been more thoroughly investigated than activities at other times of the year. Current surveys have now identified most of the nesting areas in the U. S. Extensive survey work and research investigations of several major breeding areas have helped delineate many factors contributing to the species' current status, thus enabling the development of specific recommendations that may enhance the species' survival during the reproductive season.

311. Increase reproduction and survival at occupied breeding sites.
Activities that reduce interior least tern reproductive success and survival on its breeding grounds are probably among the principal factors responsible for the species' current status. Actions directed at eliminating or

minimizing such impacts are essential to the interior least tern's recovery.

3111. Evaluate predator impacts on eggs and chicks and identify species responsible for the predation.
Predation can be high in California and coastal least tern colonies (Atwood et al. 1979, Burger 1984, Massey 1981). Surveys on the Lower Mississippi River revealed that nest predation, especially by coyotes, has substantially reduced reproductive success at certain colonies. The vulnerability of terneries to such predation increases when island habitat accretes to the shoreline during periods of low water (Smith and Renken 1990). Studies conducted in the Missouri River system have documented a high percentage of interior least tern egg and chick loss to predation (Nebraska Game and Parks Commission, unpublished data, Mayer and Dryer 1990). During 1987-1989, predation accounted for most of the nest losses on the Platte River except riverine nests on the central Platte where flooding caused the mortality (Kirsch 1990, Lingle 1989). Both avian and mammalian species are among the suspected predators. Further studies that document such losses should continue. Investigations that focus specifically on identifying predators, and the cues they use in locating nests and/or chicks, determining the time of predation, etc., are necessary if egg and chick mortality are to be curtailed.

3112. Evaluate techniques for predator management and implement where appropriate.
Lethal and non-lethal methods for managing mammalian predators have been extensively developed for other wildlife management purposes. They include: eliminating or relocating the animal, erecting electric fences, and developing taste aversions. Electric fences have been used to protect nesting California and coastal least terns (Massey and Atwood 1980, 1982; Minsky 1980). The applicability of these and other techniques (e. g. predator exclusion cages) to the interior least tern should be investigated. Few management efforts have focused on managing avian predators, such as common ravens (*Corvus corax*), American crows, great horned owls (*Bubo virginianus*), great blue herons (*Ardea herodias*), California gulls (*Larus californicus*), and ring-billed gulls (*L. delawarensis*). Appropriate management measures should be implemented at interior least tern sites that are now experiencing significant and repeated loss due to predation.

3113. Restrict public use within nesting areas and investigate enforcement options.

Disturbance of California and coastal least tern colonies caused by foot traffic and recreational vehicles has been well-documented (Massey and Atwood 1979, Goodrich 1982, Burger 1984) and is also true for interior least terns (Schwalbach 1988, Kirsch 1987-90, Lingle 1989, Smith and Renken 1990). Losses incurred by these activities can be direct, by destroying eggs and chicks, as well as indirect, by inhibiting territory establishment, feeding behavior, incubation and other reproductive behavior. A variety of techniques that restrict access to nesting areas have been successful in a few states and should be implemented on a wider scale. These include posting, restricted access, and fencing (Morris 1979, 1980; Larkins 1984, Massey and Atwood 1979). Because many interior least tern nesting areas are located in remote areas, strict enforcement of regulations is often impractical. Although the site may receive substantial recreational use, budget restrictions rarely allow full-time monitoring by professional staff. It is essential, therefore, that actions to restrict recreational activities always be accompanied by an aggressive public relations effort that will effectively reach all potential visitors to an area and adequately explain the purpose of the regulations. "Tern wardens" who patrol nesting areas to explain the restrictions, should be considered for particularly important breeding areas (McCulloch 1982). The U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and state wildlife agencies could become involved in public relations efforts and patrols to protect interior least tern nesting areas on the river systems. Agents of the Missouri Department of Conservation maintain an active enforcement program at Mississippi River terneries. Similar state and federal enforcement endeavors have begun on the Missouri River in North and South Dakota, and Nebraska, and on the Platte River in Nebraska. Field research on interior least terns should be carefully examined for its effects on the reproductive success of the birds (Brubeck et al. 1981). Research proposals should be scrutinized for their benefit to interior least tern recovery.

3114. Manage water levels and river flows to reduce nest and chick loss.

A significant proportion of the interior least tern population resides along rivers where much habitat has been destroyed by reservoir construction, channelization, water depletion, vegetative

encroachment, and modification of flow regimes (Currier et al. 1985, Nebraska Game and Parks Commission 1985b, Schwalbach et al. 1986, 1988, Eschner et al. 1981, Smith and Stucky 1988, Sidle et al. 1989). This riverine habitat is subject to a number of additional threats, including untimely water releases from dams that flood sandbar nesting habitat (Dryer and Dryer 1985, Schwalbach et al. 1986, 1988; Schwalbach 1988, G. R. Lingle, personal communication). Managing water levels early in the spring along some rivers could help to resolve this problem. Nesting habitat, expected to be flooded late in the season, could be submerged when interior least terns begin establishing territories in early May, forcing them to seek higher grounds that would be safe throughout the nesting season. It is essential, however, that sufficient nesting habitat is available above the fluctuation zone. High waters in spring also helps keep sandbars devoid of vegetation by reducing sprouting of young herbaceous growth and by increasing deposition of coarse sediments (Currier et al. 1985, O'Brien and Currier 1987).

Annual flow regimes need to be developed for many river segments where interior least terns occur. For example, along the central Platte River the Service has developed flow recommendations to support a variety of wildlife including least tern nesting habitat and the bird's forage fish (Table 8). These recommendations have been accepted by the Federal Energy Regulatory Commission as part of the annual relicensing of upstream water projects in Nebraska (Sidle et al. 1990). The water releases will occur on the North Platte River, far upstream of interior least tern nesting habitat. The Ohio River has a major effect on the availability of interior least tern habitat in the lower Mississippi River. Management of this river and other rivers throughout the bird's range need to be examined for their effect on the interior least tern and its habitat.

3115. <u>Modify or eliminate construction activities that adversely impact reproductive success of interior least terns.</u>

Recreational and residential development along river fronts should be discouraged in nesting areas. Proposals for maintenance or development activities that do not directly disturb breeding habitat but that occur in the vicinity of nest sites should be closely scrutinized for their potential impact.

3116. <u>Investigate the effects of environmental contaminants during the breeding season.</u>

Contaminant effects on interior least terns are unknown. It would be useful to at least collect addled eggs during surveys and field studies for later contaminant analysis.

32. Protect and enhance populations during migration and winter.
Each year, 30 percent or less of the interior least tern's time is spent on the breeding grounds. A comprehensive protection plan also should focus on the species survival during migration and winter. However, migration and winter are the most poorly understood stages of the bird's life cycle and little can be recommended until migratory patterns are determined. The delineation of key areas where interior least terns spend non-breeding months is a critical step to enable the protection measures necessary for the birds' survival year-round.

321. Manage areas to maximize survival during migration.
Nothing is currently known about either the extent or causes of mortality that interior least terns might encounter during migration. Work that focuses on delineating migration routes (Step 12) should be expanded to focus on causes of mortality as well. When appropriate, measures should then be taken to lessen the impact upon the species.

322. Manage winter areas to maximize survival during winter.
During winter, interior least terns probably use open habitats. Sand, gravel, and/or cobbled marine beaches may be selected, as well as intertidal beach bars and flats.

3221. Investigate effects of human activities on winter survival.
Recreational, residential, and industrial developments each pose a potential threat to interior least terns by increasing the level of human activity. Moreover, hunting of terns in Latin America may be a factor. To date, research studies have focused primarily on describing the impacts of human activities on nesting grounds. Future efforts also should be directed at collecting similar data from wintering areas, once such areas are discovered.

3222. Investigate the effects of environmental contaminants in wintering areas.
During surveys for interior least tern wintering areas, attention should be paid to coastal pollution. Chemical use and its impacts on foreign wintering areas should be evaluated.

4. Preserve and enhance habitat.
Because of major habitat losses and increasing demands on available habitat, protecting and enhancing existing and potential interior least tern habitat is a major concern. Important breeding areas have been identified but enhancement and protection of essential habitat has been limited. Little is known about those areas along the migration route or on the wintering grounds.

41. Provide protection and management of breeding habitat.
Essential breeding habitat (Appendix 4) will need delineation,

protection, and enhancement to provide for recovery of the species. Efforts should include increased management activities to provide better use and protection of existing and potential areas. Compatibility of other uses (e.g., recreation) for breeding areas should be defined. All essential habitat needs permanent protection, where possible, through appropriate fee title acquisition, permanent easement, cooperative agreements, and memorandums of agreement or understanding among federal agencies and private organizations (Appendix 2).

411. Identify areas of essential breeding habitat.
Essential Habitat is listed in Appendix 4 to highlight known areas to be protected.

412. Continue to evaluate areas for consideration as essential breeding habitat.
Recognizing the fragile nature of much of the interior least tern's breeding habitat, continued evaluation and designation of essential habitat in primary breeding areas will protect areas from detrimental development.

413. Establish liaison with agencies and organizations with land and water management responsibilities.
Due to increasing pressure for development and use of land and water resources to meet human needs, efforts should be made to communicate with agencies, organizations, and individuals whose decisions affect the future of interior least tern habitat. The purpose would be to resolve conflicts between known development actions and future conflicts through planning of land and water development.

414. Revise, establish, or utilize land and water laws and regulations to provide protection along rivers and lakes.
Increasing demands for agricultural land and urban development, wetland drainage, power generation, water for irrigation, recreational space, and operation of river reservoirs have threatened or destroyed interior least tern habitat. Enforcement of laws and regulations, particularly those involving instream flow protection, 404 permits, and endangered or threatened species habitat protection, is needed to restrict or modify such developments on the remaining essential interior least tern habitat. All land- and water-use legislation should be scrutinized for potential impact to interior least tern habitat. Undesirable legislation should be modified and laws enacted that will expand the consideration given wildlife during water and land development planning.

415. Develop criteria and priorities for breeding habitat protection.
To provide adequate protection, some habitat will have to be purchased in fee title, or placed under a protective easement or cooperative landowner agreement. Although permanent protection of essential areas usually will be preferred, in some instances, temporary protection of ephemeral nesting areas may be achieved through agreements with private parties and public authorities. Protection of

areas listed as essential habitat (Appendix 4) is based upon tradition of occupancy, number of birds present, site productivity, proximity to other protected sites, imminence of habitat destruction, and ephemeral nature of the site.

416. Develop management plans for riverine breeding habitat. Techniques may vary from site to site depending on need and opportunity, but plans should be developed for management of essential riverine habitat (see Step 2).

4161. Determine direct, indirect, and cumulative effects of manipulation of river hydraulics, flow regimes, and sediment discharge on breeding and foraging habitat.

Manipulation of river flow regimes and river hydraulics through water diversion, storage of flows by dams, discharge from dams for power generation, navigation and irrigation demands, bank stabilization, and channelization has significantly altered the natural dynamic processes responsible for loss and creation of sandbars used for nesting (Nunnally and Beverly 1986, Sandheinrich and Atchison 1986, Smith and Stucky 1988). As a result, breeding habitat could be lost at a higher rate than what is being created. Modifications of river flow regimes through operation of reservoirs and lock and dams also has caused concern for long-term effects of riverbed degradation on interior least tern habitat. Although many direct effects of human manipulations have been identified, suspected indirect and cumulative impacts of ongoing and future river developments need to be determined. Under Section 7 of the Endangered Species Act the U. S. Fish and Wildlife Service and the U. S. Army Corps of Engineers have consulted on the effects of proposed dams in the Platte River system, and are consulting on the effects of main stem dam operations on interior least terns along the Arkansas and Missouri Rivers (U. S. Fish and Wildlife Service 1987b, 1987c, 1989, 1990). Section 7 consultation provides an opportunity to protect much of the interior least tern's breeding habitat.

4162. Identify river flow regimes that will protect and enhance breeding and foraging habitat.

Control of river flows is desirable to prevent inundation of nests and young (Nebraska Game and Parks Commission 1985c), discourage growth of woody vegetation, and to maintain a river with a nutrient base necessary for production of fish used as food by interior least terns. Proper instream flow is a major goal of ongoing Section 7 consultations regarding the interior least tern.

4163. Determine the relationship of existing artificial breeding sites to river sites.

California and coastal least terns readily use man-made habitats. Islands, spoil piles, and beaches formed by dredged sand and gravel, and located immediately adjacent to the Platte River in Nebraska and elsewhere are used by interior least terns. A large percentage of the Platte River breeding population of interior least terns nests at sand and gravel pits. Dike fields are commonly used along the Mississippi River (Hamel et al. in press, Landin et al. 1985, Rumancik 1987, Smith and Renken 1990). Terns may use barges filled with sand on river segments now devoid of sandbar habitat. The importance of artificial habitat to recovery of the species, and to what extent such habitat can replace lost natural sandbars, should be determined.

