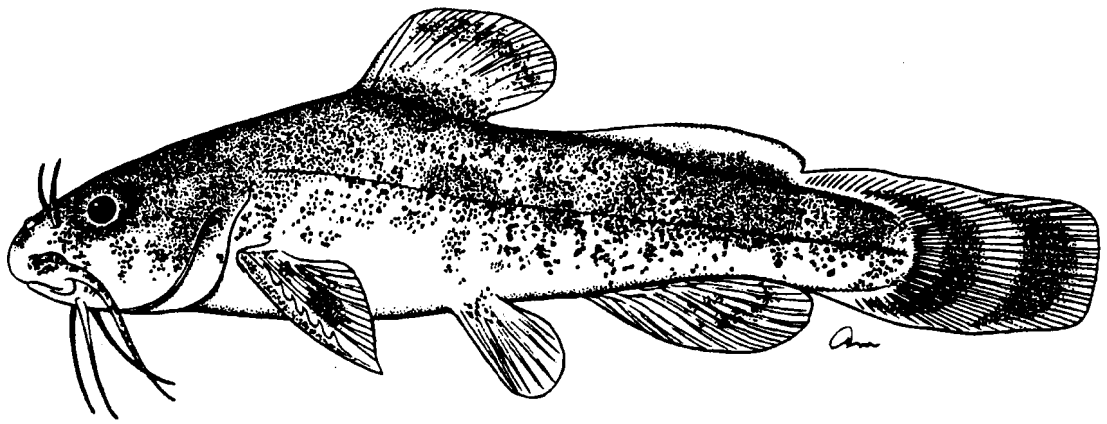
NEOSHO MADTOM RECOVERY PLAN



NEOSHO MADTOM

Noturus placidus Taylor

RECOVERY PLAN

Prepared by Natural Science Research Associates

Thomas L. Wenke, Ph.D.
Fort Hays State University
Hays, Kansas

Mark E. Eberle, M.S.
Natural Science Research Associates
Hays, Kansas

for

Region 6
U.S. Fish and Wildlife Service
Denver, Colorado

Approved: _____
Regional Director, U.S. Fish and Wildlife Service

Date: 9-30-91

DISCLAIMER

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Objectives only will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions or approvals of any individuals or agencies, other than the U.S. Fish and Wildlife Service, involved in the plan formulation. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or 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.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1991. Neosho madtom recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 42 pp.

Additional copies may be purchased from:

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
(301) 492-6403 or 1-800-582-3421

The fee for the plan varies with the number of pages of the plan.

Artist credit: Ann Musser, Fisheries Division, Museum of Natural History, University of Kansas, Lawrence, Kansas

ACKNOWLEDGMENTS

Acknowledgment is made to the following people for their contributions toward preparation of this plan:

James Berk, Guy Ernsting, Bill Stark, Jim Stroh, Joe Tomelleri, and Shelley Wells (Natural Science Research Associates);
Dr. Frank Cross and Joe Collins (University of Kansas);
William Layher, Ken Brunson, and Robert Wood (Kansas Department of Wildlife and Parks);
Brad Loveless (Wolf Creek Nuclear Operating Corporation);
Dr. William Pflieger (Missouri Department of Conservation);
Leon Hobson, Don Snethen, and Walt Wagner (Kansas Department of Health and Environment);
John Henderson (Kansas State Board of Agriculture); and
John Skeen (Oklahoma Department of Wildlife Conservation).

We also gratefully acknowledge the patient efforts of Dan Mulhern, U.S. Fish and Wildlife Service, Manhattan, Kansas.

EXECUTIVE SUMMARY

Current Species Status: The Neosho madtom (Noturus placidus) is a small member of the catfish family (Ictaluridae) endemic to the Neosho, Cottonwood, and Spring Rivers of Kansas and adjacent areas of Missouri and Oklahoma. It was listed as a threatened species on May 22, 1990 (55 F.R. 21148). Populations exist in three distinct regions separated by reservoirs: (1) the Neosho Basin above John Redmond Reservoir in Kansas; (2) the Neosho Basin below John Redmond Reservoir; and (3) the Spring River. A fourth region, the Spring River in Oklahoma, below Lowell Reservoir (at the confluence of Spring River and Shoal Creek), has not been adequately sampled and might be occupied by Neosho madtoms. Adults of this species usually occupy gravel riffles. Populations of the Neosho madtom seem to be stable, but habitat loss has been extensive due to construction of reservoirs. Localized threats to populations exist. These include gravel bar removal, drought, chemical pollution, alteration of the flow regime, and possible interspecific competition. Knowledge of reproductive requirements is lacking and protection through State laws and policies is inadequate. The Neosho madtom currently is protected by all three States as a threatened or endangered species.

Habitat Requirements and Limiting Factors: The Neosho madtom requires loosely packed gravel riffles, burrowing into the gravel during the day and coming out to feed on aquatic invertebrates at night.

Recovery Objective: Delisting.

Recovery Criteria: The goal of this recovery plan is the protection of self-sustaining populations of the Neosho madtom and the habitat occupied by this species. Determination of the population boundaries and establishment of the appropriate number of populations to be protected in order to consider delisting, are the first priorities of this recovery plan; as such the following recovery criteria are interim.

Delisting of the Neosho madtom will be considered when the appropriate number of viable, self-sustaining populations has been documented in the three regions occupied by this species. In addition, enhanced legal protection for these populations at the State level and sufficient biological information to properly manage this species shall be obtained. Revisions or updates of this recovery plan will become necessary as some of the tasks are completed.

Actions Needed:
1. Conduct studies on biology of Neosho madtoms to determine criteria tobe used for delisting.
2. Develop criteria to be used for delisting.
3. Monitor populations of the Neosho madtom.
4. Develop Neosho madtom reintroduction plans.
5. Enhance protection of Neosho madtom populations and habitat.
6. Complete surveys for Neosho madtom in unsurveyed areas.

Total Estimated Cost of Recovery: The Neosho madtom could be recovered at an estimated cost of $412,000.

Date of Recovery: Delisting should be possible in 1997, if specific recovery criteria have been identified and met.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

PART I

INTRODUCTION

The Neosho madtom (Noturus placidus Taylor) is a small member of the catfish family (Ictaluridae) that typically inhabits stream riffles in the Neosho, Cottonwood, and Spring Rivers within the Arkansas River Basin (Figure 1). This species occurs almost exclusively in Kansas, but smaller populations are found in adjacent areas of Ottawa and, possibly, Craig Counties in Oklahoma and Jasper County, Missouri. Within this limited range, the Neosho madtom has experienced short-term population declines due to habitat degradation resulting from drought, removal of gravel bars, and water pollution from feedlot runoff (Cross and Braasch 1968, Deacon 1961, Wagner et al. 1984). Considerable long-term habitat loss has resulted from construction of mainstream impoundments in Oklahoma and Kansas, which have inundated Neosho madtom habitat in about one-third of its historic range. Several other potential threats to this species have been identified and considered in this recovery plan. Development of a sound management program for the Neosho madtom is hampered by shortcomings in our knowledge of its biology.

In Kansas, the Neosho madtom currently is listed as a threatened species (K.A.R. 115-15-1) under the Kansas Nongame and Endangered Species Conservation Act (K.S.A. 32-501 through 32-510). In Missouri, this species is listed as endangered (3CSR10-4.111; RSMo 252.240), and in Oklahoma it also is considered to be endangered (Skeen, pers. comm.; 29 Okla. St. Ann. 5-412). The U.S. Fish and Wildlife Service listed the Neosho madtom as a threatened species on May 22, 1990 (55 F.R. 21148). The Neosho madtom has been assigned a recovery priority of 11C. This signifies that threats against this species are moderate, and are not fully known or understood, and that conflict with construction or other development projects is a possibility.

Description

The Neosho madtom was described formally by Taylor (1969), but it had been recognized as a distinct taxon since the 1950's (Cross 1967). Prior to that, it usually was identified as Noturus miurus Jordan (brindled madtom), which also occurs in the Spring River, or Noturus eleutherus Jordan (mountain madtom), which is not found in the Neosho River drainage.

Both the Neosho madtom and brindled madtom have the typical appearance of North American catfishes characterized by the general body shape, sensory barbels on the head, scaleless skin, and presence of a dorsal adipose fin that, in madtoms, is joined or nearly joined to the top of the caudal (tail) fin (see Figure 2). Neosho and brindled madtoms are usually less than 75 mm (3 in) in total length and have mottled coloration with dark vertical bars on the caudal fin. The pattern of the dark pigment on the adipose fin is the best external characteristic that can be used to distinguish these two species. On the Neosho madtom, the dark pigment does not reach the dorsal margin of the adipose fin as it does on the brindled madtom (Figure 2).

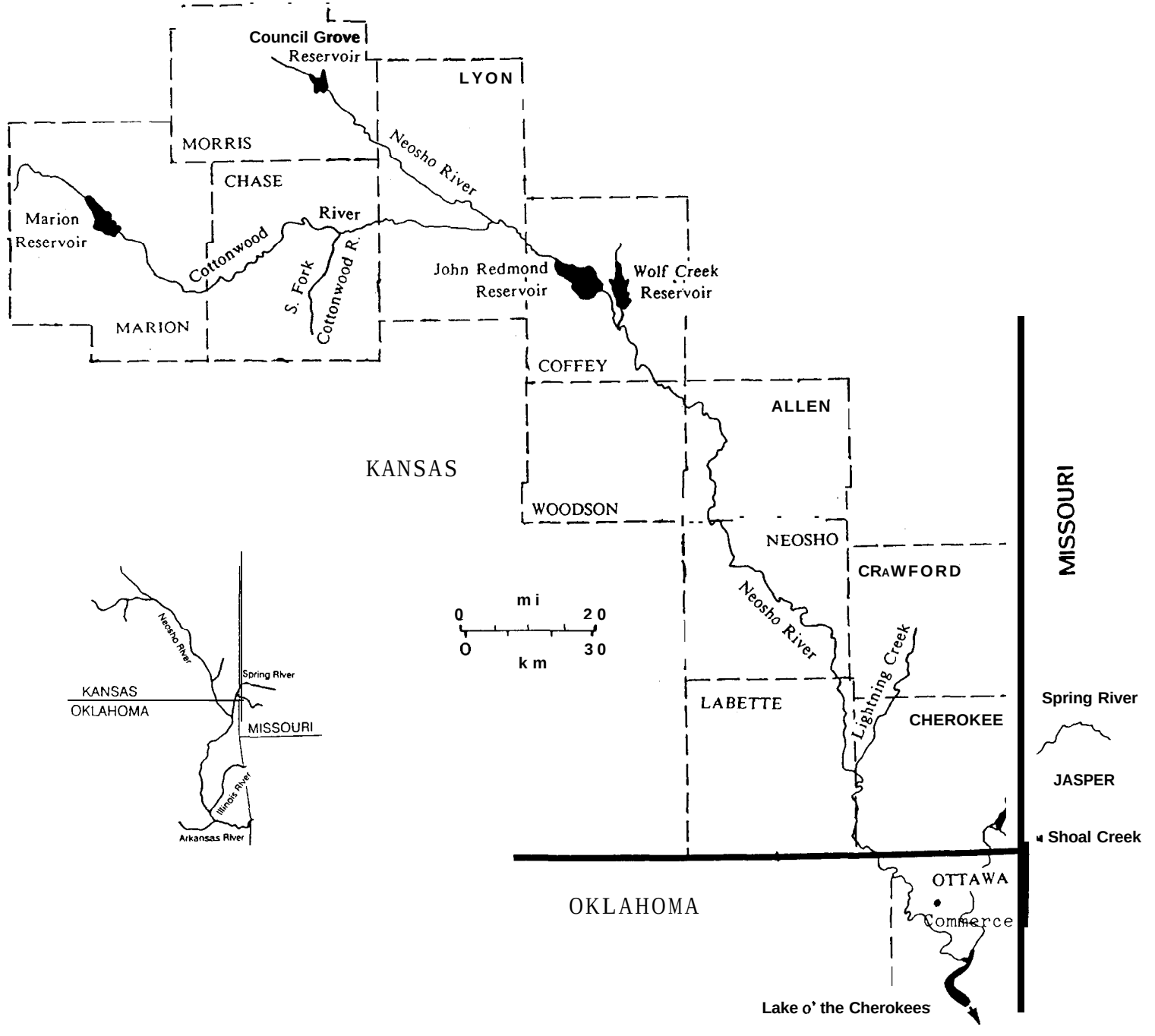
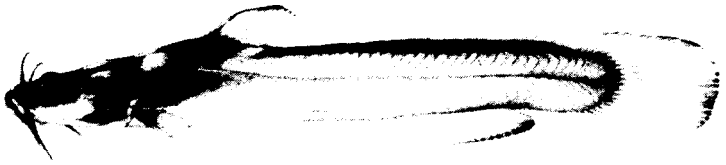