4164. Identify need and techniques of improving habitat by management of substrate and by vegetation control through physical and/or non-toxic chemical means.

Existing woody vegetation may have to be removed from sandbars to provide suitable nesting habitat through physical or chemical means. Annual control may be necessary. Dredging and spreading sand or gravel of particular particle size could improve substrates for nesting and increase the height of sandbars to prevent continuous inundation. Currently, the U. S. Army Corps of Engineers and the Platte River Whooping Crane Habitat Maintenance Trust have been clearing islands on the Missouri and Platte Rivers, respectively.

4165. Study feasibility and determine need for creating new habitat and implement trials to determine success rates of creating new habitat.

A variety of techniques have been used to create artificial nesting sites for the California and coastal least terns and to attract terns to the sites (Massey 1981, Fancher 1984, Kotliar and Burger 1984). Creation of artificial habitat may be necessary in areas where manageable habitat is non-existent. This may be particularly important in areas where natural habitat has been lost to channelization and water diversion. For example, most of the lower Missouri River (Iowa, Kansas, Missouri, and Nebraska) is now a channel and artificially created sites (e.g., ash disposal sites at power stations in Iowa) (Wilson 1984, 1986; Dinsmore and Dinsmore 1989) are the only habitat available. As part of the annual relicensing effort for upstream water projects along the Platte River in Nebraska, restored least tern nesting habitat has been ordered by the Federal Energy Regulatory Commission for each bridge segment in the central Platte (Sidle et al. 1990). Additional restoration

will be needed elsewhere along the Platte River. Habitat on the Cimarron River appears to be progressively deteriorating from upstream to downstream as the channel narrows and woody vegetation encroaches. Vegetation control likely will be necessary to maintain essential habitat. Likewise, habitat restoration will be necessary if least terns are to recover in the Iowa and Missouri reaches of the Missouri River. In the Mississippi River, the Missouri Department of Conservation and the U. S. Army Corps of Engineers have developed a cooperative proposal to construct two artificial islands between St. Louis and Cape Girardeau, Missouri. Smith and Stucky (1988) discussed other recommendations, including modification of dike structures.

4166. Develop lake and reservoir control policies where existing and potential habitat is threatened.
Water levels affect interior least tern reproductive success by increasing or decreasing the amount of habitat available on the shoreline of reservoirs (e. g., Lakes Oahe and Sakakawea in the Dakotas, and Salt Plains National Wildlife Refuge, Oklahoma) and in dike fields. Changes in these levels during critical periods may delay initiation of nesting, flood nest sites or feeding areas, or increase the distance from nest sites to the water's edge. Lakes and reservoirs with interior least tern habitat must be identified and any policies controlling water levels need to be scrutinized to determine the effect on interior least tern reproductive success.

4167. Identify needs and techniques for managing water levels.
Lakes and reservoirs currently supporting nesting interior least terns or that provide suitable nesting habitat should be evaluated to determine if water level management is feasible. Where feasible, techniques should be developed to manage water levels to improve reproductive success.

418. Evaluate success of protection and management techniques.
Monitoring must be sufficient to detect and measure the positive effects of protection and management and to avoid potentially detrimental impacts on interior least tern habitat. Daily and seasonal activity patterns of interior least terns, along with locations of specific nesting areas, will provide key measures of the birds' response to various management practices. Monitoring vegetation to determine where changing habitat conditions exist and monitoring potential predator levels in the area should be considered. All techniques used to improve interior least tern habitat should be evaluated to determine their cost-efficiency.

42. Provide protection and management of migration habitat.
If migration sites are identified, their protection and enhancement will be essential. At that point, assessment of further needs of migrating interior least terns will be carried out. As stop-over habitats are identified, current and potential threats to those sites should be delineated. On publicly-owned sites, current land-use patterns or management actions that could conflict with interior least tern use of existing habitats should be identified. Feasibility of protecting major privately-owned stop-over sites should be assessed.

43. Provide protection and management of winter habitat.
Survival and continued existence of the species may depend on availability of suitable winter habitat. Furthermore, reproductive success of adults may partially be a function of their physical condition as they begin spring migration. Consequently, the quality and quantity of winter habitat may limit recovery of the species.

431. Identify areas of essential winter habitat.
Essential winter habitat first needs to be identified by surveys in Latin America.

432. Develop criteria and priorities for winter habitat protection.
Once further research is carried out in wintering areas, factors will be identified as being essential for winter habitat. At that point, a land protection strategy should be developed. Areas that support the greatest number of interior least terns, especially those supporting individuals from important sub-populations should be given priorities in a habitat management/protection plan.

433. Develop management techniques.
Once actual and/or potential interior least tern wintering habitat is identified, methods of managing those habitats should be developed and improved so that wintering habitat is of sufficient quantity and quality to accommodate and promote expansion of interior least tern populations to more stable levels.

5. Develop and implement an education program that publicizes information about the interior least tern, including its life history, reasons for current status and options for recovery.
Conservation of coastal least terns has benefitted greatly from public information endeavors (Jackson and Jackson 1985, Toups 1976). The interior least tern's successful recovery will depend on curtailing and/or redirecting human recreation and development activities. Therefore, resource managers and the general public should be provided with sufficient information to explain and justify changes in previous actions. Current efforts to develop a public information program have made an impressive start in this direction but must be intensified. These efforts also could benefit from better coordination at the national level to target specific audiences.

51. Inform and educate the public on the bird's plight and recovery efforts.
The first priority in developing a public information program

should be to educate the general public about the significance and value of the interior least tern. The public's support and cooperation ultimately will be essential to the species full recovery.

511. Identify target audiences among the general public.
Materials prepared to increase public awareness and appreciation of the interior least tern can be more effective if they are developed to meet specific interests and concerns of a particular audience. Time should be spent delineating which public groups are affected, either directly or indirectly, by interior least tern conservation efforts and how each audience can best be reached.

512. Develop and distribute educational materials appropriate for various audiences.
Current efforts should be expanded to make greater use of the various media, including newspapers, radio, and television. The primary focus of this task should be to provide background information describing the interior least tern's life history and habitat requirements and to describe how human activity/disturbance can threaten the survival of interior least terns. The public should also be made aware of the necessity to enact local regulations to protect the interior least tern. However, information materials should not increase the potential for observer disturbance to nesting birds. The Service's Tulsa office has produced an information brochure useful throughout the range of the interior least tern.

513. Develop materials for newspapers, radio, and television, that highlight specific interior least tern projects.
In several states, cooperative projects between state and federal agencies, as well as private organizations and individuals are underway to protect interior least terns. Such efforts which generate public support should be applauded and widely publicized, particularly at the local level.

514. Provide controlled viewing opportunities if and when appropriate.
Guided opportunities for observing interior least terns may be one of the best vehicles for generating public support and concern. Led by a qualified biologist under conditions that minimize or prevent disturbance to the birds, such trips can educate visitors first-hand about the need for strong protection and curtailment of some recreational activities.

52. Inform and educate public resource management agencies.
Some interior least terns occur on lands that are protected and/or managed by state and federal resource agencies. Recreation permitted on these areas (e.g., hiking, vehicle use, camping) can reduce the bird's reproductive success. In some areas an agency's own activities may also pose a threat (e.g., control of water levels in lakes and along rivers). Contact with

these agencies will facilitate better management of the areas for interior least terns.

521. Identify critical resource agency constituents.
Each resource agency (including state, federal, and private organizations) whose activities can impact the interior least tern should be identified.

522. Develop educational materials appropriate to respective agencies and their management authority.
Resource managers need to be provided with basic life history information about the interior least tern as well as specific management information and recommendations directly pertinent to their area of responsibility.

523. Provide public resource agencies with periodic updates on the interior least tern's status and progress of recovery efforts.
It is important that each public agency responsible for ensuring the interior least tern's survival, either directly or indirectly, be kept abreast of the success of their efforts at both the local and national level. Periodic updates not only inform them of progress being made, but also remind them of their responsibilities to the conservation of interior least terns.

6. Coordinate recovery efforts.
Development of a recovery plan for interior least terns involves coordination of biologists, agencies, and governments so that the most comprehensive, up-to-date information is collected and disseminated in an efficient way. Proper coordination would also help ensure rapid implementation of those actions necessary for full recovery.

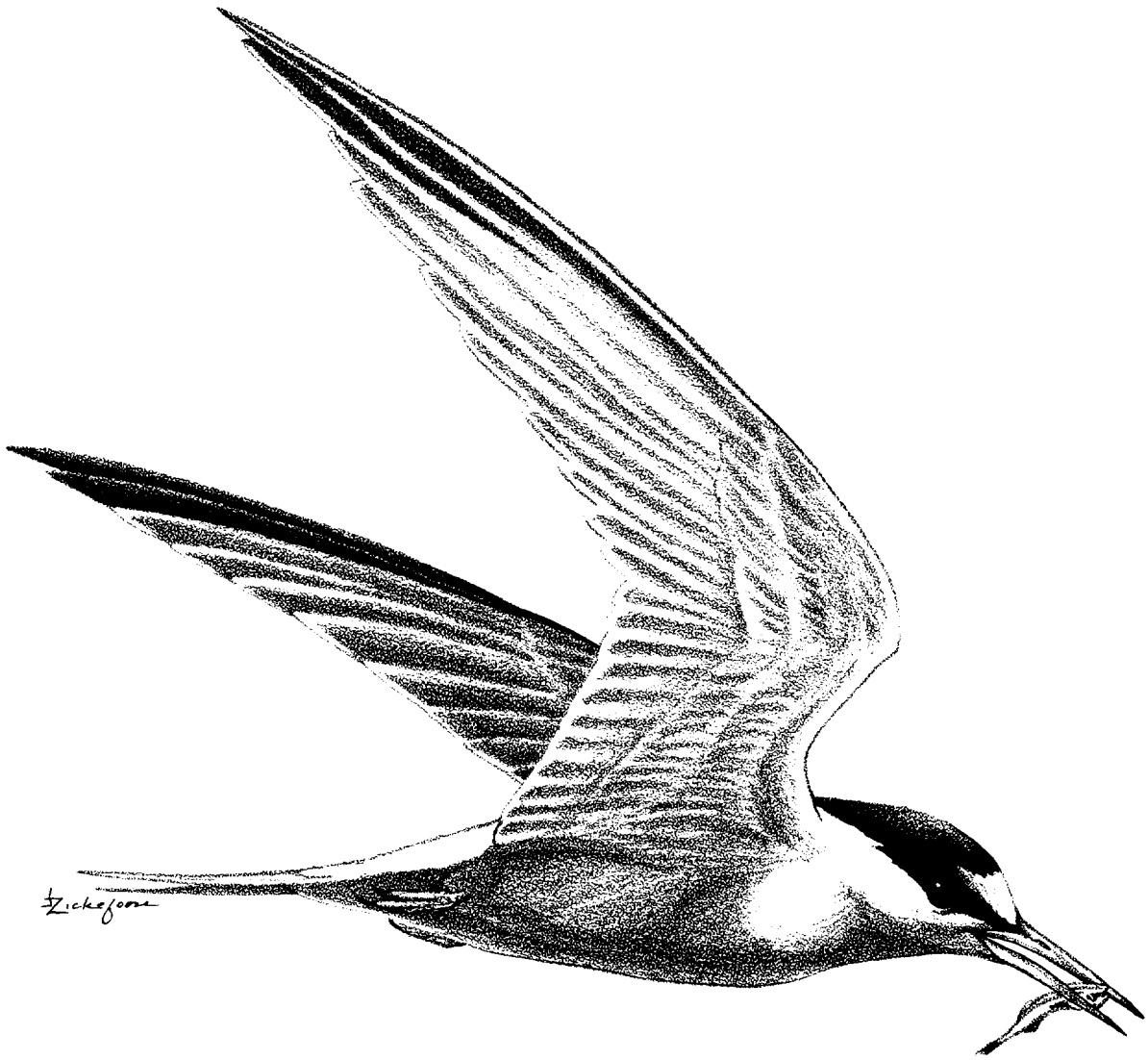
61. Designate a recovery plan coordinator.
Designation of a coordinator is recommended. Duties of the coordinator would include: a) coordination of the implementation of the recovery plan; b) naming an individual in each state to coordinate and implement recovery tasks; c) monitoring execution of the plan's implementation schedule; d) maintaining collaboration with state, federal, and international agencies; disseminating critical annual data; and coordinating range-wide research activities for interior least terns. A least tern contact person should also be designated for each state.