Council Grove
Reservoir
LYON
MORRIS
CHASE
Neosho River
Marion
Reservoir
Cottonwood
River
S. Fork
Cottonwood R.
John Redmond
Reservoir
Wolf Creek
Reservoir
MARION
COFFEY
ALLEN
KANSAS
WOODSON
NEOSHO
CRAWFORD
MISSOURI
mi
0 20
0 30
km
Neosho River
Lightning Creek
LABETTE
CHEROKEE
Spring River
JASPER
Shoal Creek
KANSAS
OKLAHOMA
MISSOURI
Spring River
Illinois River
Arkansas River
OTTAWA
Commerce
OKLAHOMA
Lake o' the Cherokees

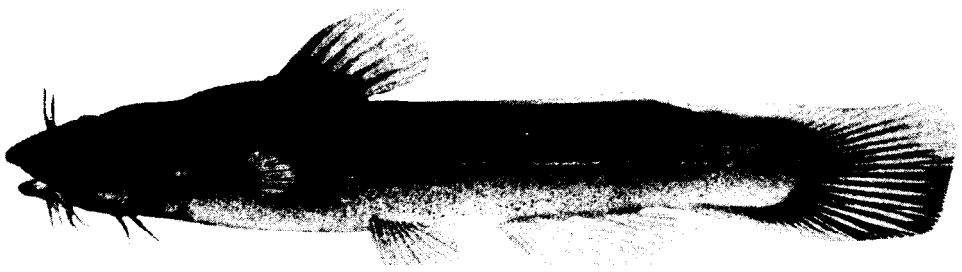
Figure 2.--***The Neosho madtom and three related species from the Neosho Basin.*** The brindled madtom is similar in appearance to the Neosho madtom, but typically is not found in gravel riffles. The slender madtom might compete with the Neosho madtom for habitat in the Spring River, and it apparently has been introduced into the upper Neosho River drainage. The stonecat is the largest madtom and it occupies areas of a riffle with larger stones, while the Neosho madtom inhabits areas of smaller gravel in the same riffle. Illustrations approximate life size.

Neosho Madtom, ***Noturus*** *placidus* Taylor

Brindled Madtom, ***Noturus miurus*** Jordan



Slender Madtom, ***Noturus exilis*** Nelson



Stonecat, ***Noturus*** *flavus* Rafinesque

The stonecat (Noturus flavus Rafinesque) and slender madtom (Noturus exilis Nelson) are species of madtoms that live within the range of the Neosho madtom, and might occur in the same general habitat. Neither the stonecat nor the slender madtom has the mottled skin pigmentation present on the Neosho and brindled madtoms (Figure 2). The slender madtom grows to about twice the size of the Neosho madtom, and the stonecat can reach 200 mm (8 in) in total length or more. Another species (not illustrated), the freckled madtom (Noturus nocturnus Jordan & Gilbert), occasionally is collected with the Neosho madtom. The body of the freckled madtom is not conspicuously mottled, but the underside of the head and the belly has dark speckles. Its maximum length is about 100 mm (4 in) in total length.

Type specimens of the Neosho madtom from the Neosho River near Emporia, Kansas, are located at the Museum of Zoology at the University of Michigan (holotype--UMMZ 167653; 27 paratopotypes--UMMZ 167654) and the Museum of Natural History at the University of Kansas (82 paratopotypes--KU 2517).

Historical and Present Distribution

Since 1886 (Gilbert 1886), the Neosho madtom has been reported in at least 161 collections from 46 documented sites in the Neosho, Cottonwood, Spring, and Illinois Rivers in Kansas, Missouri, and Oklahoma. Most of these collections contained 1 to 31 preserved specimens, but a few larger samples included between 57 and 116 individuals. The present distribution of the Neosho madtom lies principally in the Neosho River from extreme southeastern Morris County, Kansas, to near Commerce, Oklahoma (5 miles south of the Kansas-Oklahoma line), and in the Cottonwood River from central Chase County, Kansas, to its confluence with the Neosho River in Lyon County, Kansas (Figure 1).

Smaller populations of Neosho madtoms have been recorded on seven occasions from 1963 to 1983 at four localities in the Spring River in eastern Cherokee County, Kansas, and western Jasper County, Missouri (Figure 1). In the most recent collection from this area taken in 1983, Wagner et al. (1984) reported one specimen from a site in Cherokee County, Kansas. A comprehensive survey of the Spring River drainage in Kansas (Terry 1986) did not include any records of this species. Although it is likely that the Neosho madtom still occurs in the Spring River, the species apparently has never been very abundant; however, additional surveys of this river specifically for Neosho madtoms are needed. It is possible that differences in physical and chemical conditions between the Spring and Neosho Rivers might inhibit the development of larger populations of the Neosho madtom in the Spring River, or perhaps other species of fishes that are not found in the Neosho River have a competitive advantage over the Neosho madtom in the Spring River. The Spring River in Oklahoma has not been sampled adequately for Neosho madtoms. Specimens collected from sites upstream and downstream from this reach suggest the possibility that Neosho madtoms might inhabit this region.

The presence of the Neosho madtom in the Illinois River of Oklahoma was documented by seven specimens collected at four locations from 1946 through 1950, prior to the construction of Tenkiller Dam. The cold hypolimnetic discharges from Tenkiller Reservoir apparently have caused the extirpation of

the Neosho madtom from the Illinois River (Moss 1981). Dr. Frank Cross (University of Kansas, pers. comm.) also has suggested that Neosho madtoms in the Illinois River might have been waifs that periodically moved downstream through the Arkansas River from the Neosho River, and did not represent a distinct Illinois River population. In either case, the construction of impoundments on the Neosho (Grand) River in Oklahoma and the transformation of the Illinois River below Tenkiller Reservoir into a trout stream have eliminated about one-third of the native range of the Neosho madtom (Moss 1981).

Despite the loss of Neosho madtom habitat in areas impounded by dams, the species is still found throughout the remainder of its range, and recent surveys have extended the known range of the Neosho madtom in Kansas (Ernsting et al. 1989). In 1987, two Neosho madtoms were collected from Lightning Creek, a Neosho River tributary in western Cherokee County, Kansas (Figure 1). This was the first record of this taxon from a small tributary stream in the Neosho basin. During two trips to this site in 1989, no Neosho madtoms were caught. In 1988, one Neosho madtom was collected from the Neosho River near Dunlap, Morris County, Kansas, which extended the range of this species approximately 25 stream kilometers (15.5 river mi) upstream from near Americus, Lyon County, Kansas. This site was sampled again in 1989 and no Neosho madtoms were collected. The absence of previous records from the Neosho River in Morris County might be a reflection of the limited number of collections made in this reach of the river, or it might indicate that the Neosho madtom is expanding its range upstream in response to more stable streamflows below Council Grove Reservoir. It also is possible that both the Dunlap and Lightning Creek records represent short-term range extensions at the periphery of the long-term distributional core of the species. Thus, they would be part of a normal expansion and contraction of the range of the species as it responds to fluxes in environmental conditions.

Habitat Preference

Adult Neosho madtoms typically inhabit riffles with a gravel bottom. Although they reach their greatest abundance in gravel riffles, smaller populations occasionally are found in other types of habitat. They have been collected from areas with a fine gravel or sand bottom overlain with leaf litter and detritus in the Spring and Illinois Rivers (Taylor 1969; Moss 1981), a habitat they apparently occupy throughout the year. We also have found them in this habitat in the Neosho and Cottonwood Rivers (Dr. Thomas Wenke, Natural Science Research Associates, Hays, Kansas, pers. comm.) as young-of-the-year or as adults that probably were forced from riffles by declining water levels. They also have been reported in areas with large stone or cobble bottoms (Taylor 1969; Brad Loveless, Wolf Creek Nuclear Operating Corporation, pers. comm.); however, these areas typically are inhabited by stonecats.

Moss (1983) found that adult Neosho madtoms were most abundant in water with a current of 0.3 to 1.2 m/second (1 to 4 ft/second) and a bottom substrate comprised of particles that ranged in size from small gravel to pebbles (2 to 64 mm or .08 to 2.5 in). The size of substrate particles preferred by the madtoms varies with the size of the individual; the larger the fish, the larger

the substrate particles. Young-of-the-year Neosho madtoms seem to be most abundant downstream from the riffle in water that is deeper (0.3 to 1.0 m or 1 to 3 ft) and slower than in the riffle habitat usually occupied by adults (Moss 1981). Young madtoms also are found in riffles near the shore or in areas of finer substrate material.

In laboratory experiments with simulated stream habitat (Moss 1983), Neosho madtoms were intrusive into large gravel and pebble substrates (8 to 64 mm or 0.3 to 2.5 in) during the day, but moved about in search of food at night. Neosho madtoms are somewhat gregarious in their natural habitat, but it is not known whether this is a result of social interactions or use of the habitat resources (Moss 1983). Although Moss (1983) did not observe any interspecific aggression between Neosho madtoms and stonecats, it is possible that resource partitioning may occur, with stonecats displacing Neosho madtoms toward areas with smaller sizes of bottom material. It also has been suggested (Moss 1983) that slender madtoms might compete with Neosho madtoms in the Spring River and force the Neosho madtoms into less favorable habitat.

With the exception of the two specimens collected in Lightning Creek (Ernsting et al. 1989), the presence of Neosho madtoms has not been documented in streams tributary to the Neosho, Cottonwood, and Spring Rivers. Three years before the collection of the Lightning Creek specimens, Wagner et al. (1984) suggested a correlation between the presence of Neosho madtoms and stream order. The physical dimensions of some of the sites where Neosho madtoms have been collected in the upper Neosho and Cottonwood Rivers are scarcely different from those of some of the larger tributaries in the Lower Neosho River Basin. Also, the Neosho and Spring Rivers each drain different physiographic provinces, which are likely to impart different physical and chemical attributes to each stream system. Thus, it would seem more prudent to use specific physical, chemical, and biological measurements of the streams rather than stream order to assess the suitability of a stream for Neosho madtoms.

Life History/Ecology

Population Size. Franklin (1980) estimated that a population of at least 500 individuals is needed to provide sufficient genetic variation for adaptation to changing environmental conditions. However, this number (the minimum effective population size) always is smaller than the number of individuals in an actual population because of inequities in reproductive success, including inviability of some progeny, nonmating of some individuals, and variations in age and in fecundity (Kapuscinski and Jacobson 1987).

The size of Neosho madtom populations is unknown. Estimates of about three Neosho madtoms per 100 m^2 obtained from data compiled by Moss (1983) and observations by Natural Science Research Associates (Dr. Thomas Wenke, Natural Science Research Associates, pers. comm.) indicate that the known concentrations of madtoms in riffles of the Neosho and Cottonwood Rivers certainly are large enough to possess adequate genetic variation if there is appreciable interriffle breeding among madtoms. However, the extent of interriffle breeding is not known. Because of the extreme annual water level fluctuations in the Neosho River, it is likely that some interriffle mixing of

madtoms occurs. Greater mixing would occur during droughts, because the fish would be concentrated in relatively small areas prior to redispersal. Therefore, it is probable that interbreeding occurs with unknown regularity among individuals of different riffles. It also is possible that Neosho madtoms emigrate to adjacent riffles during periods of typically higher streamflows. Perhaps young-of-the-year madtoms emigrate to other riffles from the pool below the riffle occupied by their parents (see Reproduction section below). These uncertainties represent a serious void in our knowledge of Neosho madtom biology. When this information is obtained, it will be possible to accurately determine the number of populations in each of the four regions outlined in the section on "Current Status."

Food and Feeding Habits. Neosho madtoms feed on whatever aquatic insects are most readily available, principally the larvae of caddisflies, mayflies, and dipterans, with chironomids being most abundant in young-of-the-year fish (Moss 1981). Based on laboratory experiments, feeding activity is greatest within 3 hours of sunset (Moss 1981). In simulated stream habitat, Moss (1983) found that Neosho madtoms were intrusive into gravel substrate during the day, but moved about in search of food at night. They maintained contact with the substrate and seldom swam against even a moderate current for more than a few seconds.

Reproduction. The Neosho madtom is short-lived, normally reaching age class II or, occasionally, age class III (a fish in its fourth year of growth), but little is known about its reproductive habits (Moss 1981). Although no direct observations of Neosho madtom reproductive behavior have been made, other madtoms are known to fashion cavity nests or utilize natural or man-made objects. Eggs and, in some species, the broods are guarded. Reproduction of the Neosho madtom probably is similar to that of the closely related northern madtom, Noturus stigmosus Taylor. Taylor (1969) conveyed information on collections of northern madtom eggs and young from the Huron River, Michigan; one egg mass reportedly came from gravel under a stone, but the others were collected from "tin" cans having fairly large openings. Eggs and broods were guarded by males. Taylor (1969) stated that, "it is likely that any small cavity of about the size of a number 2 can or larger with a large open end may serve as a nest."

In the Neosho madtom, egg development begins in March, but Moss (1981) speculated that spawning typically takes place in June and July. In general, this is the period of peak streamflow in the Neosho drainage, which is followed by a sharp decline in the discharge in late July and August (see streamflow graphs in appendix B). The apparent abundance of young Neosho madtoms in the quiet water below riffles suggests that the young-of-the-year fish either drift a short distance downstream to develop or that the adults move off the riffle to spawn (Moss 1981). Moss (1981) "seeded" riffles with cans, but no nests were produced. The possible importance of pools as nesting areas for the Neosho madtom has not been studied.

Associated Species. Four other species of Noturus have been collected with Neosho madtoms:

N. exilis Nelson--slender madtom,
N. flavus Rafinesque--stonecat,
N. miurus Jordan--brindled madtom; and
N. nocturnus Jordan & Gilbert--freckled madtom.

Of these species, the stonecat is collected most frequently from the riffles where Neosho madtoms are found and might compete with the Neosho madtom for space. The slender madtom, which is the most common madtom in riffles of the Spring River (Moss 1983), also might compete for habitat with Neosho madtoms in that drainage. Young-of-the-year Pylodictis olivaris (Rafinesque), flathead catfish, also are found in gravel riffles, and young Ictalurus punctatus (Rafinesque), channel catfish, swim over most types of riffle substrates.

In addition to ictalurids, several species of minnows and darters often are found in riffles with Neosho madtoms. These include:

Hybopsis x-punctata Hubbs & Crowe--gravel chub;
Phenacobius mirabilis (Girard)--suckermouth minnow;
Campostoma anomalum (Rafinesque)--central stoneroller;
Pimephales spp.--minnows;
Cyprinella lutrensis (Baird & Girard)--red shiner;
Percina caprodes (Rafinesque)--logperch;
Percina phoxocephala (Nelson)--slenderhead darter;
Percina shumardi (Girard)--river darter; and
Etheostoma spectabile (Agassiz)--orangethroat darter.

Within the streams occupied by the Neosho madtom, there are several other species protected by Kansas, including unionid mussels and fishes. Among these species are Cycleptus elongatus (LeSueur), the blue sucker (K.A.R. 115-15-2), and Etheostoma cragini Gilbert, the Arkansas darter (K.A.R. 115-15-1), which currently are classified by the Service (54 F.R. 554) as possible candidates for Federal listing as threatened or endangered species. Implementation of this recovery plan for the Neosho madtom will consider the needs of these and other species native to the Neosho River basin.

Ownership of the Neosho River

Efforts to manage the Neosho madtom in Kansas could be complicated somewhat by the question of ownership of the streambed, because access to the streams can be limited. In Kansas, riparian landowners own the streambed and control access to it, although they exert only stewardship over the water (Schneider 1974). However, the lower Neosho River from about 3 mi south of Humboldt in Allen County through Neosho and Labette Counties to the Kansas-Oklahoma border probably is owned by the State of Kansas, as outlined in a Kansas Department of Wildlife and Parks memorandum by Leland Queal dated April 12, 1979. The original U.S. Government surveys showed the lower Neosho River to be meandered throughout this reach, and it apparently was considered to be a navigable stream by the Surveyor General's Office. This would have

deeded the land to the State in 1861 unless it was specifically transferred to private ownership. Queal could find no evidence that titles between the meander lines had ever been transferred to the riparian owners, who apparently had been paying no taxes on this land.

A 1927 case before the Kansas Supreme Court that dealt in part with this issue (Webb v. Neosho County Commissioners; 124 Kan. 38) resulted in a four-to-three decision against State ownership of the Neosho River. The majority ruled from a strict interpretation of "navigability" that "the Neosho River is not a navigable stream in fact, and the riparian owners along said stream own the land to the thread or center of the stream . . . ." The minority opinion held that:

> ". . . the meandering of a stream is prima facie proof that the riparian patentee of the meandered acreage acquired title only to the river bank; and if he claims beyond that property line he must produce his title thereto . . . ."

Although a recent opinion of the State Attorney General seems to support private ownership of the lower Neosho River to the thread of the stream based on a strict interpretation of a "navigable stream" (Schneider 1974), Kansas statutes (K.S.A. 70a-106, 70a-108) and the apparent lack of evidence of formal transference of the streambed to the riparian landowners seem to support the contention that the State retains ownership of the channel, as it does with the Arkansas, Kansas, and Missouri Rivers. This specific issue has not been tested in the courts with respect to the Neosho River.

County abstracter's maps (Kansas Blue Print Co., Wichita) indicate that the only significant reach of the Neosho River in Kansas clearly in Federal ownership is U.S. Government land upstream from John Redmond Reservoir in Coffey and Lyon Counties near the towns of Hartford and Neosho Rapids. The Kansas Department of Wildlife and Parks manages the Neosho Wildlife Area, located along the river south of St. Paul in Neosho County. Small streamside parks are located at Chetopa, Humboldt, Iola, Neosho Falls, and Burlington on the Neosho River and at Emporia on the Cottonwood River.

As in Kansas, access to streams in Oklahoma and Missouri can be made with a landowner's permission or at points where the adjacent land is publicly owned. However, in the latter two States, it may be legal to walk or float the streams through areas of private ownership, although this has come under question in Missouri.

Current Status

Neosho madtom populations are divided into three distinct regions effectively separated by reservoirs as outlined below. As discussed previously in this plan, we presently are unable to define boundaries of individual populations.

One group of populations lies wholly within Kansas in the Cottonwood River and in the Neosho River above John Redmond Reservoir, which serves as an effective barrier to Neosho madtom emigrations (Figure 1). Attempts to find Neosho

madtoms in the Neosho River immediately downstream from the dam at Council Grove Reservoir have been unsuccessful; however, suitable habitat exists in this reach that might support undiscovered populations of this species.

A second group of populations occupies the segment of the Neosho River from John Redmond Reservoir downstream to the area west of Commerce, Oklahoma. The reach of the Neosho River from Chetopa, Kansas, downstream to the headwaters of Lake o' the Cherokees in Oklahoma has not been sampled adequately for Neosho madtoms and might support additional populations of this species.

The third group of Neosho madtom populations occurs in the Spring River. Presently, this is represented by a short stretch of the river in Cherokee County, Kansas, and Jasper County, Missouri. However, the section of the Spring River upstream from this reach in Missouri and the section downstream from this reach in Oklahoma have not been intensively surveyed for Neosho madtoms. If Neosho madtoms occur in the Spring River of Oklahoma, they would represent a fourth group of Neosho madtom populations, separated from the populations upstream in the Spring River of Missouri and Kansas by Lowell Reservoir at the confluence of Spring River and Shoal Creek in Cherokee County, Kansas. The inundated channels of the Spring and Neosho Rivers at the upper end of the Lake o' the Cherokees would serve as a barrier between the possible Spring River populations in Oklahoma and those in the Neosho River. Results from population studies outlined in this recovery plan might indicate that these three subunits of the range of the Neosho madtom should be treated as separate "recovery regions," each of which might require somewhat different recovery goals and actions to protect appropriate numbers of viable, self-sustaining populations.

Based on data provided by known collections, the numbers of Neosho madtoms seem to have remained reasonably stable at most sites. Collections of 60 to 120 specimens made during the 1950's and 1970's were efforts to obtain large numbers of individuals for research purposes. Most other records of this species, with 1 to 30 specimens per site, represented less intensive work, usually associated with qualitative surveys. During March 1989, as many as 12 individuals were obtained at some sites by sampling less than 25 percent of each riffle (Dr. Thomas Wenke, Natural Science Research Associates, pers. comm.). Samples taken in the late summer or fall (as was done in the large collections in the 1950's and 1970's) could be expected to include a significantly greater number of individuals, including young-of-the-year fish. Although the overall population of Neosho madtoms seems to have remained stable, local declines or extirpations have been noted, and threats to local populations still exist.

Threats to the Neosho Madtom

Mainstream Impoundments. Relative to the probable distribution of this species 100 years ago, the historic range of the Neosho madtom has shrunk due to the loss of about one-third of the potential habitat with the construction of dams at Lake o' the Cherokees, Lake Hudson, Fort Gibson Reservoir, and Tenkiller Reservoir all in Oklahoma. These losses were the result of inundation of

habitat and cold hypolimnetic discharges (Moss 1981). Additional losses of riffle habitat have occurred behind John Redmond Reservoir on the Neosho River in Kansas and 18 smaller mainstream dams on the Neosho and Cottonwood Rivers in Kansas and Oklahoma.

The loss of riffle habitat impounded behind dams is obvious in Oklahoma, but it has not been fully assessed in Kansas. Aerial and ground surveys of the Neosho, Cottonwood, and Spring Rivers in Kansas were conducted during 1989 by Natural Science Research Associates (Dr. Thomas Wenke, Natural Science Research Associates, Hays, Kansas, pers. comm.) to obtain a rough estimate of the loss of riffle habitat behind dams in the mainstream channels. Given that the size of the areas impounded by the smaller dams will fluctuate with the regular changes in streamflow, the full extent of habitat loss will have to be gauged over several seasons.

There are 477 stream kilometers (296 stream mi) of the Neosho River from Council Grove Reservoir to Commerce, Oklahoma. Of this total, about 31 stream kilometers (20 stream mi) (6.6 percent) are impounded in the conservation pool at John Redmond Reservoir from the dam to a point near Hartford, Kansas. In addition, we estimate that roughly 72 stream kilometers (45 stream mi) (15.2 percent) might be inundated behind 15 smaller structures (listed in appendix A). Not all of this distance would consist of riffles if the dams were absent and not all of these areas would be fully inundated during periods of low flow, but the indication is that up to 20 percent of the area of potential Neosho madtom habitat in the Neosho River in Kansas would be unavailable to riffle species. Of the approximately 115 stream kilometers (71 stream mi) of the Cottonwood River from the mouth of Middle Creek near Elmdale, Kansas, to its confluence with the Neosho River, perhaps 10 stream kilometers (6 stream mi) (8.7 percent) could be ponded behind two small dams. No dams are known to us on the Spring River within the 16 stream kilometers (10 stream mi) known to be occupied by the Neosho madtom in Kansas and Missouri.

In total, approximately 113 stream kilometers (70 stream mi) of the river segments within Kansas that might otherwise be inhabited by the Neosho madtom appear to be impounded. This represents a loss of about 18 percent of the potential habitat in Kansas and adjacent areas of Oklahoma and Missouri where Neosho madtoms still exist. In addition to these present habitat losses, consideration is being given to increasing the elevation of the conservation pool at John Redmond Reservoir to provide additional storage capacity (M. Chester, U.S. Army Corps of Engineers, John Redmond Project Office, Burlington, Kansas, pers. comm.). The proposed increase of about 2 to 2.5 ft (0.6 to .76 m) would inundate riffle habitat occupied by the Neosho madtom near Hartford, Kansas. Future losses resulting from dam construction on the mainstream channels of the Neosho, Cottonwood, and Spring Rivers should be avoided.

Watershed Impoundments. Watershed impoundments on tributary streams also could threaten Neosho madtom habitat. Both the Soil Conservation Service and the U.S. Army Corps of Engineers have proposed the construction of small dams in the Upper Neosho River basin, although the U.S. Army Corps of Engineers' study is not active at the present time. These structures would probably reduce

annual discharge in the Neosho River because of evaporation and possible consumptive use of the impounded water. The effect of watershed dams on base flow is less certain, but observations by the Soil Conservation Service suggest that it should be enhanced (Wetter 1980). Information supporting this view was provided by Debano and Hansen (1989) who reviewed three watershed rehabilitation projects in the southwestern United States and reported peak flow reduction and enhancement of base flows. For example, in the Alkali Creek watershed of Colorado, construction of 132 gully check dams increased streamflow duration; streamflow was ephemeral before treatment, but after 7 years became perennial at the watershed mouth. The extended flow resulted from slow releases of water stored in sediments deposited behind the check dams. Although the base flow in the Neosho River also might be enhanced by the construction of watershed dams, appropriate studies on this drainage have not been conducted. It is premature to assume that an increase in base flow would necessarily benefit the Neosho madtom because this species may require peak flows for reproduction.