611. Coordinate research and management activities with federal, state, local, and private organizations.
Efficient achievement of recovery goals will be enhanced through coordination of research and management with private and governmental agencies. For example, it would be useful to establish and coordinate an international banding scheme whereby birds can be easily identified throughout the annual cycle. The recovery plan outlines many facets of interior least tern conservation that require urgent investigation. Repetition of efforts due to lack of coordination will slow the recovery process and may cause undue disturbance to the birds.

612. Coordinate international research and management activities.
Development of population management plans on an

international scale may be necessary. Interior least terns probably winter in Latin America and coordination with various nations and international conservation organizations may be necessary.

613. Coordinate development of a public information program at the national and international level.
Information and educational materials developed in one river system could be of equal benefit in other river systems. Some materials also may be helpful to states that support wintering populations. Coordination at the federal level will reduce duplication of effort and encourage more efficient use of time and money at the state level. A coordinated approach to raising an awareness of the interior least tern's plight at the international level would ensure protection throughout its range.



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III. IMPLEMENTATION

The Implementation Schedule outlines and gives priorities to tasks deemed necessary to be undertaken in the next three years to maximize recovery of the interior least tern. This process will be reviewed every three years until the recovery objective is met. Therefore, priorities and tasks may change in the future.

KEY TO IMPLEMENTATION SCHEDULE
General Category (Column 1):

Information and Research (I,R)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomy
6. Demographic studies
7. Propagation
8. Migration
9. Wintering
10. Predation
11. Competition
12. Disease
13. Environmental contaminant
14. Reintroduction
15. Other information

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Desease control
7. Pollution control
8. Public information
9. Other information

Priority (column 4) :

1. Those actions absolutely necessary to prevent extinction of the species in the foreseeable future.

2. Those actions necessary to maintain the species' current population status.

3. All other actions necessary to provide for full recovery of the species.

Agency Responsibility (column 6):

USFWS Regional Office 2 - Albuquerque
3 - Twin Cities
4 - Atlanta
6 - Denver

USFWS Research = 8
USFWS Office of Migratory Bird Management = OMBM
USFWS Office of International Affairs = IA
SA = State Wildlife Agency
BR = Bureau of Reclamation
COE = U. S. Army Corps of Engineers
NPS = National Park Service
WCHT = Platte River Whooping Crane Habitat Maintenance Trust
CW = Colonial Waterbirds

MO = Missouri River System
MS = Mississippi River System
AR = Arkansas River System
RE = Red River System
RG = Rio Grande River System

IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs 1	Fiscal Year Costs 2	Fiscal Year Costs 3
I1	Survey, census and monitor breeding populations	111-114	2 (MO)	Annual	Regions 3,6	SA, COE	$15K	$15K	$15K
			2 (MS)	Annual	Regions 3,4	SA, COE	$15K	$15K	$15K
			2 (AR)	Annual	Regions 2,4	SA, COE	$20K	$20K	$20K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$10K	$10K	$10K
I6, R6	Assess mortality and identify life history parameters (including population modeling)	116-117	3 (MO)	Annual	Regions 3,6	SA, WCHT	$10K	$10K	$10K
			3 (MS)	Annual	Regions 3,4	SA, COE	$10K	$10K	$10K
			3 (AR)	Annual	Regions 2,4,6	SA, COE	$10K	$10K	$10K
			3 (RE)	Annual	Region 2,4	SA, COE	$10K	$10K	$10K
			3 (RG)	Annual	Region 2	SA	$10K	$10K	$10K
R9, R1 R6	Survey and census winter populations	131-132	2	Annual	8,OMBM,IA	CW	$35K	$35K	$15K
I2, R3	Quantify and evaluate breeding habitat and threats	211-213	2 (MO)	2 years	Regions 3,6	SA, BR, WCHT	$15K	$10K	$10K
			2 (MS)	2 years	Regions 3,4	SA, COE	$15K	$15K	$15K
			2 (AR)	2 years	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	2 years	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	2 years	Region 2	SA	$10K	$10K	$10K
M4, R10	Evaluate predator impacts; evaluate predator management techniques and implement	3111-3112	2 (MO)	Annual	Regions 3,6	SA, WCHT	$15K	$15K	$10K
			2 (MS)	Annual	Regions 3,4	SA, COE	$10K	$10K	$10K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	Annual	Regions 2,4	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$ 5K	$ 5K	$ 5K

IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	2	3
M8, M9	Restrict human and vehicular access to nesting areas	3113	2 (MO)	Annual	Regions 3,6	SA, COE	$15K	$15K	$15K
			2 (MS)	Annual	Regions 3,4	SA	$10K	$10K	$10K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$15K	$15K	$15K
			2 (RE)	Annual	Regions 2,4	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA	$ 5K	$ 5K	$ 5K
M3, M9	Manage water levels to reduce nest and chick loss	3114	1 (MO)	Annual	Regions 3,6	COE	$20K	$20K	$20K
			1 (MS)	Annual	Regions 3,4	COE	$15K	$15K	$15K
			1 (AR)	Annual	Regions 2,4,6	COE, BR	$10K	$10K	$10K
			1 (RE)	Annual	Regions 2,4	COE	$ 5K	$ 5K	$ 5K
			1 (RG)	Annual	Region 2	COE	$ 5K	$ 5K	$ 5K
I2	Identify essential breeding habitat	411-412	2 (MO)	Ongoing	Regions 3,6	SA			
			2 (MS)	Ongoing	Regions 3,4	SA			
			2 (AR)	Ongoing	Regions 2,4,6	SA			
			2 (RE)	Annual	Regions 2,4	SA			
			2 (RG)	Annual	Region 2	SA			
M3	Establish liaison to protect breeding habitat	413	3 (MO)	Annual	Regions 3,6	SA, COE, BR			
			3 (MS)	Annual	Regions 3,4	SA, COE			
			3 (AR)	Annual	Regions 2,4,6	SA, COE, BR			
			3 (RE)	Annual	Regions 2,4	SA, COE			
			3 (RG)	Annual	Region 2	SA			
M9	Revise or establish laws to protect breeding habitat	414	3 (MO)	Annual	Regions 3,6	SA			
			3 (MS)	Annual	Regions 3,4	SA			
			3 (AR)	Annual	Regions 2,4,6	SA			
			3 (RE)	Annual	Regions 2,4	SA			
			3 (RG)	Annual	Region 2	SA			

IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs 1	Fiscal Year Costs 2	Fiscal Year Costs 3
R2, R3	Develop criteria and priorities for habitat protection	415	3 (MO)	1 year	Regions 3,6	SA			
			3 (MS)	1 year	Regions 3,4	SA			
			3 (AR)	1 year	Regions 2,4,6	SA			
			3 (RE)	1 year	Regions 2,4	SA			
			3 (RG)	1 year	Region 2	SA			
R3, M3	Develop river management plans	416	1 (MO)	Annual	Region 6	SA, COE, WCHT	$15K	$15K	$15K
			1 (MS)	Annual	Region 4	SA, COE	$10K	$10K	$10K
			1 (AR)	Annual	Regions 2,4,6	SA, COE, BR	$10K	$10K	$10K
			1 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			1 (RG)	Annual	Region 2	SA, COE, BR	$ 5K	$ 5K	$ 5K
R1, R2	Determine effects of river hydraulics and sediment discharge on breeding habitat; identify flow regimes to protect habitat	4161-4162	1 (MO)	Annual	Region 6	SA, COE, BR WCHT	$25K	$25K	$25K
			1 (MS)	Annual	Region 4	SA, COE	$20K	$20K	$20K
			1 (AR)	Annual	Region 2,6	SA, COE, BR	$20K	$20K	$20K
			1 (RE)	Annual	Region 2	SA, COE	$10K	$10K	$10K
			1 (RG)	Annual	Region 2	SA, COE	$10K	$10K	$10K
R3	Determine relationship of existing artificial breeding sites to riverine sites	4163	2 (MO)	2 years	Region 6	SA	$10K	$10K	$10K
			2 (MS)	3 years	Region 4	SA, COE	$10K	$10K	$10K
			2 (AR)	2 years	Regions 2,6	SA	$10K	$10K	$10K
			2 (RE)	2 years	Region 2	SA	$ 5K	$ 5K	$ 5K
			2 (RG)	2 years	Region 2	SA	$ 5K	$ 5K	$ 5K
M3	Modify and/or eliminate construction activities that impact breeding habitat	418	2 (MO)	Annual	Regions 3,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (MS)	Annual	Regions 3,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (AR)	Annual	Regions 2,4,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA, COE	$ 5K	$ 5K	$ 5K

IMPLEMENTATION SCHEDULE

Complete Implementation Schedule for First Three Years of Recovery Effort

General Category	Task	Task #	Priority #	Task Duration	Responsibility: Region (USFWS)	Responsibility: Other Agencies	Fiscal Year Costs: 1	Fiscal Year Costs: 2	Fiscal Year Costs: 3
M8	Inform and educate the public	511-513	2 (MO)	Annual	Regions 3,6	SA, COE	$ 5K	$ 5K	$ 5K
			2 (MS)	Annual	Regions 3,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (AR)	Annual	Regions 2,4,6	SA, COE, BR	$ 5K	$ 5K	$ 5K
			2 (RE)	Annual	Regions 2,4	SA, COE	$ 5K	$ 5K	$ 5K
			2 (RG)	Annual	Region 2	SA, COE	$ 5K	$ 5K	$ 5K
M8, M9	Inform and educate public resource management agencies	52	3 (MO)	Annual	Regions 3,6	SA, COE			
			3 (MS)	Annual	Regions 3,4	SA, COE			
			3 (AR)	Annual	Regions 2,4,6	SA, COE			
			3 (RE)	Annual	Region 2	SA, COE			
			3 (RG)	Annual	Region 2	SA, COE			
M9	Coordinate recovery efforts	61	2	Annual	Regions 2,4,6	SA, COE			

APPENDIX 1

Contact People

The following individuals have offered to provide interested parties with information pertaining to interior least terns in their area.

Roger Boyd
Biology Department
Baker University
Baldwin City, Kansas
913/594-6451

Dennis Christopherson
U. S. Fish and Wildlife Service
1501 14 St. West, Suite 230
Billings, MT 59102
406/657-6028

Mark Dryer or Paul Mayer
U. S. Fish and Wildlife Service
1500 Capitol Avenue
Bismarck, North Dakota 58501
701/255-4491

Paul B. Hamel
Tennessee Department of Conservation
701 Broadway
Nashville, Tennessee 37219-5237
615/742-6546

Laura A. Hill
U. S. Fish and Wildlife Service
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Tulsa, Oklahoma 74127
918/581-7458

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Platte River Whooping Crane Habitat Maintenance Trust
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Grand Island, Nebraska 68803
308/384-4663

Ross Lock
Nebraska Game and Parks Commission
P. O. Box 30370
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Jackson, MS 39213
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1407 College Drive
Emporia, Kansas 66801
316/342-1985

Kenneth Smith
Arkansas Natural Heritage Inventory
225 East Markham, Suite 200
Little Rock, Arkansas 72201
501/371/1706

Sartor O. Williams, III
Endangered Species Program
New Mexico Department of Game and Fish
State Capitol, Santa Fe, New Mexico 87503
505/827-9914

APPENDIX 2

Agreements Necessary For Protection Of Essential Habitat

1. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, National Park Service, U. S. Fish and Wildlife Service, and the State wildlife agency, for permanent protection and management (vegetation clearing, law enforcement, public relations, etc.) of all essential habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

2. U. S. Fish and Wildlife Service, National Park Service, and U. S. Army Corps of Engineers should acquire easements and/or fee title of essential interior least tern habitat on the Missouri River in North Dakota, South Dakota, and Nebraska.

3. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, U. S. Bureau of Reclamation, U. S. Fish and Wildlife Service, Platte River Whooping Crane Habitat Maintenance Trust, and the state wildlife agency, for the permanent protection and management of all essential habitat on the Platte River system in Nebraska.

4. The U. S. Fish and Wildlife Service should provide land protection of essential interior least tern habitat on the Platte River system.

5. Memorandum of Understanding should be developed between the U. S. Army Corps of Engineers, State natural resource agency, and the U. S. Fish and Wildlife Service for the permanent protection and management of essential habitat on the Mississippi and Ohio Rivers.

6. Memorandum of Understanding should be developed between the U. S. Fish and Wildlife Service, State wildlife agency, and the U. S. Army Corps of Engineers governing the deposition of dredge spoils on the Mississippi and Ohio Rivers for purposes of enhancing or creating interior least tern habitat.

7. Memorandum of Understanding should be developed between the U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U. S. Section of the International Boundary and Water Commission, State wildlife agencies, and appropriate agencies in Mexico for permanent protection and management of all essential habitat in the Arkansas, Red, and Rio Grande Rivers basins in Kansas, Oklahoma, Arkansas, and Texas.