Another effect of watershed dams is retention of storm runoff. Although reducing extremes in discharge might seem desirable, it is possible that Neosho madtoms and their habitat could be negatively impacted. In September 1989, fish were collected in a gravel bar at Council Grove, Kansas, by Larry Zuckerman and Sherry Ruther (Kansas Department of Wildlife and Parks, pers. comm.). They noted that the interstices of the gravel were heavily silted and attributed this to the regulation of flows from Council Grove Reservoir, although no data have been reported to confirm this. Siltation of gravel could inhibit burrowing activities of Neosho madtoms and reduce the abundance of immature insects that comprise their food. Zuckerman and Ruther suggested that the release pattern from the reservoir be modified to permit flows of sufficient magnitude to cleanse gravel bars. Reduced peak discharges also could adversely affect the spawning success of Neosho madtoms. As far as is known, Neosho madtoms spawn during the period of highest discharge during the summer. Research on reproduction of Neosho madtoms is needed to determine the importance of high flows to the spawning success of this species.

At this time, it would seem prudent to delay construction of the proposed watershed dams until appropriate analysis of the changes in streamflow patterns in the Neosho River basin is provided by the appropriate action agencies. If this information is made available and studies on the reproductive requirements of the Neosho madtom are completed, the Service, through Section 7 consultation, could assess the impacts of these structures on the Neosho madtom and its habitat.

Drought. The prolonged drought of the 1950's caused some riffles in the Neosho River to become dry, forcing riffle species, such as the Neosho madtom, into less favorable habitat. These riffle species of fishes were the slowest to recover following the resumption of continuous flow (Deacon 1961). Deacon (1961) did not find the Neosho madtom to be "common" at the sites he sampled until the third summer of continuous flow.

Droughts can be expected to recur, and the impact of droughts comparable to that of the 1950's will worsen as demands for water consumption increase. Surface water demand for industrial, agricultural, and municipal uses in the Neosho River basin (including the Neosho, Cottonwood, and Spring Rivers) is projected to increase 25 percent between 1984 and 2040, which would make the overall surface water supply inadequate in the event of a severe drought (Kansas Water Office 1987).

The concept of minimum desirable streamflows in Kansas was established by law in 1980 to help maintain surface flows in designated streams and protect them from overappropriation of water rights (K.S.A. 82a-703 and 82a-928). In developing these streamflow standards, consideration was given to consumptive appropriations (municipal, industrial, and agricultural), fish and wildlife requirements, and water quality. Minimum desirable streamflows have been established for two sites on the Cottonwood River and three locations on the Neosho River (K.S.A. 82a-950, Kansas Water Office 1988), and they have been proposed for one site on the Spring River (Kansas Water Office 1988). The adverse effects of a drought on aquatic wildlife could be lessened, but not prevented, by these minimum streamflows which cannot be met during a prolonged drought (Kansas Water Office 1988).

Water from Marion Reservoir on the Cottonwood River and from Council Grove and John Redmond Reservoirs on the Neosho River would be used to support the minimum flows in these two streams. An assessment of transit losses for reservoir releases from Council Grove and John Redmond Reservoirs during drought conditions was conducted by the U.S. Geological Survey (Carswell and Hart 1985). Under none of their scenarios would enough of the water released from the reservoirs be available to meet the minimum desirable streamflows in the lower Neosho River. If maintained as designated in Kansas, minimum desirable streamflows could enhance the survival of the Neosho madtom during brief periods of drought. However, these standards would be of little or no value in a drought similar to that of the 1950's, especially if demands on the water supply increase as projected.

Given the relatively short stretches of the Neosho River in Oklahoma and the Spring River in Missouri occupied by the Neosho madtom, minimum desirable streamflows may not be as critical in these reaches. If the streamflow requirements could be met at the designated sites in Kansas, it would be reasonable to expect adequate flows in the adjacent areas of Oklahoma and Missouri as long as excessive surface or alluvial withdrawals of water are not permitted by those States. Increased water demand may dictate a need for minimum desirable streamflow standards in these reaches as well.

Removal of Gravel Bars. Removal of gravel and pebbles from the streambed for construction purposes has eliminated specific populations of Neosho madtoms. Under natural unregulated hydrological conditions in the Neosho River basin, gravel bars will be replaced by natural processes. One example of this is the gravel bar at the confluence of the Cottonwood and South Fork Cottonwood Rivers, which was removed in 1966. The gravel bar redeveloped, and Neosho

madtoms were collected at the confluence site again in 1975 (Moss 1981). Larger gravel bars and their fish assemblages in the lower Neosho River would probably take longer to recover.

Currently, the Kansas Division of Water Resources regards removal of gravel bars as a channel change rather than a sand dredging operation (John Henderson, Kansas State Board of Agriculture, pers. comm.). This requires a permit from the Chief Engineer of the Division of Water Resources (K.S.A. 82a-301 to 305a). Permit applications must go through an environmental coordination review (K.S.A. 82a-325 to 327), which includes the following State agencies: Department of Wildlife and Parks; Office of Extension Forestry; State Biological Survey; Department of Health and Environment; State Historical Society; State Conservation Commission; and State Corporation Commission. Although these channel change proposals usually receive serious objections from some environmental review agencies (John Henderson, Kansas State Board of Agriculture, pers. comm.), the Chief Engineer could approve a permit even if an environmental review agency determined that a project would adversely impact the environment (K.S.A. 82a-327d). However, if a State threatened or endangered species is involved, a permit also must be obtained from the Department of Wildlife and Parks. This agency, therefore, has the final authority to prevent non-Federal activities judged to be detrimental to State-protected species.

In Oklahoma, gravel removal from a stream requires a permit from the Oklahoma Department of Mines (45 Okla. St. Ann. 8A-724). Because the permit approval process allows for public participation, objections can be raised if adverse effects are anticipated. Although not guaranteed, threats to an endangered species could conceivably result in permit denial. In Missouri, a permit is required from the Department of Natural Resources; approval of such a permit may involve an assessment of impacts to threatened species. In neither State is the review process as extensive as that in Kansas, and both Oklahoma and Missouri should consider increasing the level of protection they provide in this regard for State-listed species, such as the Neosho madtom.

In the matter of gravel removal from streams, Federal laws are of little help to the States, except for certain sections of the Endangered Species Act to address impacts on federally protected species. Section 7 requires Federal Agencies to consult with the Service if any actions they undertake "may affect" listed species. Section 9 of the Endangered Species Act prohibits unauthorized taking of listed species; including activities which might "harass" or "harm" the species. Because the Spring, Cottonwood, and Neosho Rivers are not considered navigable under the Rivers and Harbors Act (33 U.S.C. 403; 33 CFR Ch. II, Part 322.2), no excavation permit is needed from the U.S. Army Corps of Engineers if dredged material will not be discharged into the river. It is possible, however, that placement of equipment in the river could result in harmful deposition of materials. If so, some protection might be provided under Sections 401 or 404 of the Clean Water Act (40 CFR Ch. 1).

Wolf Creek Nuclear Power Generating Station. The Wolf Creek Generating Station is located on a Neosho River tributary east of John Redmond Reservoir near Burlington, Kansas. The possible effects of accidental releases of thermal or

radioactive water on the Neosho madtom and other forms of aquatic life are uncertain, but the likelihood of such an accident is small. Although normal operation of Wolf Creek Generating Station will not have significant effects on the chemistry of the Neosho River, water releases from John Redmond Reservoir could be substantially reduced during periods of drought (U.S. Nuclear Regulatory Commission 1982). If there is a repeat of the severe drought of the 1950's, operation of Wolf Creek Generating Station could reduce releases from John Redmond Reservoir to the Neosho River by an average of nearly 50 percent of those expected without Wolf Creek Generating Station operation (U.S. Nuclear Regulatory Commission 1982). Assuming a life span of about 40 years, Wolf Creek Generating Station should be operational until about the year 2025.

Feedlot Pollution. Pollution from feedlots has caused appreciable losses of Neosho madtoms within Kansas. Feedlot runoff decimated Neosho madtom populations in the Cottonwood and Neosho Rivers upstream from John Redmond Reservoir in 1966 to 1967 (Cross and Braasch 1969). These areas were subsequently repopulated, and legislative action was taken to regulate feedlot operations. In Oklahoma and Missouri, only a limited number of stream miles are inhabited by Neosho madtoms, and we have found no records of fish kills caused by feedlots located in these areas.

From 1973 to 1986, 11 fish kills were investigated by Kansas Department of Wildlife and Parks in the Neosho River (Ken Brunson, Kansas Department of Wildlife and Parks, pers. comm.), and at least three of these were caused by feedlots. All were in 1978 and 1979 in Morris County, which was not known to support any populations of Neosho madtoms until 1988. Affected stream reaches in these three fish kills were 5 to 8 km (3 to 5 mi) compared to 16 to 40 km (10 to 25 mi) in the three fish kills caused by feedlots in the 1960's. The number of fishes reported killed in the 1960's ranged from 225,000 to 425,000, while the total mortalities for the fish kills in the 1970's were 300 to 2,500. These data suggest that the threat posed by feedlot pollution to the Neosho madtom has been reduced by a "shift" of feedlot operations to southwestern Kansas and by improved control of the feedlot industry.

Kansas law governing the feedlot industry states that feedlot operators shall "provide adequate drainage, from feedlot premises, and such drainage shall be so constructed as to control pollution of streams and lakes . . . ." (K.S.A. 47-1505). Also, the Kansas Department of Health and Environment has devised standards for feedlot design and site selection (Kansas Department of Health and Environment, undated). The Kansas Department of Health and Environment also has developed quality standards for the surface waters of Kansas (K.A.R. 28-16-28), but these do not apply to feedlot runoff because feedlots are not designed to discharge. Although fish kills resulting from feedlot runoff are sometimes due to inadequate design, often they result from improper operation and maintenance of feedlot facilities. The Kansas Department of Health and Environment currently is developing more rigorous standards for feedlots (Walt Wagner, Kansas Department of Health and Environment, pers. comm.) and, presumably, these standards will be amended in the future as conditions warrant.

Nonpoint Source Pollution. The impacts of nonpoint source pollution of both urban and agricultural origin has not been documented. However, because both municipalities and crops occur along the rivers which provide habitat for this species, specific water quality requirements and tolerance for this species should be investigated (see task 142).

Cherokee County, Kansas, Superfund Site. The entirety of the Spring River in Cherokee County, Kansas, lies within a Superfund Cleanup Site as designated by the Environmental Protection Agency. Mining in this area for lead, zinc, and coal has resulted in elevated levels of sulfate and trace metals in stream water (Spruill 1984). The effects of these pollutants on past or existing Neosho madtom populations have not been documented. Current known populations exist upstream from planned cleanup activities. Protection of the Neosho madtom and its habitat will need to be considered as cleanup plans proceed for this site.

General Regulations Protecting the Neosho Madtom

Water Quality Standards. Little is currently known about the specific water quality requirements of the Neosho madtom. The natural occurrence of this species in extremely low numbers in the Spring River might be due to differences in water quality between the Spring and Neosho Rivers. More research on this aspect of Neosho madtom biology needs to be conducted.

Within Kansas, the Department of Health and Environment's standards for surface water quality already afford a measure of protection for Neosho madtoms. The Cottonwood River and the Neosho River downstream from Council Grove Reservoir are classified as "special aquatic life use waters" (waters that contain either unique habitat types and biota, or species that are listed as threatened or endangered in Kansas). These stream segments have specific criteria for many environmental parameters (K.A.R. 28-16-28e). Further, if these criteria are determined to be underprotective, Kansas Department of Health and Environment could develop appropriate site-specific standards. (K.A.R. 28-16-28e).

The water quality standards in Kansas also recognize threatened or endangered species. Although Kansas Department of Health and Environment could issue a variance if "important social and economic development" is impaired, the general provisions of the surface water quality standards state that ". . . no degradation of water quality by artificial sources shall be allowed that would result in harmful effects on populations of any threatened or endangered species of aquatic life in a critical habitat . . . ." (K.A.R. 28-16-28c). Listed as a threatened species by the State of Kansas, the Neosho madtom occupies State-designated "critical habitat," a category so designated because of its importance for the survival of threatened or endangered species. Within Kansas, the Cottonwood River from its confluence with Middle Creek to its confluence with the Neosho River is considered critical habitat (State designation), as is the Neosho River from west of Dunlap to the Kansas-Oklahoma border, and the Spring River from the Kansas-Missouri border to 0.8 km (0.5 mi) below the Highway 96 bridge.

The water quality standards for Missouri and Oklahoma have no provisions that recognize the special needs of State-listed threatened and endangered species. These standards should be improved.

Protection of Threatened and Endangered Species. The amount of protection afforded to the Neosho madtom by endangered species legislation in Kansas, Missouri, and Oklahoma varies considerably among the three States. Federal designation as a threatened species offers additional protection to the species beyond the powers of the States.

In Kansas, the threatened status of the Neosho madtom by State regulation gives the Kansas Department of Wildlife and Parks considerable authority to protect this species (K.A.R. 115-15-3, formerly K.A.R. 23-17-2). Persons undertaking or sponsoring any project involving public money, assistance from a public agency, or requiring a State or Federal permit must obtain a permit from the Kansas Department of Wildlife and Parks if the project is likely to destroy individuals of a protected species or their State-designated critical habitats. These projects could include roads and bridges, stream channel alterations, dams, landfills, sewer plants, powerplants, and airports. The Kansas Department of Wildlife and Parks could issue the permit if the project sponsor agrees to mitigating and compensating measures that will minimize the loss of animals or habitat; however, the Kansas Department of Wildlife and Parks can refuse a permit if the resource loss is judged to be unacceptable. State law, however, is not applicable to Federal projects (e.g., activities of the U.S. Army Corps of Engineers) unless specifically authorized by Congress. Persons undertaking or sponsoring projects not funded from public sources and not requiring a State or Federal permit, such as housing developments, also must obtain a permit from Kansas Department of Wildlife and Parks if the action will destroy threatened or endangered species. As with publicly funded or assisted projects, a permit can be refused if the resource loss is judged to be unacceptable. However, the regulation of privately funded projects is applicable only when individual animals are directly harmed; habitats are not protected. Currently, housing developments are the only projects in this category that involve the Kansas Department of Wildlife and Parks. Although it is possible that erosion from housing developments could cause damaging siltation, it is unlikely that this would be of sufficient magnitude to harm populations of Neosho madtoms.

The Missouri Department of Conservation and the Oklahoma Department of Wildlife Conservation review applications for projects that might have adverse impacts on State-listed species. Although these departments have some degree of influence with other State agencies to ensure protection of threatened and endangered species, the State conservation departments have no statutory authority to deny these applications. The regulations protecting habitat are not as inclusive as those protecting the species themselves. These regulations should be strengthened.

Under provisions of Section 7 of the Endangered Species Act (16 U.S.C. Ch. 35), Federal Agencies are required to consult with the Service to ensure that their actions are not likely to jeopardize the continued existence of a species included on the Federal list of threatened and endangered taxa, or result in

the destruction or adverse modification of federally-designated critical habitat. This also applies to any non-Federal action that may include involvement by Federal Agencies (i.e., funding, permitting, etc.). This level of protection cannot be provided by the States alone. With respect to the Neosho madtom, construction or operation of dams by the U.S. Army Corps of Engineers and the Soil Conservation Service are the Agency actions most likely to have an impact on this species.

Excessive Collections. Concerns have been expressed about overcollecting of the Neosho madtom at sites with samples of as many as 116 individuals reported. Specifically, it has been noted that the site on the Neosho River west of Commerce, Oklahoma, has experienced a decline in the number of Neosho madtoms since August 1976 when 85 individuals were taken. Only three specimens were collected in this vicinity in September 1983, and only one specimen in March 1989. In 1989, Natural Science Research Associates surveyed the length of the river from the Stepps Ford Bridge to a point about 1 km (0.6 mi) downstream (Dr. Thomas Wenke, Natural Science Research Associates, Hays, Kansas, pers. comm.). They noted an overall absence of the gravel riffle habitat preferred by Neosho madtoms. It is possible that some other perturbation, such as the scouring of gravel from the streambed, might have impacted the Neosho madtom population and its habitat at this site.

Collection permits are required by the conservation agencies in Kansas, Missouri, and Oklahoma. These permits govern the taking of all fishes, including the Neosho madtom and other State-protected species. In Kansas, approval of these permits is granted by a conservation officer rather than someone in the environmental services or nongame sections who would be more knowledgeable about threatened and endangered species. This process should be improved.

In Missouri, fish collection permit applications are reviewed by an ichthyologist with the Department of Conservation. In Oklahoma, permits must be accompanied by a letter of recommendation. All three States require a summary of all specimens taken. When prudent, information on individuals of protected species that are captured and released should be requested from holders of scientific collection permits.

Inclusion of the Neosho madtom on the Federal list of threatened species also makes a Federal collection permit necessary. Initially, these permits should limit the number of museum voucher specimens from each collection site to two individuals for presence/absence surveys. The number of specimens permitted to be killed or removed from each site for other research purposes should be considered on a case-by-case basis. Based on information provided above (see sections on Life History/Ecology; Current Status), a limit of 30 individuals from riffles in an area that reasonably can be reached by walking from a road, bridge, or other access point seems prudent. However, biological research might indicate that this limit should be adjusted.

Biological Research Needs

Interspecific Competition. An unknown aspect of Neosho madtom ecology that might pose a threat to its survival is the possibility of competition with slender madtoms. The apparent paucity of Neosho madtoms in the Spring River might be due to physical or chemical features of the stream; however, Moss (1983) suggested that it might be attributable to competition with the slender madtoms. If true, this relationship probably developed naturally in the Spring River, but the presence of slender madtoms in the Upper Neosho Basin is a matter of concern.

The slender madtom was not reported from the Neosho River and two tributaries downstream from Council Grove Reservoir until after 1970 (Ernsting et. al. 1989), possibly reflecting the limited number of collections from these streams. However, they also suggest a possible introduction of slender madtoms because they had not been previously reported from surveys elsewhere in the Upper Neosho River basin. Current records are from sites upstream from the known range of the Neosho madtom; however, if the slender madtom extends its range downstream, it could pose a threat to Neosho madtom populations upstream from John Redmond Reservoir.

If research into the foraging ecology and reproductive requirements of these species documents that the slender madtom is indeed an effective competitor, the Neosho madtom could be further threatened. Studies to determine the level of competition between these two species have been given a high priority so that management decisions regarding possible control of the slender madtom in the Neosho and Cottonwood Rivers can be made before it expands its range.

There also is the potential for competition for resources between the Neosho madtom and other related species, such as the stonecat. However, the similarities between these species are much less than with the slender madtom. Stonecats are commonly found in collections with Neosho madtoms, so the two apparently have adapted to living in proximity to one another.

Absence of Knowledge on Reproduction. A somewhat less specific threat to the survival of the Neosho madtom is our lack of information about its reproductive biology. Except for the approximate time of spawning, we know little about this subject in nature or in the laboratory.

Neosho madtoms probably nest in cavities of some sort, which is a common trait among species of North American catfishes. Moss (1981) seeded riffles with small cans, but none were used by Neosho madtoms. Given that young-of-the-year Neosho madtoms often are found in pools downstream from riffles, there is a strong possibility that the Neosho madtoms move off the riffles into these pools to spawn when the flows rise in the late spring and early summer, as suggested by Moss (1981). While the gravel riffle offers an abundant supply of insect larvae to support the madtoms throughout most of the year, the slower waters of the pool would possibly provide more cavity structures for spawning and brood protection.

Understanding the reproductive requirements of the Neosho madtom and being able to simulate them in the laboratory also could prove important to the survival of this species. If adequate protection is provided to the remaining Neosho madtom habitat within the Neosho, Cottonwood, and Spring River basins, it should not be necessary or desirable to introduce this species outside of these basins. However, given that the habitat losses associated with the major reservoirs in Kansas and Oklahoma are permanent, the Neosho madtom is confined to a reasonably small area of streams that periodically will be subjected to droughts and other perturbations. The ability to propagate Neosho madtoms in a hatchery could be critical in efforts to repopulate areas where populations have been decimated.

Characterization of Specific Habitat Requirements. Additional study is needed to characterize in more detail the specific habitat requirements of this species. Tolerance levels of riffle sedimentation, degree of use of pools and other nonriffle areas, and ability to withstand environmental perturbations such as pollution and gravel removal are all undocumented. More adequate protective measures can be implemented with a better understanding of some of these parameters.

Conservation Measures

On July 26, 1990, the Service entered into an agreement with the Soil Conservation Service and the Kansas Department of Wildlife and Parks to study the effects of proposed watershed developments on Neosho madtoms in the Cottonwood River drainage. This study should help assess any impacts on this species which may result from these structures, as outlined in task 533 of the Narrative Outline. The study team, as initially proposed, would have authority to regulate releases from all proposed structures in the South Fork Cottonwood Watershed, which may provide the means to preclude adverse effects on Neosho madtom populations, if they are suspected. Any such plan for water releases must be approved by the South Fork Watershed District. On April 5, 1991, the Soil Conservation Service requested formal Section 7 conservation with the Service. On June 20, 1991, the Service provided its biological opinion on watershed developments in the Cottonwood River Basin, indicating that the proposed monitoring study would result in "no jeopardy" to the Neosho madtom. Field monitoring of possible effects is, therefore, considered a critical element of this watershed development project.

PART II

RECOVERY

Objective and Criteria

The objective of this recovery plan is to delist the species once self-sustaining populations of the Neosho madtom and its habitats are secured within each of the regions occupied by this species in the Neosho, Cottonwood, and Spring River systems in Kansas, Oklahoma, and Missouri. The number of populations in each region will be determined through implementation of this recovery plan.

Delisting of the Neosho madtom will be considered when the appropriate number of self-sustaining populations has been documented in the following regions: (1) the Neosho and Cottonwood Rivers above John Redmond Reservoir; (2) the Neosho River downstream from John Redmond Dam to the upper end of Lake o' the Cherokees; and (3) the Spring River in Cherokee County, Kansas, and Jasper County, Missouri. A fourth region of populations might occur in the Spring River in Oklahoma below Lowell Reservoir (at the confluence of Spring River and Shoal Creek). At least one self-sustaining population should be maintained in regions 1 and 2. If habitat conditions are presently or potentially suitable, at least one self-sustaining population should be documented in regions 3 and 4 as well. Each population shall consist of a minimum of 500 sexually mature individuals. These recovery criteria are interim criteria, pending further study on groups of populations in regions 1 and 2 (task 1). Small concrete dams (appendix A) probably serve as partial barriers to the movements of Neosho madtoms. These structures subdivide regions 1 and 2 into smaller groups of populations. There are 6 of these smaller groups in region 1, and 11 in region 2. Each of these subregions might include one or more self-sustaining populations. If so, then the number of self-sustaining populations needed to delist the species should be increased.

Once the populations of Neosho madtoms are clearly defined, the stability of these populations should be monitored for a minimum of 3 years. The density of Neosho madtoms from samples obtained in suitable gravel riffle habitat should initially be 3 per 100 m^2 in each population counted toward delisting (Moss 1983). However, as reproductive and population studies are completed, this density may be adjusted specifically for each population segment identified. In addition to the verification of a suitable number of self-sustaining populations of the Neosho madtom, sufficient biological knowledge also should be obtained to support establishment of the minimum habitat standards and provide the means to artificially propagate Neosho madtoms for their return to areas that might be decimated by unpreventable calamities.

Although removing the Neosho madtom from the Federal list of threatened species is an achievable goal, the greatly reduced range of this species probably will keep the Neosho madtom on the State lists of protected species. This would

provide the Neosho madtom and its habitat with protection in the statutes and regulations of Kansas, Missouri, and Oklahoma that is not afforded to other, more common taxa. Improvement of the State laws would greatly support the accomplishment of the recovery criteria.

Step-down Outline

1 Conduct studies on the biology of Neosho madtoms to determine criteria to be used for delisting.

11 Determine population size and mobility of Neosho madtoms.

111 Study Neosho madtom movements between riffles.

112 Conduct systematics studies to determine population boundaries.

12 Assess the degree of competition between Neosho madtoms and slender madtoms.

13 Study reproductive behavior in nature.

131 Document streamflow requirements for spawning.

132 Determine spawning habits of Neosho madtom as related to habitat selection.

133 Determine recruitment rates in the wild.

14 Document environmental limiting factors.

141 Determine tolerance to siltation.

142 Define water chemistry limiting factors.

143 Determine the effects of gravel riffle degradation.

144 Document physical and chemical attributes of the Neosho and Spring Rivers.

145 Assess the impacts of Superfund Site cleanup.

15 Study feasibility of artificial propagation.

2 Develop criteria to be used for delisting.

3 Monitor populations of the Neosho madtom.

31 Implement routine monitoring program under direction of wildlife conservation agencies in Kansas, Missouri, and Oklahoma.

32 Provide for specific assessment of the impact of fish kills on Neosho madtom populations being monitored.

4 Develop Neosho madtom reintroduction plans.

41 Survey potential reintroduction sites.

42 Prioritize reintroduction sites.

43 Develop site-specific reintroduction plans.

44 Implement site-specific reintroduction plans and monitor reintroduction efforts.

45 Develop emergency response plan.

5 Enhance protection of Neosho madtom populations and habitat.

51 Improve existing statutes, regulations, and policies.

511 Protect minimum discharges necessary to maintain riffle habitat and adequate flows for spawning.

512 Evaluate endangered species protection in Missouri and Oklahoma.

513 Enforce existing and future State regulations.

514 Increase endangered species protection in Kansas.

515 Improve collection permit regulations.

52 Solicit assistance to protect habitat.

53 Ensure compliance with Section 7 of the Endangered Species Act by all Federal Agencies.

531 Conduct Section 7 consultation on reservoir construction projects.

532 Coordinate dam operations to benefit the Neosho madtom.

533 Study impacts of tributary watershed dams on river discharge.

534 Conduct Section 7 consultation on other Federal actions potentially affecting the Neosho madtom.

54 Develop information and education program.

55 Develop control program for slender madtoms, if necessary.

6 Complete surveys in unsurveyed areas.

61 Conduct intensive surveys of the Spring River in Missouri, Kansas, and Oklahoma.

62 Conduct intensive survey of the Neosho River in Oklahoma

63 Conduct surveys in additional tributaries.

Narrative Outline

1 Conduct studies on the biology of Neosho madtoms to determine criteria to be used for delisting.

Further information is needed on Neosho madtom mobility, reproductive behavior, competition with slender madtoms, and other potentially limiting environmental factors.