8. U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation, and The Nature Conservancy should acquire easements and/or fee title of essential interior least tern habitat in the Arkansas, Red, and Rio Grande river basins in Kansas, Oklahoma, Arkansas, and Texas.

9. Memorandum of Understanding should be developed between the U.S. Fish and Wildlife Service, State wildlife agencies, and the U.S. Army Corps of Engineers governing removal and deposition of dredge spoil from the McClellan-Kerr Arkansas River Navigation System, in Oklahoma and Arkansas, for purposes of enhancing or creating least tern habitat.

Appendix 3. Example of a memorandum of understanding

MEMORANDUM OF UNDERSTANDING

The Nature Conservancy
U.S. Army Corps of Engineers
Oklahoma Department of Wildlife Conservation
U.S. Fish and Wildlife Service
Tulsa Audubon Society
River Parks Authority

WHEREAS _____, an Oklahoma corporation, ("Owner") has acquired certain lands and riverbeds on the Arkansas River floodplain in Tulsa County, Oklahoma, as more particularly shown on the plat attached hereto as Exhibit A (the "Property"); and

WHEREAS said Property has special value for wildlife including nesting populations of the endangered Interior Least Tern, Stern antillarum athalassos; and

WHEREAS The Nature Conservancy ("Conservancy"), a private, nonprofit organization committed to the conservation and management of rare and endangered species, communities, and ecosystems, has expressed an interest to coordinate the efforts of local, state, and federal agencies in protecting the Least Tern; and

WHEREAS The United States Army Corps of Engineers ("Corps") has certain water management responsibilities on the Arkansas River that might affect the habitat of the Least Tern; and

WHEREAS the U.S. Fish and Wildlife Service ("USFWS") has federal management responsibilities over federally-listed endangered species such as the Least Tern, and the Oklahoma Department of Wildlife Conservation ("ODWC") has state management responsibilities over state-listed endangered species such as the Least Tern; and

WHEREAS the Tulsa Audubon Society ("TAS"), a private, nonprofit organization, has expertise in the preservation of birds such as the Least Tern; and

WHEREAS the River Parks Authority ("RPA") is a public trust charged with the responsibility of protecting and enhancing interalia, natural communities and species along the Arkansas River and its environment in Tulsa County, Oklahoma.

WHEREAS the Owner, ODWC, USFWS, Conservancy, TAS, the Corps and RPA all have an interest in protecting nesting populations of the rare and endangered Interior Least Tern on the Arkansas River; and

WHEREAS The Owner is agreeable to manage jointly these lands to protect the Least Tern.

NOW THEREFORE, the Owner hereby grants to The River Parks Authority, an

exclusive license and permit, consisting of the following rights for the purposes described, in and to the lands described in Exhibit A attached hereto and made a part hereof, to-wit:

RIGHTS GRANTED TO THE RIVER PARKS AUTHORITY

1. The River Parks Authority shall have the right to enter upon and use said lands for the purpose of protecting all Least Tern nesting, fledging, feeding, resting and cover sites, located on said property. Said purposes shall include but not be limited to inspection, monitoring, research and, if deemed necessary, manipulation of the sites to enhance the Least Tern population. The River Parks Authority, upon consultation with the USFWS, may authorize personnel from the Corps, USFWS, ODWC, TAS, the Conservancy and others to enter said lands for the purposes described herein. Such consultation is necessary to alleviate potential for violations of the Endangered Species Act.

2. The River Parks Authority shall have the right to control and limit access to Least Tern nesting sites in breeding season, as necessary, and to erect and place any signs, posters, or other devices to identify the land as a protected area.

SAID RIGHTS ARE SUBJECT TO THE FOLLOWING LIMITATION, HOWEVER:

1. No one will construct facilities on said premises nor modify the land surface or habitat thereon until a proposal thereof has been reviewed and approved by USFWS and Owner.

2. All existing RPA regulations (e.g., no vehicle, dogs on leash, curfew clauses) will apply.

OBLIGATIONS OF RIVER PARKS AUTHORITY

AS PARTIAL CONSIDERATION for the rights hereby granted by the Owner, RPA agrees to:

Solicit expert advice regarding the protection, management and enhancement of the Least Tern population on the lands from the agencies and organizations that are party to this agreement and from other sources available to it, and shall exercise its best efforts to implement said recommendations consistent with the terms of this agreement.

OBLIGATIONS OF THE OWNER

THE OWNER agrees that:

1. In its planning and use of said lands, it shall, whenever practicable, take into consideration protection of said preserve area for endangered bird species.

2. It shall exercise its best efforts to implement recommendations of the River Parks Authority.

GENERAL PROVISIONS

1. Neither Owner nor any other party to this agreement is required to

obligate or spend funds under this agreement, it being the intent of the parties that staff time and expertise be the primary contribution of each party to the effective implementation of this Agreement.

2. This permit may be terminated, in whole or in part, by the Owner or by the River Parks Authority upon 90 days written notice to the other party.

3. All notices required under this agreement shall be effective when mailed to the following persons:

To Owner:	To River Parks Authority:
_____	Jackie Bubenik, Executive Director
_____	River Parks Authority
_____	707 South Houston, Suite 202
_____	Tulsa, Oklahoma 74127

4. By their signatures hereto, the Corps, USFWS, ODWC, TAS, and the Conservancy agree to assist the Owner and The River Parks Authority by providing expertise and assistance toward the common goal of protecting, managing, and enhancing the Least Tern population on the lands described.

IN WITNESS WHEREOF, the parties hereto have subscribed their names as of the dates indicated:

_____

By: _____ Dated: _____

_____Its:_____

THE NATURE CONSERVANCY Dated: _____

Attest:

By: _____ By: _____

_____Its Vice President Its Assistant Secretary

U.S. ARMY CORPS OF ENGINEERS Dated: _____

_____

By: _____

Its: _____

OKLAHOMA DEPARTMENT OF WILDLIFE CONSERVATION

By: _____ Dated: _____

_____Its: _____

U.S. FISH AND WILDLIFE SERVICE

By: _____ Dated: _____

_____Its: _____

TULSA AUDUBON SOCIETY Dated: _____

_____

Attest:

By: _____ By: _____
_____Its: _____ Its: _____

RIVER PARKS AUTHORITY Dated: _____

Attest:

By: _____ Dated: _____
_____Its: _____

APPENDIX 4

Essential Breeding Habitat for Interior Least Terns

Riverine sandbars, river channel environment including open channel area, channel width, and appropriate instream flows, and lake shorelines and other habitats provide essential habitat for the interior least tern. The interior least tern is completely dependent on these habitats for food and nesting sites. Therefore, destruction or adverse modification of remaining habitats will cause continued reduction of the species range and eventually a reduction in population numbers. The areas described and mapped herein as essential habitat will provide the space necessary for continued existence and growth of interior least tern populations required to meet the recovery objective. The following maps depict essential habitat for the interior least tern. Hatch marks along river segments and certain national wildlife refuges indicate the areas where essential habitat intermittently occurs depending on water conditions. For example, sandbars and interior least terns do not occur along every kilometer of the indicated segments of rivers. Locations of nesting birds may change from year to year within the indicated segment.

I. Missouri River System

Montana - Missouri River between Fort Peck Dam and North Dakota

North Dakota - Yellowstone River and Missouri River between Garrison Dam and the Cannonball River.

South Dakota - Cheyenne River from the Belle Fourche River to Lake Oahe; Missouri River from Ft. Randall Dam to mouth of the Niobrara River and from Gavin's Pt. Dam to Ponca, Nebraska.

Nebraska - Missouri River from South Dakota to mouth of the Niobrara River and from Gavin's Pt. Dam to Ponca; Niobrara River from Highway 183 bridge to Missouri River; Loup River from St. Paul to Platte River; Platte River from Lexington to Chapman and from Columbus (Highway 81 bridge to Missouri River.