11 Determine population size and mobility of Neosho madtoms.

The size of Neosho madtom populations is unknown. Based on the known concentrations of madtoms in riffles, the Neosho and Cottonwood Rivers' populations probably are large enough to possess adequate genetic variation if there is appreciable emigration by Neosho madtoms to riffles other than those occupied by their parents. However, populations in the Spring River might not be large enough to provide the level of genetic diversity outlined in the objective. Because the interriffle movements of Neosho madtoms and the degree of interriffle breeding are unknown, these matters need to be investigated, to define the minimum effective population size. Information obtained on the size and boundaries of Neosho madtom populations will be necessary before the number and minimum size of self-sustaining populations required for delisting can be determined.

111 Study Neosho madtom movements between riffles.

Studies need to be conducted to determine whether Neosho madtoms move to adjacent riffles. This project can be implemented on a pilot basis at a single group of riffles. Population estimates should be determined, with marking of individual fish in order to identify movements. If the Neosho madtoms do emigrate to nearby riffles, documentation should be obtained for the age class of the emigrating fish, the portion of the population that emigrated, the flow conditions, and other appropriate data.

112 Conduct systematics studies to determine population boundaries.

Electrophoretic studies or other molecular systematics research of specimens from throughout the range of the Neosho madtom also should be conducted to help define the boundaries of the populations. Coupled with results of task 111, minimum size of populations also may be determined.

12 Assess the degree of competition between Neosho madtoms and slender madtoms.

Quantitative data from field surveys and studies in simulated stream habitat should be used to determine the degree of competition, if any, between Neosho and slender madtoms. Unless and until it is determined that slender madtoms pose no competitive threat to Neosho madtoms, all field surveys should include specific information on slender madtoms collected in the Neosho, Cottonwood, and Spring Rivers.

If the slender madtom populations recently reported from the Upper Neosho River basin are introductions, and the species effectively competes with the Neosho madtom, time could be critical in the implementation of a successful control program before the slender madtom expands its range. Thus, it is important that a determination be made soon as to the degree of competition, if any, between these species.

13 Study reproductive behavior in nature.

Research should be conducted to determine spawning habits, recruitment factors, and habitat and environmental requirements (e.g., flow conditions, water depth, etc.). Information about Neosho madtom reproduction would be helpful in assessing impacts of proposed human activities that would alter habitat. It also could provide information for artificially improving the spawning habitat (e.g., enhancing habitat structure) and the environmental conditions (e.g., maintaining spawning flows).

131 Document streamflow requirements for spawning.

Studies should determine what flow volumes are necessary to trigger spawning and enhance survival of eggs and young. Information regarding the possible relationship between the peak river discharge and time of spawning could be important in regulating water releases from mainstream impoundments.

132 Determine spawning habits of Neosho madtom as related to habitat selection.

There is a need to determine the specific substrate size and water depths preferred by madtoms for reproduction. The extent to which pools are utilized instead of riffles is an important data gap.

133 Determine recruitment rates in the wild.

There is little known about the natural rate of recruitment in Neosho madtom populations, and what factors may be affecting or limiting this recruitment.

14 Document environmental limiting factors.

Knowledge of chemical and physical limiting factors not only would help assess impacts of proposed changes in Neosho madtom habitat, but also could provide a basis for improvements in the quality standards for surface waters in all three States, if they are necessary.

141 Determine tolerance to siltation.

Of particular importance is the assessment of the tolerance level of Neosho madtoms and their food species to siltation of riffles. Included in this should be a review of literature regarding such effects and tolerances of similar species in other waters. Until these data are available, projects should be postponed that are likely to alter the physical and chemical conditions of streams in the Neosho and Spring River basins, such as construction of watershed dams and reallocation of water storage in Federal reservoirs. Funding for needed studies should be provided by project proponents as part of overall project design costs.

142 Define water chemistry limiting factors.

Tolerance limits of this species to chemical factors such as pH, oxygen levels, and natural and human-caused pollutants should be investigated. Development of a water quality standards model would enable biologists to assess impacts of specific events in the rivers, and to provide better protection of water quality within Neosho madtom habitat. The assistance of the Environmental Protection Agency and the Kansas Department of Health and Environment will be needed to develop an appropriate model.

143 Determine the effects of gravel riffle degradation.

Projects which impact riffles, either through gravel removal or disruptions such as channelizing, may negatively impact Neosho madtoms. Specific studies should document what happens to the fish when an occupied gravel riffle is destroyed or adversely affected. Funding for needed studies should be provided by project proponents and State and Federal permitting agencies.

144 Document physical and chemical attributes of the Neosho and Spring Rivers.

Correlations between Neosho madtom abundance and habitat and water quality of these two rivers could help identify specific limiting factors. This would allow protection measures to focus on manageable parameters.

145 Assess the impacts of Superfund Site cleanup.

Plans for the cleanup of the Cherokee County, Kansas, Superfund Site will need to include measures to minimize or avoid the effects of this action on Neosho madtoms occurring in the Spring River. Plans should indicate protective measures which may need to be taken and restoration work that may need to be conducted, if impacts appear possible.

15 Study feasibility of artificial propagation.

Certain unpreventable circumstances detrimental to the Neosho madtom, such as a prolonged drought, are likely to occur in the future. Given the limited remaining natural range of the Neosho madtom, the ability to artificially propagate the species for later reintroductions might be critical to its survival. Research should be conducted on the techniques necessary to successfully raise Neosho madtoms, including the role genetics may play in determining brood stocks (see task 112). An implementation plan and facilities to carry out these efforts, should they be necessary, also should be developed (see task 4).

2 Develop criteria to be used for delisting.

Utilizing data gathered under task 1, specific criteria should be developed indicating how and under what schedule delisting may proceed. Guidelines need to be developed, in detail, specifying the number of self-sustaining populations required, as well as minimum population sizes, for each specific region.

3 Monitor populations of the Neosho madtom.

Because the Neosho madtom occupies such a limited range, monitoring of its populations will be necessary, not only to judge the effectiveness of the recovery plan, but also to ensure the long-term survival of the species. Data from the monitoring program could indicate subtle environmental changes that might have an impact on Neosho madtom populations.

31 Implement routine monitoring program under direction of wildlife conservation agencies in Kansas, Missouri, and Oklahoma.

The Service and the three State conservation agencies should develop standardized procedures for a monitoring program of the status of populations of the Neosho madtom throughout its range. Ideally, surveys should be made in late summer or early fall when it would be possible to obtain information on the age structure and reproductive success of the populations. A single field team with experience in the capture of Neosho madtoms or similar taxa could be composed of employees of the State conservation agencies, a qualified private organization, or a combination of the two.

The number of populations and sites that need to be sampled should be determined after completion of task 11. Based on information provided by Moss (1983) and previous collection data, a sample population density of three Neosho madtoms per 100 m^2 of gravel riffle habitat represents the target population density at each site. The sizes of the riffles in each area will differ, and in locations where riffles are smaller than 100 m^2, more than one riffle might need to be sampled within each population to achieve a minimum sample area.

32 Provide for specific assessment of the impact of fish kills on Neosho madtom populations being monitored.

Attempts should be made to identify and enumerate Neosho madtoms at fish kills. Conservation departments often are not notified of a kill until 48 hours or more after its occurrence. Decomposition, therefore, is a problem, especially during the summer. Even with early notification and adequate personnel, many small fish simply are not detected. In spite of these problems, a more detailed assessment of fish kills is needed to determine the magnitude of effect, if any, on Neosho madtom populations. Fish kill reporting and investigation procedures need to be reviewed and refined to identify mortality and survivability of Neosho madtoms. Implementation of such procedures will need to be done in a manner which avoids placing additional stress on surviving individuals.

4 Develop Neosho madtom reintroduction plans.

The Service and the three State conservation agencies need to design a reintroduction plan to be implemented if imminent destruction of Neosho madtom populations or habitats is likely or when reintroduction opportunities are identified. This plan should clearly designate specific agency personnel responsibilities for the decision to implement the plan and actual implementation activities. Reintroduction may not be necessary for small-scale fish kills caused by pollution, because Neosho madtoms would repopulate naturally as they have done in the past. However, reintroduction might be justified in the event of extensive illegal riffle removal, prolonged low discharge, or competition from slender madtoms, which might necessitate poisoning some stream reaches. Also, if Neosho madtoms are found to have formerly been more abundant in the past, or if the habitat conditions are found to be suitable, then reintroduction in regions 3 and 4 may be considered.

The fishes could be obtained from several sources in the Neosho River basin or from artificially propagated stocks (see task 15), and minimum stocking rates should be equivalent to those densities recommended in task 11. Riffle removal can be mitigated by adding cobbles and/or gravel to the river, thus creating an artificial riffle. This technique is currently used to improve sportfisheries in streams that have been channelized (Edwards et al. 1984).

41 Survey potential reintroduction sites.

Potential habitat areas need to be identified and evaluated to determine those sites most suitable for reintroduction.

42 Prioritize reintroduction sites.

Based on the results of task 41, sites should be prioritized to maximize the potential for success.

43 Develop site-specific reintroduction plans.

Each site potentially identified as a reintroduction site needs a plan developed which indicates how reintroduction would be conducted. Plans should specify personnel responsible for each aspect of the reintroduction effort. Results of genetics studies (task 15) should be incorporated into this plan.

44 Implement site-specific reintroduction plans and monitor reintroduction efforts.

Using the plans generated in task 43, reintroductions should be accomplished at selected sites in response to localized extirpations. Monitoring of reintroduced populations will need to be conducted to document success.

45 Develop emergency response plan.

A plan should be developed outlining measures necessary to protect specified Neosho madtom populations from large or dangerous toxic spill events. Fish could be salvaged alive ahead of an advancing fish kill, and maintained in safety in captivity until the threat passed and they could be returned to the river. The plan should specify personnel, equipment, and locations and facilities necessary for implementation.

5 Enhance protection of Neosho madtom populations and habitat.

Legal protection of Neosho madtom populations and habitats need to be increased and implemented. Other measures to physically protect and restore Neosho madtom habitats also need to be implemented.

51 Improve existing statutes, regulations, and policies.

New laws might need to be enacted and aspects of existing laws might need to be modified in response to the results of research recommended in this recovery plan. States should coordinate with the Service for assistance with draft statutes.

511 Protect minimum discharges necessary to maintain riffle habitat and adequate flows for spawning.

When the rates and seasonal aspects of stream discharge that are necessary to maintain gravel riffle habitats (task 14) and support flows for successful spawning of Neosho madtoms (task 13) are known, efforts need to be undertaken to protect these flows. The current policy of the U.S. Army Corps of Engineers is to regulate water releases for the benefit of fish populations whenever possible. Information obtained from tasks 13 and 14 will allow conservation agencies to effectively advise the U.S. Army Corps of Engineers, Soil Conservation Service, Nuclear Energy Regulatory Commission, and other agencies involved with dam constructions and operations.

The States should provide protection against overexploitation of surface and alluvial ground water supplies that would be detrimental to Neosho madtom and their habitat. Specific recognition of the needs of wildlife as a beneficial use of instream flows should be provided in State statutes. The results of research on the impacts of watershed dams (task 533) should be utilized in developing methods to provide protection of water supplies for the Neosho madtom. The States also should work to improve water quality and control pollution (i.e., feedlots and agricultural and urban runoff) which will compound the effects of lower water flows.

Current procedures regulating water releases to achieve minimum desirable streamflow will not suffice in the event of a severe drought. Consultation and coordination between the Service and the U.S. Army Corps of Engineers, Nuclear Energy Regulatory Commission, Kansas Water Office, and appropriate agencies in Oklahoma and Missouri are needed to ensure that minimum water releases are maintained during a severe drought. A plan describing how this will be accomplished needs to be developed.

512 Evaluate endangered species protection in Missouri and Oklahoma.

Current statutes and regulations in Missouri and Oklahoma may be insufficient to provide adequate protection to State-listed threatened and endangered species, such as the Neosho madtom, and their habitats. These two States should review existing legislation to determine the necessity of increasing protection comparable to the standards set by the Environmental Services Section of the Kansas Department of Wildlife and Parks and the regulations of the Kansas Department of Health and Environment, which specifically recognize the needs of State-listed threatened and endangered species.

513 Enforce existing and future State regulations.

The value of laws and regulations is dependent upon the degreeof enforcement. The resources of the State conservation agencies necessary to enforce laws protecting threatened and endangered species and their habitats are inadequate, and the penalties are not sufficient to discourage most violators. Efforts need to be made to train State conservation officers in endangered species identification and law enforcement, and to increase involvement of State personnel experienced in endangered species or nongame programs. Strict enforcement of existing and improved State regulations that protect endangered species should be supported by stiffer, mandatory fines.

514 Increase endangered species protection in Kansas.

Current State laws and regulations protecting State threatened and endangered species, including the Neosho madtom, and their habitats are apparently reasonably adequate up to the point where Section 7 consultation (task 53) would be necessary. The indirect impacts of privately funded projects on an aquatic ecosystem, such as housing developments, are not addressed in current State statutes and need to be incorporated. Additional policies may result from implementation of this recovery plan.

515 Improve collection permit regulations.

A Federal permit is required to collect the Neosho madtom and other federally listed species. Each collection permit should designate limits on the number of Neosho madtoms that can be killed or otherwise removed from their habitat at each location. Although no more than two voucher specimens should be collected during presence/absence studies, studies that require more specimens should be considered on a case-by-case basis. Based on currently available information, an initial limit of 30 individuals from any site seems prudent. New information might make it necessary to adjust this limit.

Holders of collection permits should be required to record the total number of Neosho madtoms collected and released at each site. This information would supplement data from the regular monitoring program (see task 31). These criteria should be adopted immediately for use on Federal collection permits. To ensure the same level of protection after the species is removed from the Federal list, the States should adopt similar stringent standards that accommodate any modifications warranted by additional biological information.

52 Solicit assistance to protect habitat.

Use incentives from State programs (e.g., Missouri's "Streams for the Future" program) and enlist private organizations such as The Nature Conservancy to involve private landowners in a comprehensive wildlife conservation program that specifically includes the Neosho madtom.

53 Ensure compliance with Section 7 of the Endangered Species Act by all Federal Agencies.

Control of certain activities performed by Federal Agencies is beyond the authority of State agencies. Consultations with the Service as stipulated by Section 7 of the Endangered Species Act should be conducted by Federal Agencies to comply with the Endangered Species Act. Section 7 consultations will ensure that Federal projects do not negatively impact Neosho madtom populations.

531 Conduct Section 7 consultation on reservoir construction projects.

All Federal Agencies proposing to build mainstem and tributary reservoirs in the Neosho River basin must conduct Section 7 consultations with the Service in the location and operation of these reservoirs that may affect the Neosho madtom. State and local agencies also should coordinate with the Service in construction and operation of reservoirs to avoid or minimize impacts to the Neosho madtom or its habitat.

532 Coordinate dam operations to benefit the Neosho madtom.

Mainstem and tributary dams already in existence may be operated in such a way to benefit the Neosho madtom through modifications of flow releases. Tributary dams may require spillway modifications to ensure such benefits, and proposed dams should be designed with total release capabilities.

533 Study impacts of tributary watershed dams on river discharge.

Watershed dams on streams tributary to the Neosho, Cottonwood, and Spring Rivers may impact discharge rates and alter seasonal flows in the rivers. Stream fauna also may be altered through changing environmental conditions or as a result of gamefish stockings in the impoundments. The extent of any of these changes within these basins and their effect on the Neosho madtom need to be documented by those agencies proposing to build such structures before these projects are undertaken (see task 511).

534 Conduct Section 7 consultations on other Federal actions potentially affecting the Neosho madtom.

A variety of actions have the potential for adversely affecting the Neosho madtom. These include possible habitat impacts from such projects as bridges, highways, and powerline and pipeline crossings, as well as water quality impacts from feedlots, pesticide registrations, and municipal sewage effluents. The Service must be consulted when there is Federal involvement in these actions. For non-Federal actions of this type, State and local governments should coordinate with their State conservation agency and with the Service to avoid or minimize impacts from such projects.

54 Develop information and education program.

With the cooperation of the Service, the three State conservation agencies need to develop strong, comprehensive, educational programs on threatened, endangered, or rare species, with a special recognition of federally listed taxa. An Information and Education Program devoted strictly to the Neosho madtom may not have the same effect as one implemented for highly visible species, such as the bald eagle, black-footed ferret, or whooping crane. Such an effort undertaken solely for the Neosho madtom would be likely to backfire if the madtom is considered by local citizens to be standing in the way of progress (e.g., the snail darter). Any educational program would most successfully take an "ecosystem" approach, showing that several other aquatic and terrestrial species in the Neosho and Spring River basins are threatened, based on Federal and State documentation and, therefore, the ecosystem is threatened.

55 Develop control program for slender madtoms, if necessary.

If slender madtoms are found to effectively compete with Neosho madtoms to the detriment of the latter, programs to control the slender madtom may need to be developed and implemented in the Neosho and Cottonwood Rivers. The slender madtom is part of the native fauna in the Spring River, and control programs would not be desirable in this basin.

6 Complete surveys in unsurveyed areas.

Several river areas that may provide potentially suitable habitat for Neosho madtoms have not been adequately surveyed. Additional surveys need to be completed.

61 Conduct intensive survey of the Spring River in Missouri, Kansas, and Oklahoma.

The Spring River in Oklahoma has relatively poor access; therefore, it probably has not been sampled adequately. Access appears to be more feasible in Missouri, but more intensive sampling needs to be conducted there as well. Appropriate tributary streams also should be sampled during this survey. The presence of Neosho madtoms in the Spring River in Oklahoma would represent a fourth region of populations.

62 Conduct intensive survey of the Neosho River in Oklahoma.

The Grand-Neosho River in Oklahoma from the Kansas border to the upper end of Lake o' the Cherokees has not been adequately sampled for Neosho madtoms. This river reach should be surveyed intensively to quantify populations which may occur.

63 Conduct surveys in additional tributaries.

Surveys for Neosho madtoms should be conducted in the South Fork Cottonwood River, Lightning Creek, and other tributaries which may be determined to have apparently suitable habitat. Some surveys should possibly be conducted during high-river flows when these tributaries may serve as refugia from high water.

Literature Cited

Carswell, W.J. and R.J. Hart. 1985. Transit losses and travel times for reservoir releases during drought conditions along the Neosho River from Council Grove Lake to Iola, east-central Kansas. U.S. Geol. Surv. Water-Resources Invest. Rept. 85-4003. 40 pp.

Cross, F.B. 1967. Handbook of fishes of Kansas. Univ. Kansas Mus. Nat. Hist., Misc. Publ. No. 45:1-357.

Cross, F.B. and M. Braasch. 1968. Qualitative changes in the fish-fauna of the upper Neosho River system, 1952-1967. Trans. Kansas Acad. Sci. 71:350-360.

Deacon, J.E. 1961. Fish populations, following a drought, in the Neosho and Marais des Cygnes rivers in Kansas. Univ. Kansas Publ., Mus. Nat. Hist. 13:359-427.

Debano, L.F. and W.R. Hansen. 1989. Rehabilitating depleted riparian areas using channel structures. Pages 141-148 In: R.E. Gresswell, B.A. Barton, and G.L. Kershner, eds. Practical approaches to riparian resource management: An educational workshop. Bureau of Land Management: Billings, MT. BLM-MT-PT-89-001-4351.

Edwards, C.J., B.L. Griswold, R.A. Tubb, E.C. Weber, and L.C. Woods. 1984. Mitigating effects of artificial riffles and pools on the fauna of a channelized warmwater stream. N. Amer. J. Fish. Mgmt. 4:194-203.

Ernsting, G.W., M.E. Eberle, and T.L. Wenke. 1989. Range extensions for three species of madtoms (Noturus: Ictaluridae) in Kansas. Trans. Kansas Acad. Sci. 92:206-207.

Franklin, I.R. 1980. Evolutionary change in small populations. Pages 135-149 In: M.E. Soule and B.A. Wilcox, eds. Conservation Biology: An Evolutionary-Ecological Perspective. Sinauer Associates, Inc.: Sunderland, MA.

Gilbert, C.H. 1886. Third series of notes on Kansas fishes. Bull. Washburn Coll. Lab. Nat. Hist. 1:207-211.

Kansas Department of Health and Environment. Undated. Designed standards for confined livestock feeding operations. Kansas Department of Health and Environment Agric. Waste Unit Bulletin, Topeka, KS. 32 pp.

Kansas Water Office. 1987. Kansas water supply and demand report. Kansas Water Office, Topeka, KS. 79 pp.

Kansas Water Office. 1988. Kansas water plan executive summary: Fiscal year working draft, April 1988. Kansas Water Office, Topeka, KS. 39 pp.

Kapuscinski, A.R. and L.D. Jacobson. 1987. Genetic guidelines for fisheries management. Sea Grant Research Rept. No. 17, Univ. Minnesota. 66 pp.

Moss, R.E. 1981. Life history information for the Neosho madtom (Noturus placidus). Kansas Dept. Wildl. Parks Contract No. 38, Pratt, KS. 33 pp.

Moss, M.E. 1983. Microhabitat selection in Neosho River riffles. PhD dissert., Univ. Kansas. 294 pp.

Schneider, C.T. 1974. Opinions of the Attorney General. Vol. 8, Opinion 74-137. State of Kansas, Topeka, KS. Pages 1173-1177.

Spruill, T.B. 1984. Assessment of water quality resources in the lead-zinc mined areas in Cherokee County, Kansas, and adjacent areas. U.S. Geological Survey, Lawrence, KS. Open File Report 84-439. 102 pp.

Taylor, W.R. 1969. A revision of the catfish genus Noturus Rafinesque, with an analysis of higher vertebrate groups in the Ictaluridae. U.S. Natl. Mus. Bull. 282. 315 pp.

Terry, P.A. 1986. A biological survey of the Kansas segments of Spring River and Shoal Creek.M.S. thesis, Pittsburg St. Univ., Pittsburg, KS. 72 pp.

U.S. Nuclear Regulatory Commission. 1982. Final environmental statement related to the operation of Wolf Creek Generating Station, Unit No. 1. Nuclear Regulatory Commission, Washington, D.C.

Wagner, B.A., A.A. Echelle, and O.E. Maughan. 1984. Status of three species of Oklahoma fishes. Oklahoma State Univ., Stillwater, OK. Submitted to U.S. Fish and Wildlife Service, Albuquerque, NM. 20 pp.

Wetter, L.H. 1980. The effects of small watershed dams on stream flow. Trans. Kansas Acad. Sci. 83:237-238.

PART III

IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and costs for the recovery program. It is a guide for meeting the objectives elaborated in Part II of this plan. This schedule indicates the general category for implementation, recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks ("ongoing" denotes a task that, once begun, should continue on an annual basis), the responsible agencies, and estimated costs for the Service tasks. These actions, when accomplished, should bring about the recovery of the Neosho madtom and protect its habitat. Needs for agencies other than the Service are not identified and, therefore, Part III does not reflect the total financial requirements of the recovery of this species.

KEY TO IMPLEMENTATION SCHEDULE COLUMNS

Definition of Priorities

Priority 1: An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2: An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery or reclassification of the species.