II. Mississippi River - From Highway 146 bridge, Missouri and Illinois to Vicksburg, Mississippi

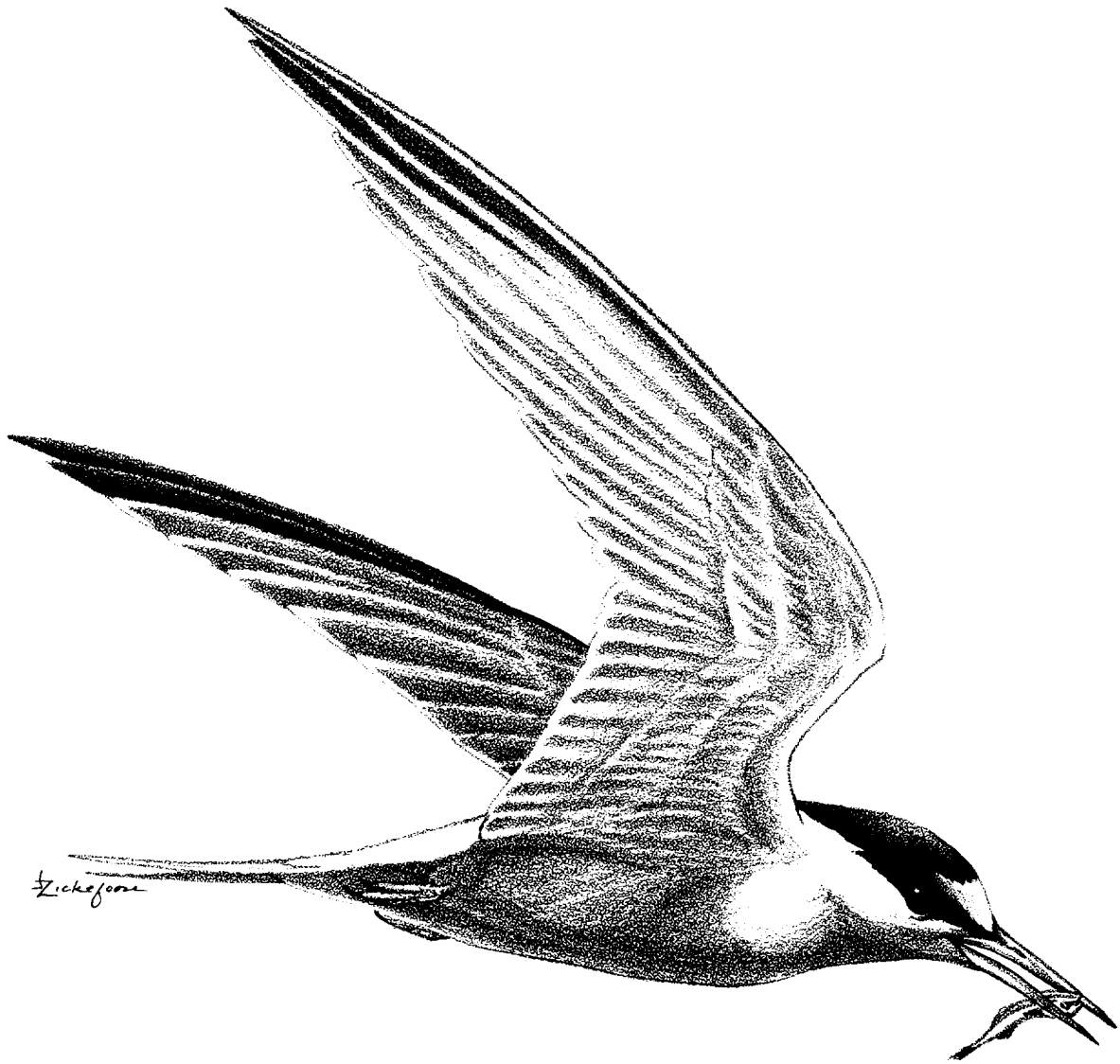
III. Arkansas River system

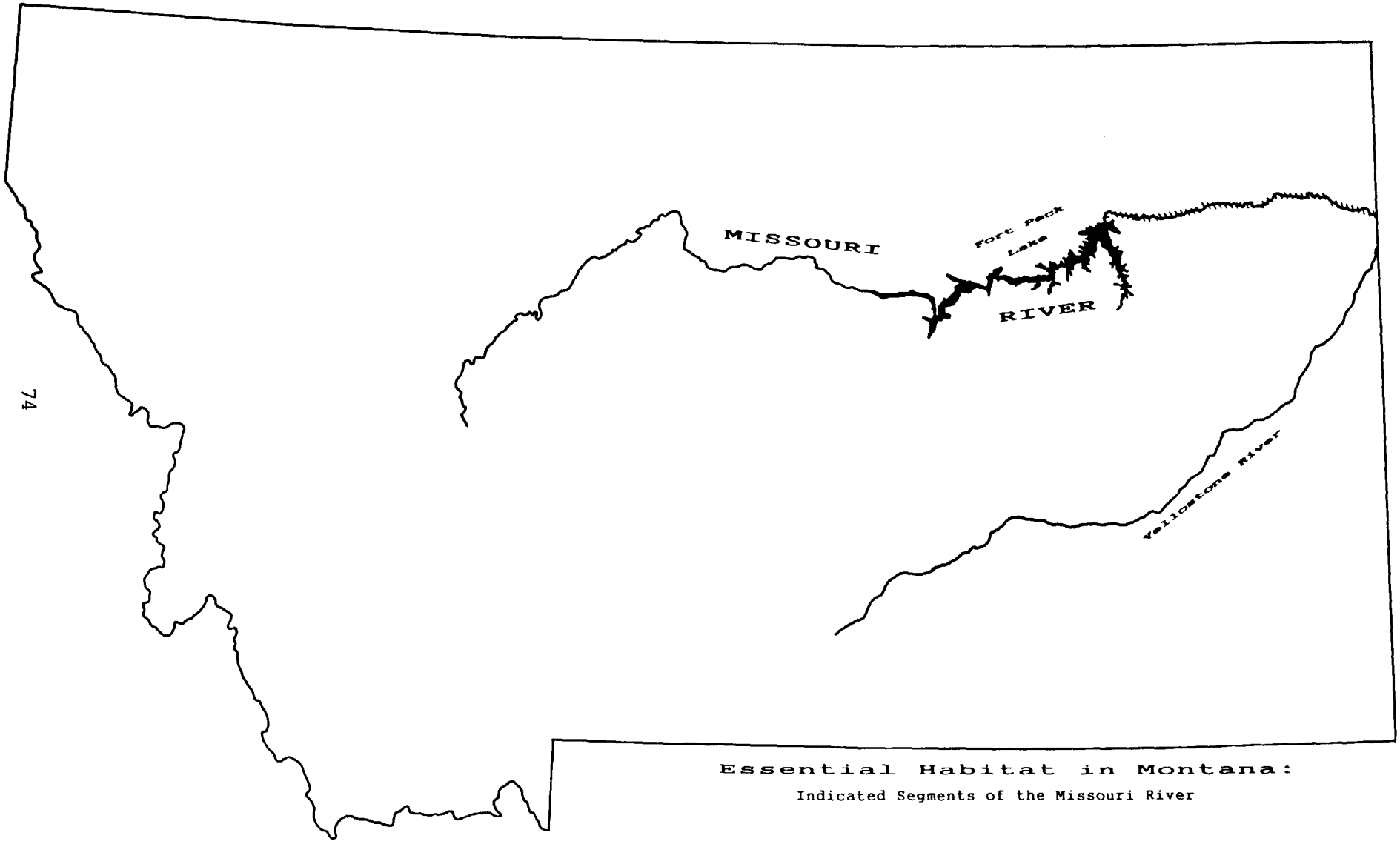
Kansas - Quivira National Wildlife Refuge and Cimarron River

Oklahoma - Salt Plains National Wildlife Refuge; from below Kaw Dam to Arkansas River and Arkansas River from Tulsa to Muskogee; Cimarron River in Beaver, Harper, Woods, Woodward, Major, Kingfisher, Logan, and Payne counties; Canadian River in Ellis, Roger Mills, Dewey, Cleveland, McClain, Haskell, Pittsburgh, Hughes, Muskogee, and Sequoyah counties; Sequoyah National Wildlife Refuge;

Red River from Harmon county to Highway 277/281 bridge.
Texas - Canadian River from Sanford Dam to Oklahoma; Prairie Dog Town Fork/Red River from Briscoe/Armstrong county boundary to Burkburnett, Texas.

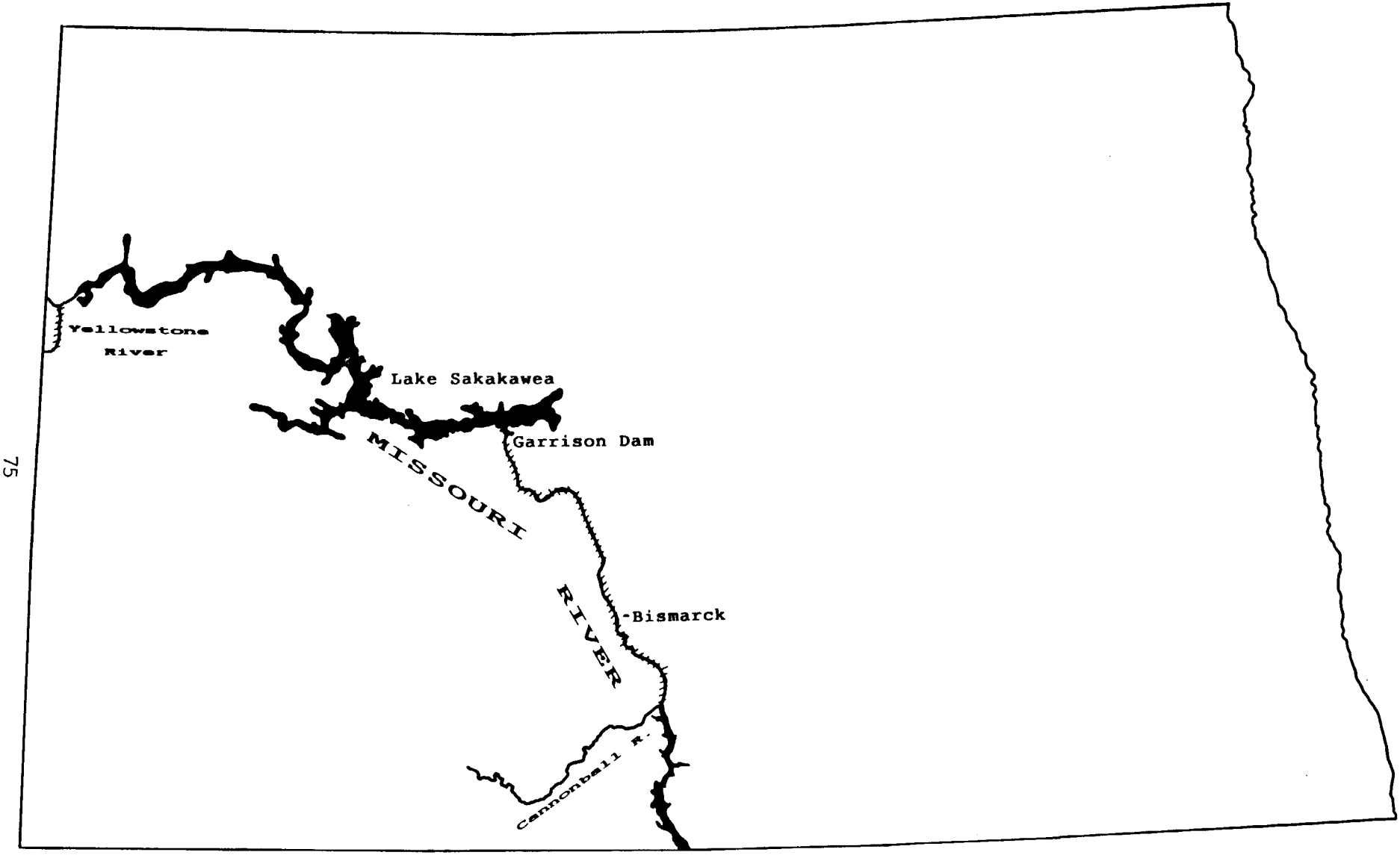
IV. Pecos River - Bitter Lake National Wildlife Refuge, New Mexico.



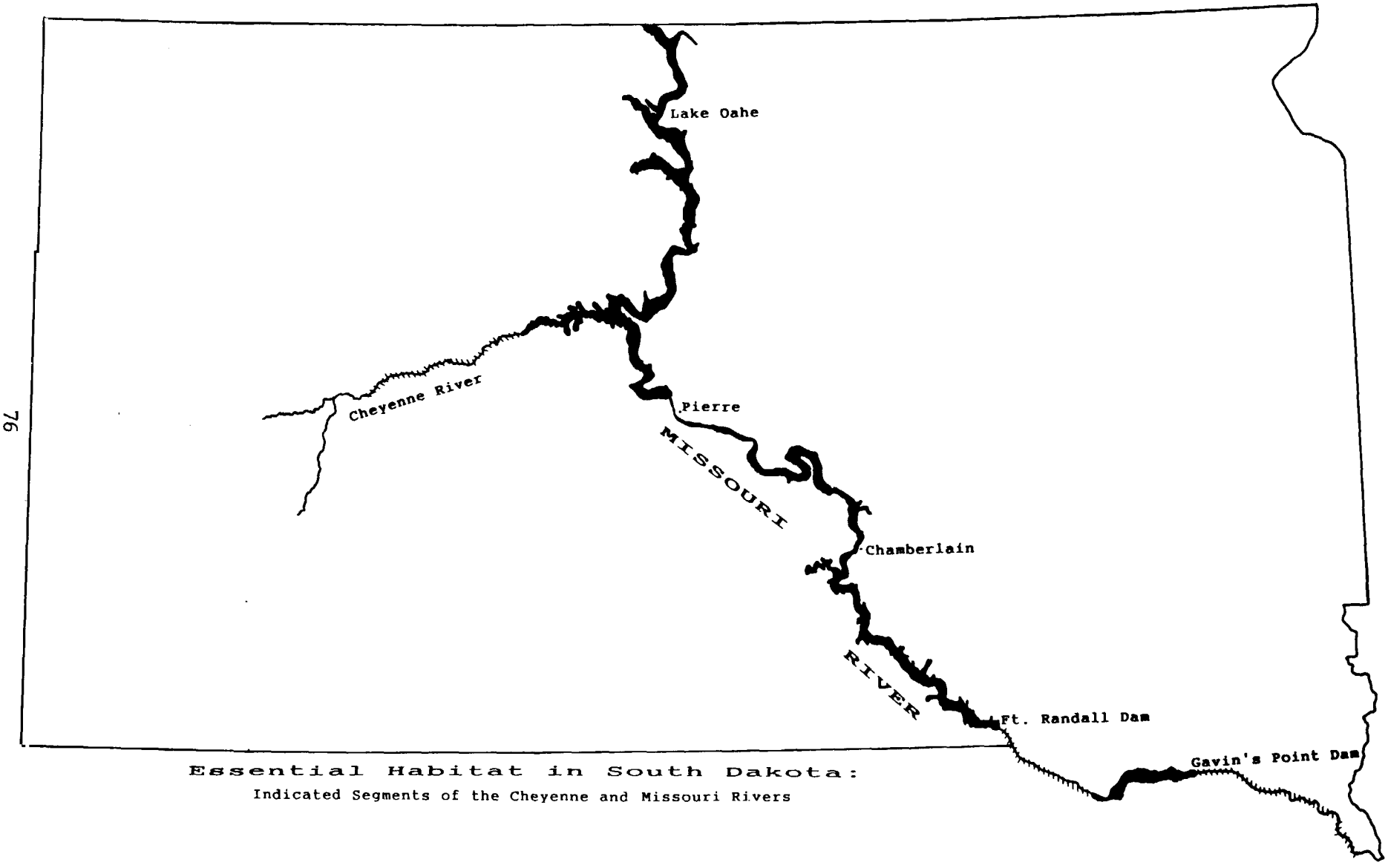


Essential Habitat in Montana:

Indicated Segments of the Missouri River

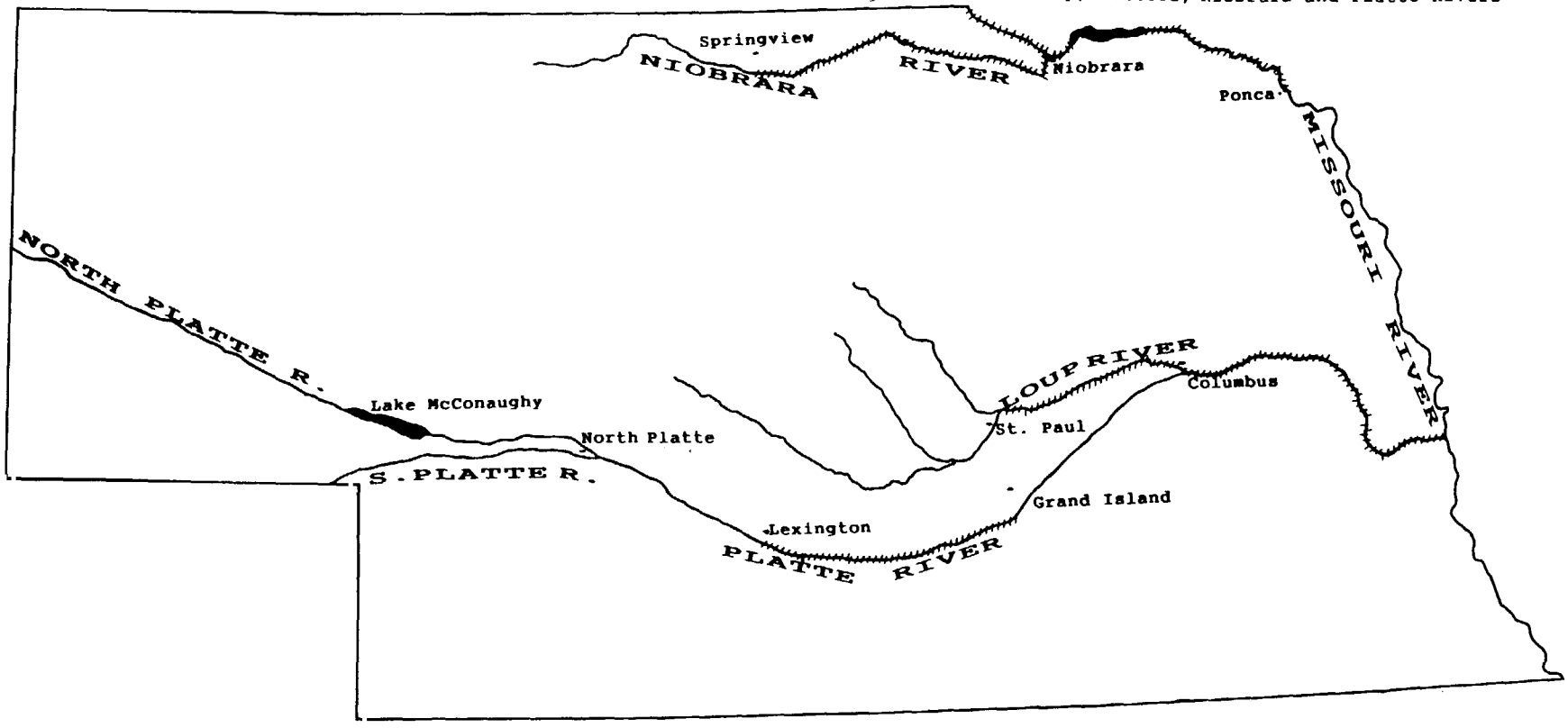


Essential Habitat in North Dakota:
Indicated Segments of the Missouri and Yellowstone Rivers



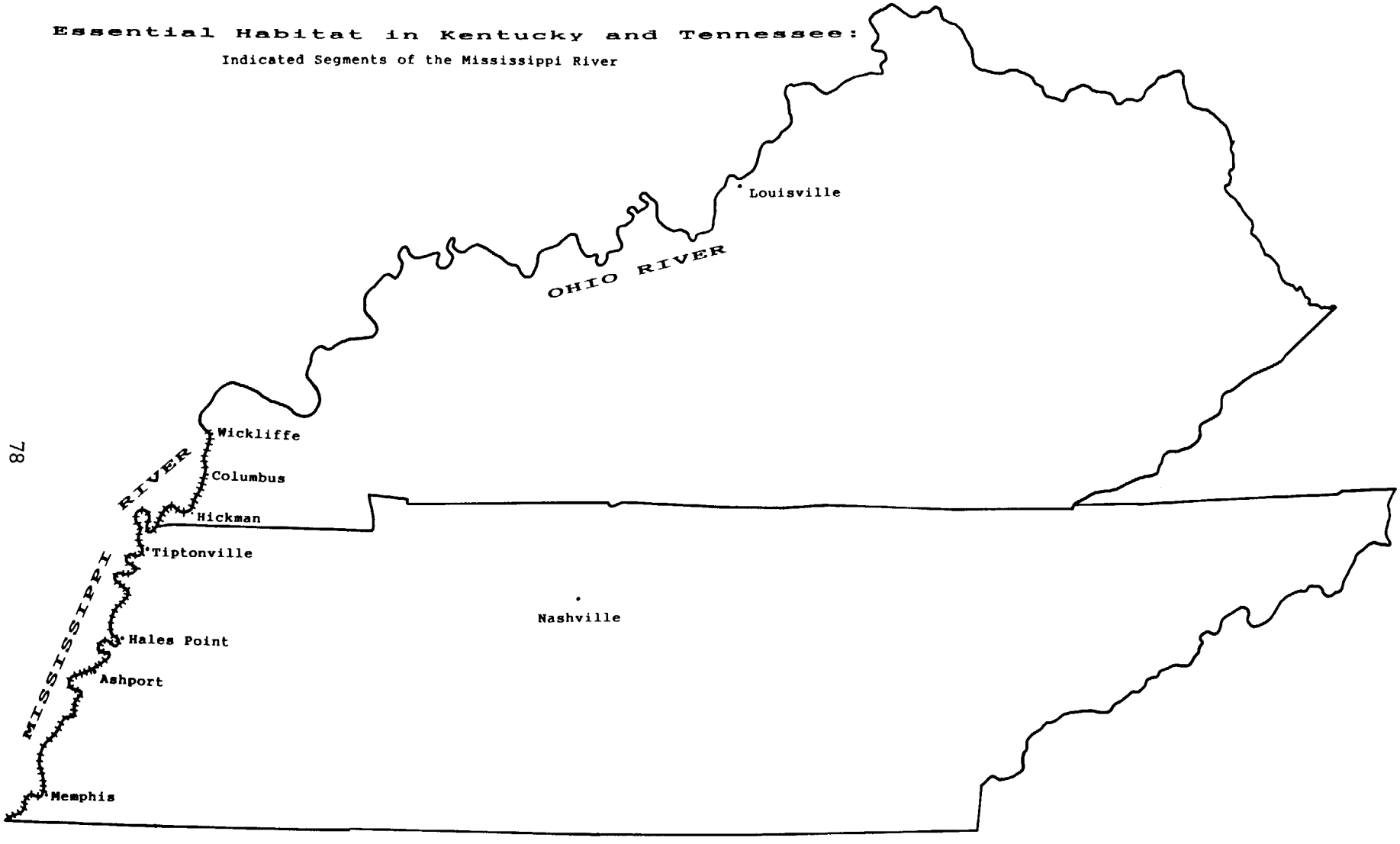
Essential Habitat in South Dakota:
Indicated Segments of the Cheyenne and Missouri Rivers

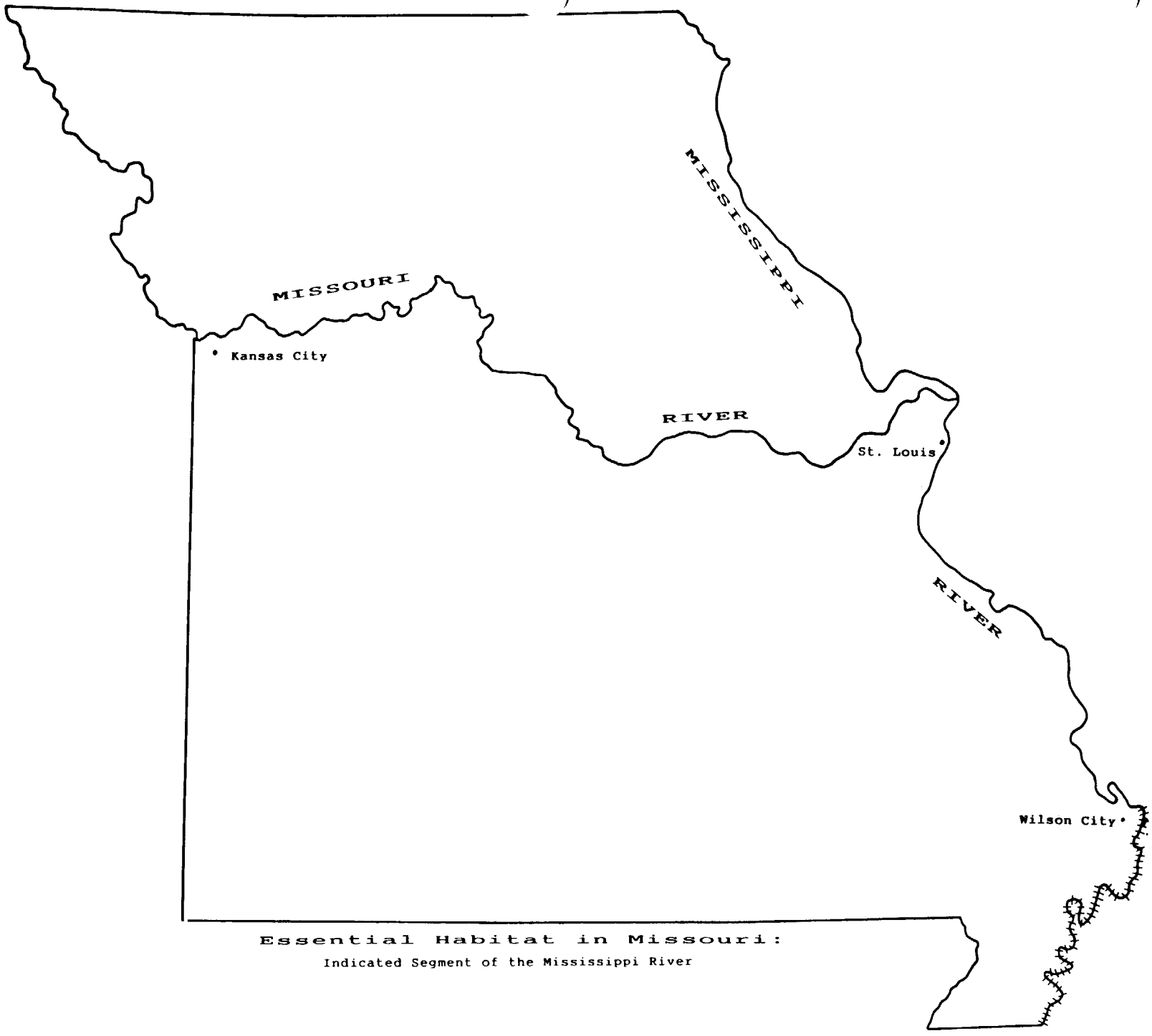
Essential Habitat in Nebraska: Indicated Segments of the Loup, Missouri, Niobrara and Platte Rivers



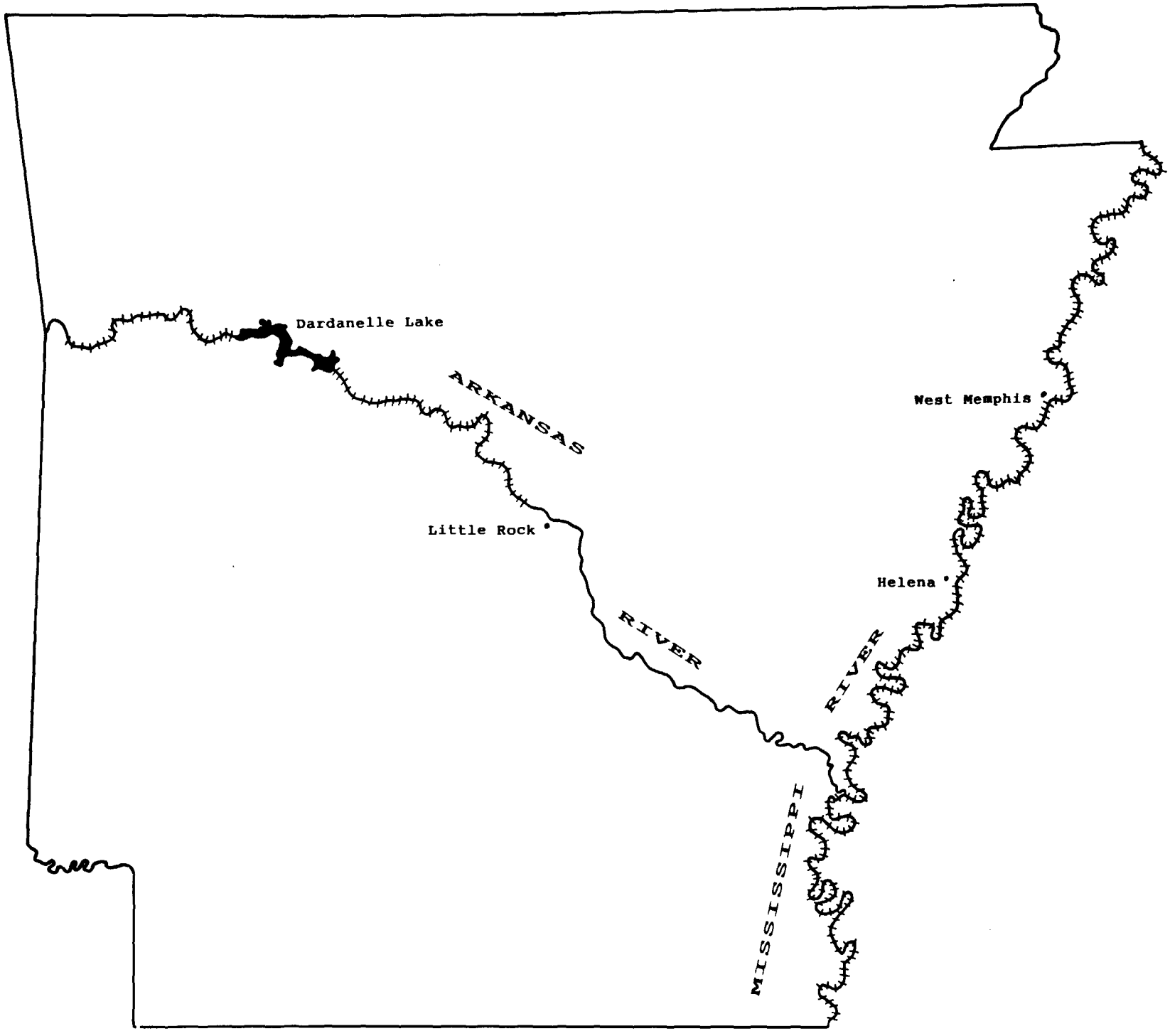
Essential Habitat in Kentucky and Tennessee:

Indicated Segments of the Mississippi River





Essential Habitat in Missouri:
Indicated Segment of the Mississippi River

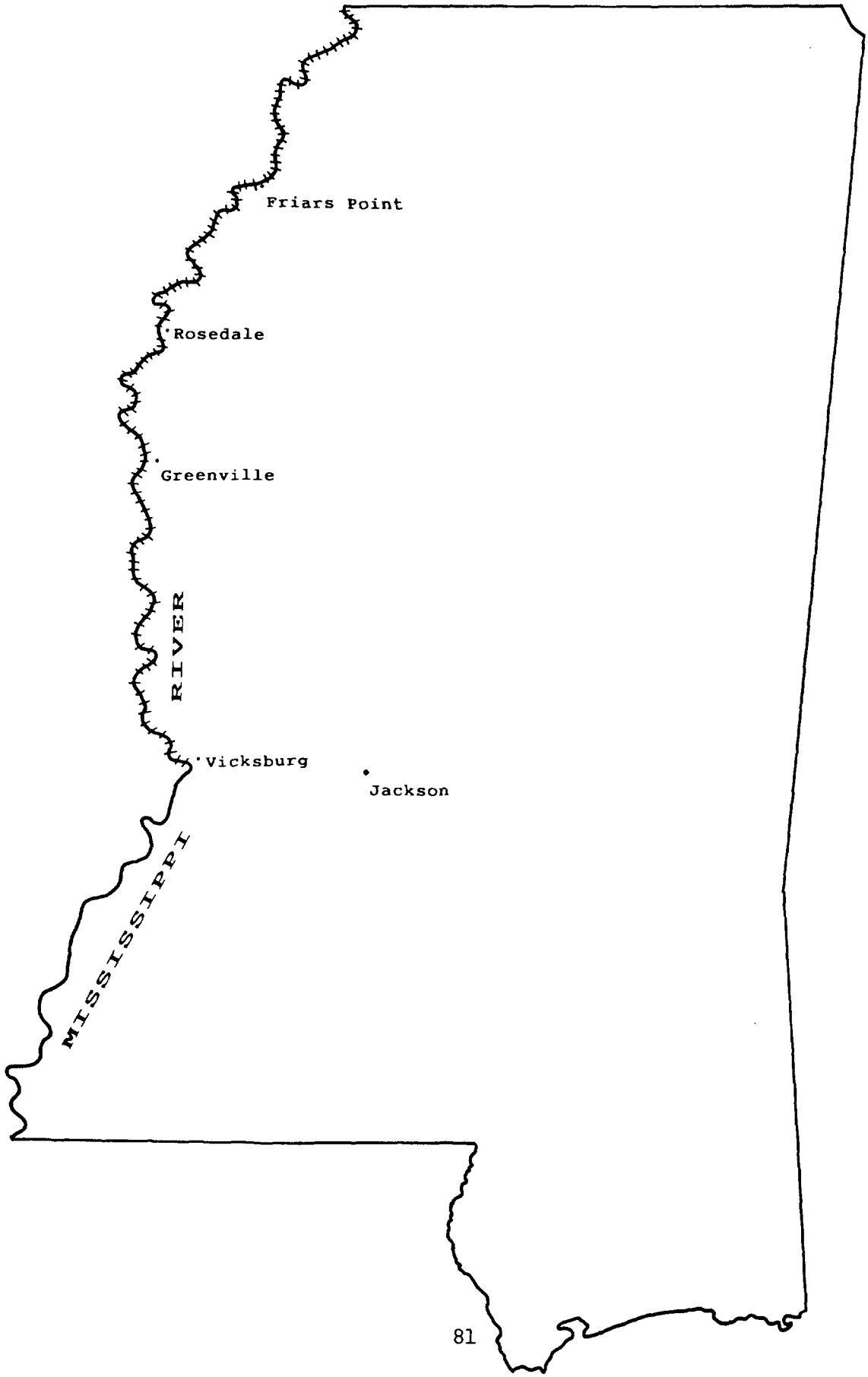


Essential Habitat in Arkansas:

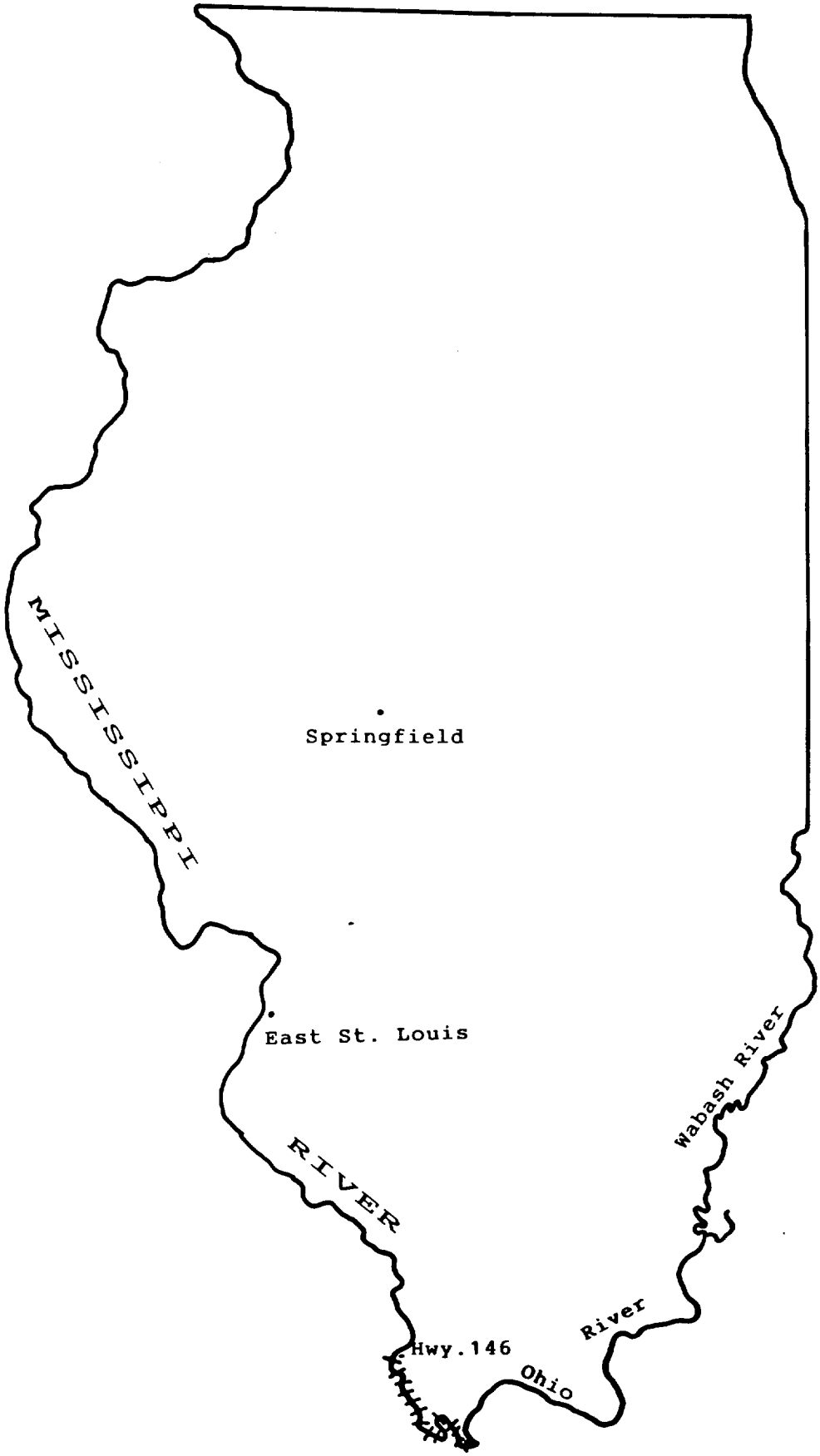
Indicated Segments of the Arkansas and Mississippi Rivers

Essential Habitat in Mississippi

Indicated Segment of the Mississippi River

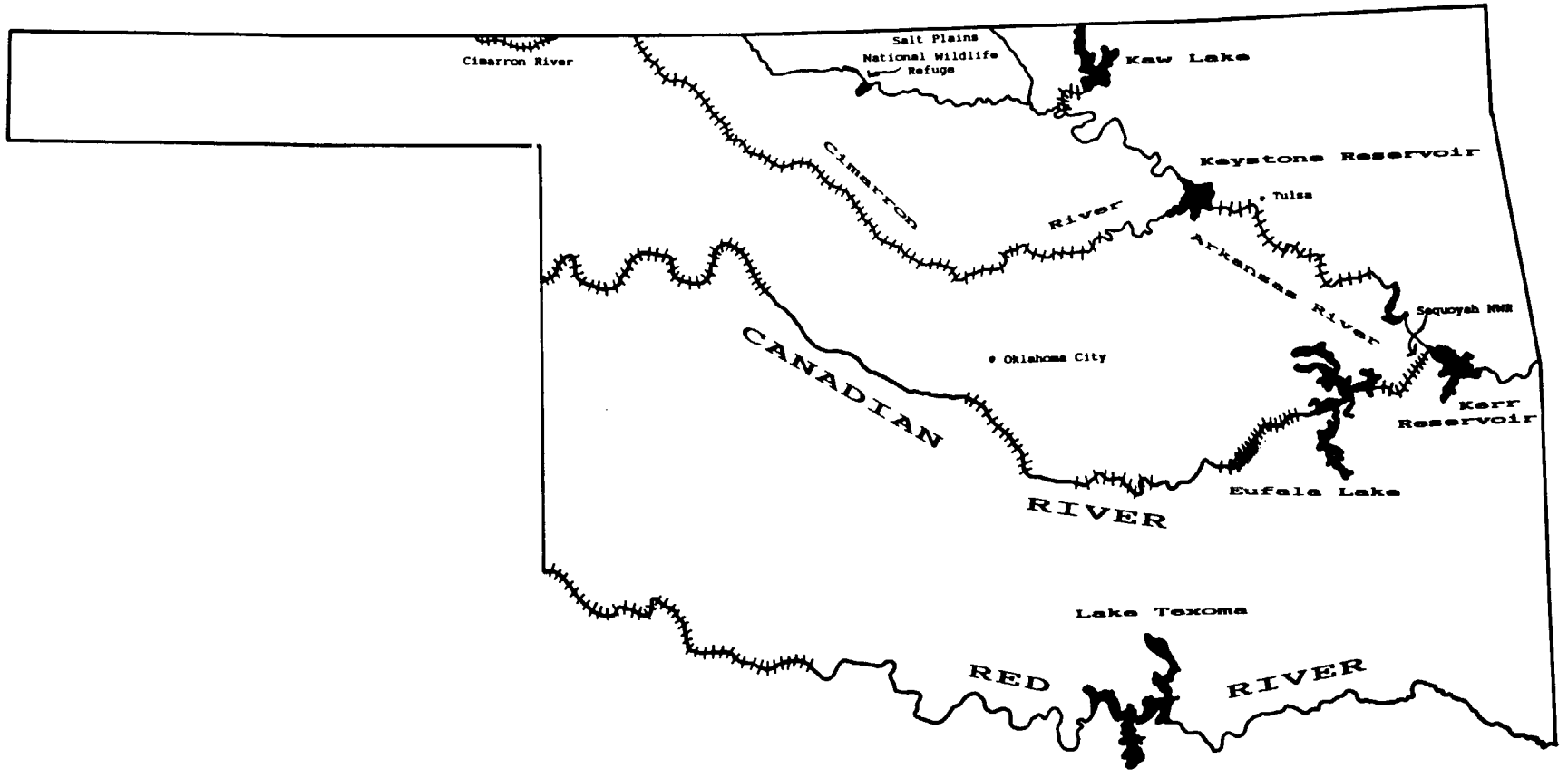


Essential Habitat in Louisiana:
Indicated Segment of the Mississippi River



Essential Habitat in ILLinois:

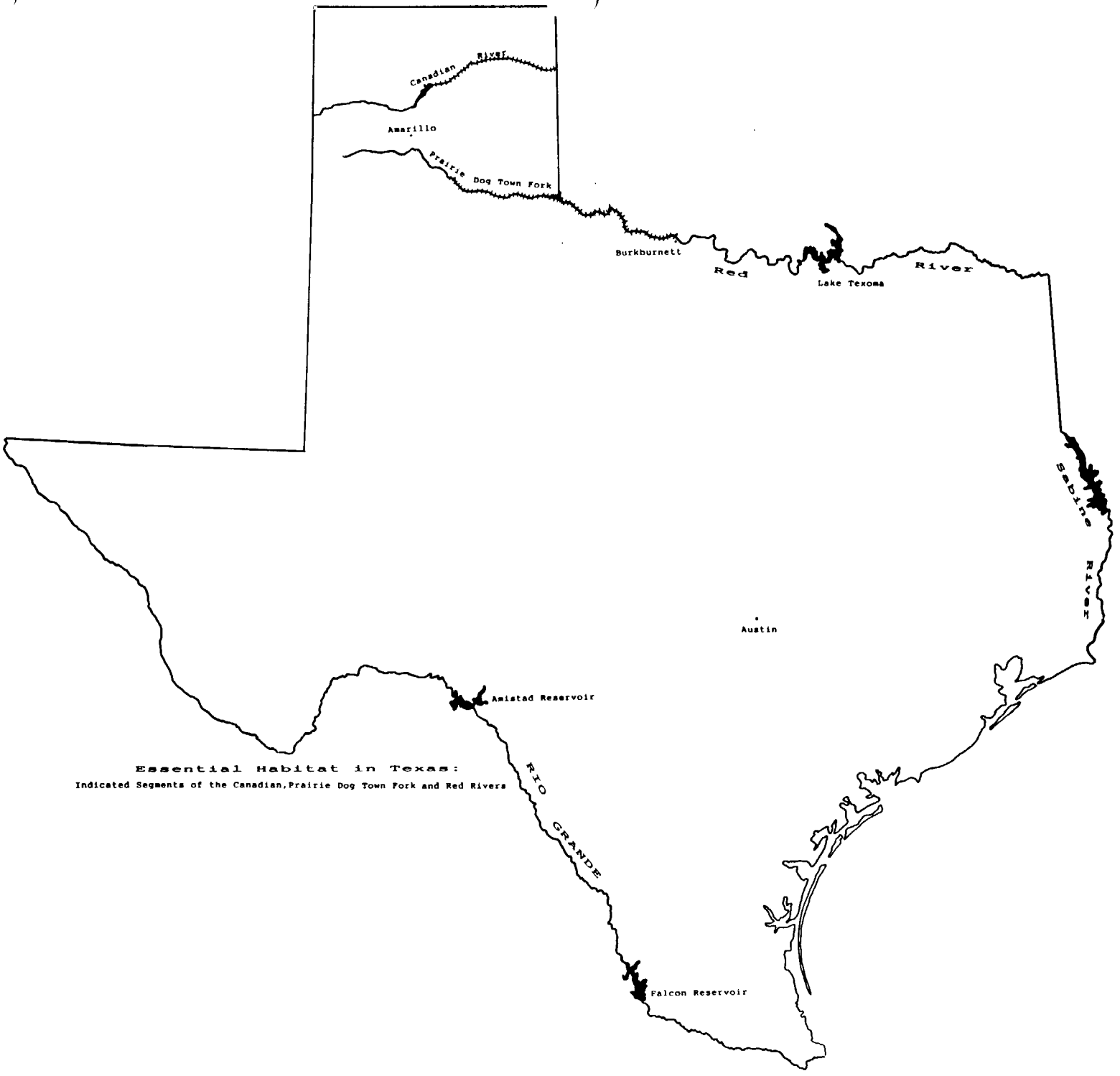
Indicated Segment of the Mississippi River



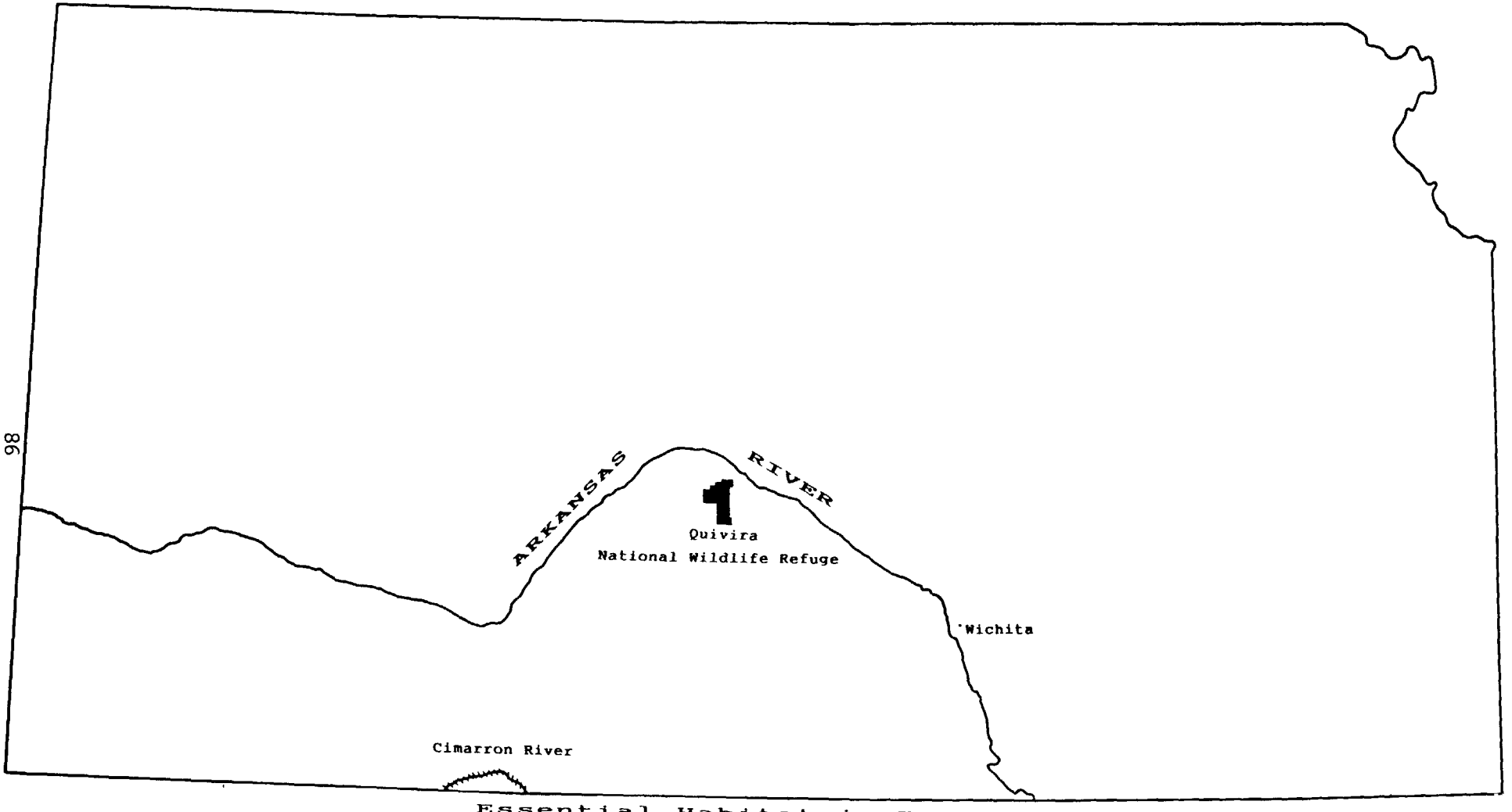
Essential Habitat in Oklahoma:

Sequoyah & Salt Plains National Wildlife Refuge

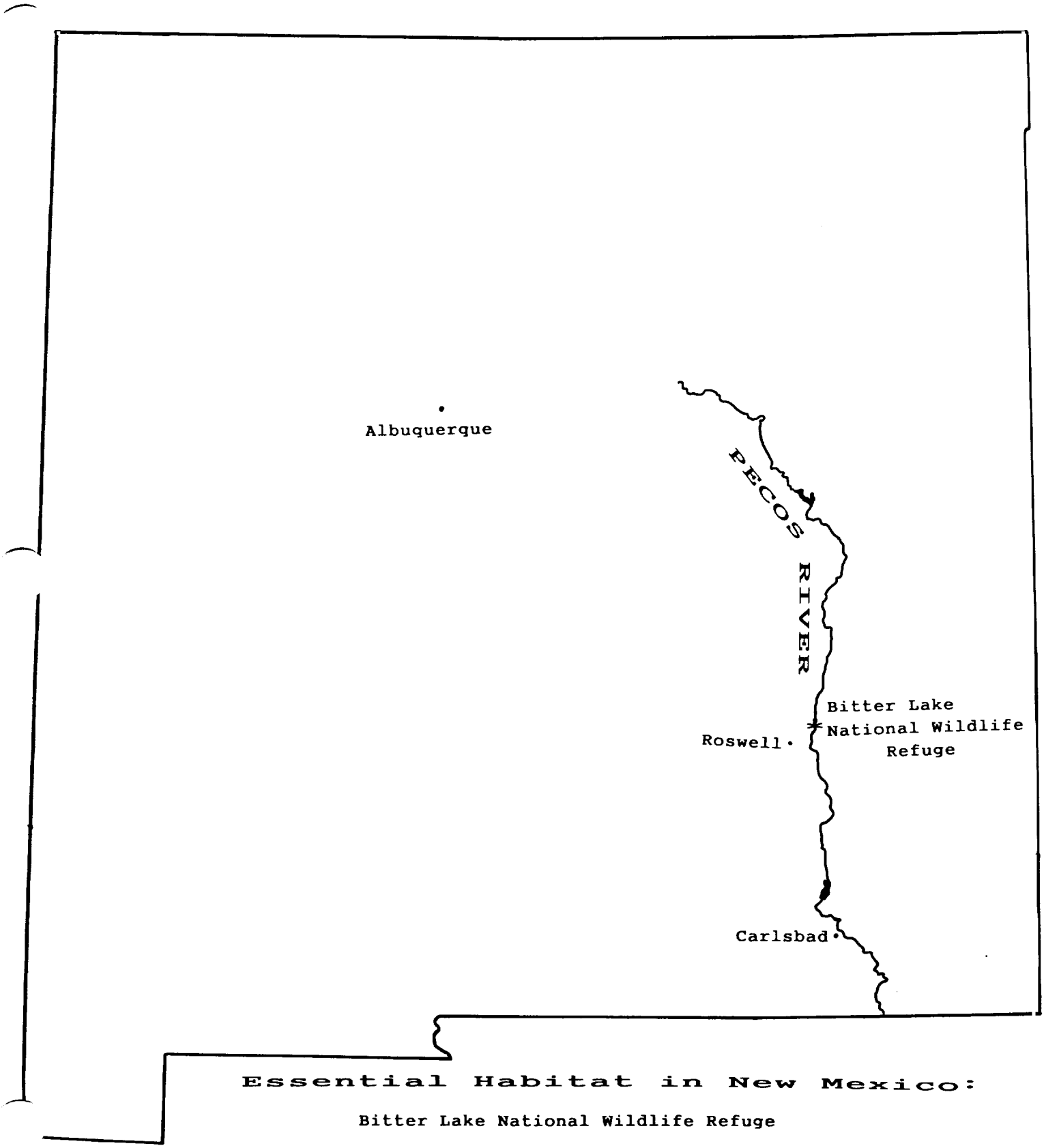
Indicated Segments of the Arkansas, Canadian, Cimarron and Red Rivers



Essential Habitat in Texas:
Indicated Segments of the Canadian, Prairie Dog Town Fork and Red Rivers



Essential Habitat in Kansas:
Quivira National Wildlife Refuge and Cimarron River



Essential Habitat in New Mexico:

Bitter Lake National Wildlife Refuge

Appendix 5

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