Abbreviations Used

ACE--U.S. Army Corps of Engineers
FWS--U.S. Fish and Wildlife Service
  FWE--Fish and Wildlife Enhancement
  RW--Refuges and Wildlife
  LE--Law Enforcement
KDHE--Kansas Department of Health and Environment
KDWP--Kansas Department of Wildlife and Parks
MDC--Missouri Department of Conservation
ODWC--Oklahoma Department of Wildlife Conservation
SCS--Soil Conservation Service
FHA--Federal Highway Administration
EPA--Environmental Protection Agency
REA--Rural Electrification Administration
NERC--Nuclear Energy Regulatory Commission

RECOVERY IMPLEMENTATION SCHEDULE
NEOSHO MADTOM

PRIORITY NUMBER	TASK NUMBER	PLAN TASK	TASK DURATION	RESPONSIBLE AGENCY REGION	FWS PROGRAM	OTHER	COST ESTIMATES (X $1000) FY-1	FY-2	FY-3	COMMENTS/NOTES
1	111	Study movements between riffles	2 years	2,3,6	FWE	KDWP,MDC, ODWC	4	4	—	
1	112	Systematic Studies	2 years	2,3,6	FWE	KDWP,MDC, ODWC	4	4	--	
1	12	Assess degree of interspecific competition	2 years	2,3,6	FWE	KDWP,MDC, ODWC	4	4	--	
1	2	Develop delisting criteria	1 year	2,3,6	FWE	KDWP,MDC, ODWC	4	—	--	
1	511	Protect minimum streamflows	ongoing	2,6	FWE	KDWP,ODWC, SCS,NERC, ACE	5	6	7	Administrative costs
2	131	Determine streamflow requirements	2 years	2,3,6	FWE	KDWP,MDC, ODWC,ACE,SCS	3	3	—	
2	132	Spawning habits and habitat selection	2 years	2,3,6	FWE	KDWP,MDC ODWC,ACE,SCS	3	3	--	
2	133	Determine recruitment rates in the wild	2 years	2,3,6	FWE	KDWP,MDC, ODWC	3	3	--	
2	141	Determine tolerance to siltation	2 years	2,3,6	FWE	ACE,KDWP, SCS	4	4	—	
2	142	Water chemistry limiting factors	2 years	2,3,6	FWE	KDWP,MDC, ODWC,EPA, KDHE	4	4	--	
2	143	Effects of riffle degradation	2 years	2,3,6	FWE	KDWP,MDC, ODWC,ACE, FHA,SCS	4	4	--	

RECOVERY IMPLEMENTATION SCHEDULE
NEOSHO MADTOM

PRIORITY NUMBER	TASK NUMBER	PLAN TASK	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	COST ESTIMATES (X $1000) FY-1	FY-2	FY-3	COMMENTS/NOTES
2	144	Neosho and Spring River differences	2 years	2, 3,6	FWE	KDWP,MDC ODWC,EPA	4	4	—	
2	145	Superfund Site cleanup	ongoing	6	FWE	KDWP,KDHE, EPA	S	S	S	To be funded by Superfund program
2	31	Monitor populations	ongoing	2, 3,6	FWE	KDWP,MDC ODWC	S	S	S	
2	44	Emergency response plan	2 years	2, 3,6	FWE	KDWP,MDC ODWC,EPA, KDHE	S	S	—	Administrative costs
2	512	Enhance protection-Oklahoma and Missouri	continuous			ODWC,MDC	4	4	4	Administrative costs
2	513	Enhance protection-enforcement	ongoing			KDWP,MDC ODWC	8	8	8	Administrative costs, field time
2	533	Study impacts of tributary watershed dams	3 years	6	FWE	ACE,SCS, KDWP	12	12	12	Administrative costs, field time
2	55	Develop slender madtom control program	3 years	6	FWE	KDWP	2	2	2	
2	61	Survey Spring River	1 year	2, 3,6	FWE	KDWP,MDC, ODWC	S	--	--	
2	62	Survey Neosho River in Oklahoma	1 year	2,6	FWE	ODWC	S	--	--	
2	63	Survey tributaries	2 years	2, 3,6	FWE	KDWP,MDC ODWC	S	S	--	
3	15	Study artificial propagation	2 years	6	FWE	KDWP	5	S	—	Estimate provided by Dexter National Fish Hatchery
3	32	Assess impact of fish kills	ongoing	2, 3,6	FWE	KDWP,MDC, ODWC,EPA, KDHE	5	S	S	Administrative costs, field time

RECOVERY IMPLEMENTATION SCHEDULE
NEOSHO MADTOM

PRIORITY NUMBER	TASK NUMBER	PLAN TASK	TASK DURATION	RESPONSIBLE AGENCY FWS REGION	FWS PROGRAM	OTHER	COST ESTIMATES (X $1000) FY-1	FY-2	FY-3	COMMENTS/NOTES
3	41	Survey potential reintroduction sites	ongoing	2,3,6	FWE, RW	KDWP,MDC, ODWC	10	S	S	Administrative costs, field time
3	42	Prioritize reintroduction sites	ongoing	2, 3,6	FWE, RW	KDWP,MDC, ODWC	5	5	—	Administrative costs
3	43	Develop reintroduction plans	ongoing	2, 3,6	FWE, RW	KDWP,MDC, ODWC,SCS, ACE,FHA	S	5	S	Administrative costs
3	44	Implement reintroduction plans	ongoing	2,3,6	FWE, RW	KDWP,MDC, ODWC,ACE, SCS,FHA	S	S	S	Administrative costs
3	514	Enhance protection-Kansas	continuous			KDWP	6	6	6	Administrative costs
3	515	Enhance protection-collection permits	ongoing	2,3,6	FWE, LE	KDWP,MDC, ODWC	5	5	S	Administrative costs
3	52	Solicit assistance to protect habitat	3 years	2, 3,6	FWE, RW	KDWP,MDC, ODWC	S	3	3	Administrative costs, private organizations involved
3	531	Coordinate reservoir construction	continuous	2,3,6	FWE	ACE,SCS, KDWP,MDC, ODWC	S	6	7	Administrative costs, consultations
3	532	Coordinate dam operations	continuous	2,3,6	FWE	ACE,SCS	S	6	7	Administrative costs, consultations
3	534	Coordinate other federal costs	continuous	2,3,6	FWE	FHA,EPA, REA,ACE	S	6	7	Administrative costs, consultations
3	54	Information and education program	ongoing	2,3,6	FWE	KDWP,MDC, OWDC	10	5	S	Administrative costs, educational materials

APPENDIX A

Summary of Dams

SUMMARY OF DAMS IN THE NEOSHO RIVER SYSTEM WITHIN THE RANGE OF THE NEOSHO MADTOM

Cottonwood River

Cottonwood Falls, Chase, CO., T19S, R8E, Sec. 29
Height of structure: 3 m

Soden Dam, Emporia, Lyon, CO., T19S, R11E, Sec. 22
Height of structure: 3 m

Neosho River

1.25 mi N and 2.25 mi W of Americus, Lyon, CO., T17S, R10E, Sec. 33
Ruggles Dam, 2.5 mi S of Americus, Lyon, CO., T18S, R10E, Sec. 24
2 mi N and 1.5 mi W of Emporia, Lyon, CO., T18S, R11E, Sec. 32
Height of structures: 1.5 m, 2.4 m, 3 m

Burlington, Coffey, CO., T21S, R15E, Sec. 26
Height of structure: 3.7 m

Neosho Falls/Riverside Park, Woodson, CO., T23S, R17E, Sec. 33
Height of structure: 3.7 m

Iola/Riverside Park, Allen, CO., T24S, R18E, Sec. 34
Height of structure: 3 m

Humboldt, Allen, CO., T26S, R18E, Sec. 4
Height of structure: 3 m

Barker Dam, 2.5 mi N of Chanute, Neosho, CO., T27S, R18E, Sec. 5
2 mi N and 2 mi E of Chanute, Neosho, CO., T27S, R18E, Sec. 11
1 mi S and 2 mi E of Chanute, Neosho, CO., T27S, R18E, Sec. 27
Height of structures: 1.5 m, 1.5 m, 2.3 m

1.5 mi S of Erie, Neosho, CO., T29S, R20E, Sec. 5
Height of structure: 1.5 m

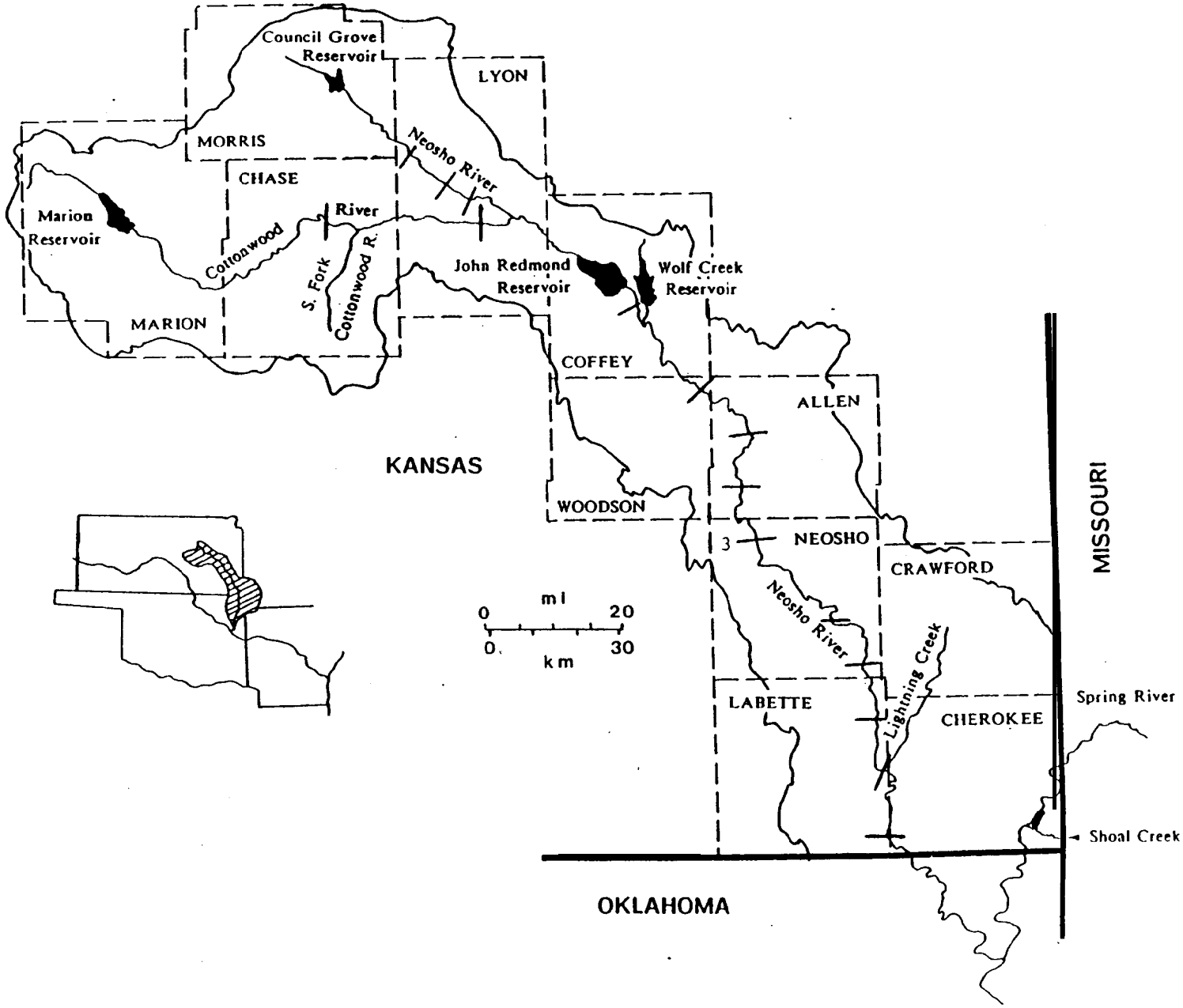
5 mi N and 7 mi E of Parsons, Neosho, CO., T30S, R21E, Sec. 20
Height of structure: 1.8 m

Kansas Ordinance Plant, Labette, CO., T31S, R21E, Sec. 33
Height of structure: 2.4 m

Oswego, Labette, CO., T33S, R21E, Sec. 15
Height of structure: 2.1m

Chetopa/City Park, Labette, CO., T34S, R21E, Sec. 35
Height of structure: 2.4 m

NOTE: Distances were measured from "city centers" as marked on Kansas Department of Transportation General (County) Highway maps.



Approximate locations of smaller dams on the Cottonwood and Neosho rivers.

/ = dam; number indicates more than one structure.

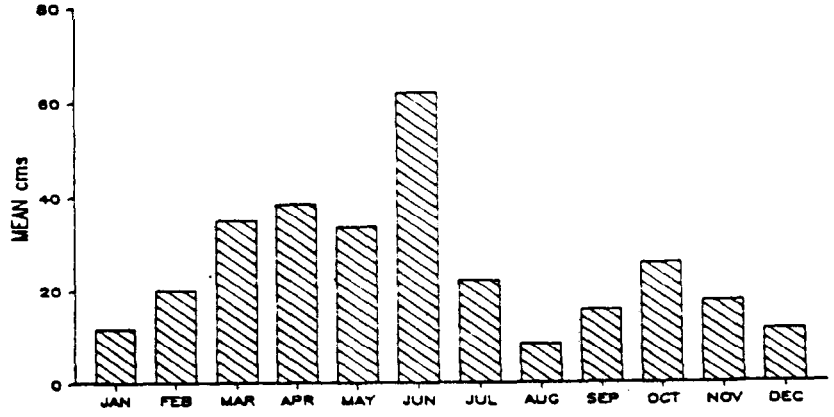
APPENDIX B

Summary of Mean Daily Discharges

The following nine graphs are summaries of the monthly averages of the mean daily discharges at U.S. Geological Survey gaging stations. They illustrate the general flow pattern of the Neosho, Cottonwood, and Spring Rivers in the areas occupied by the Neosho madtom.

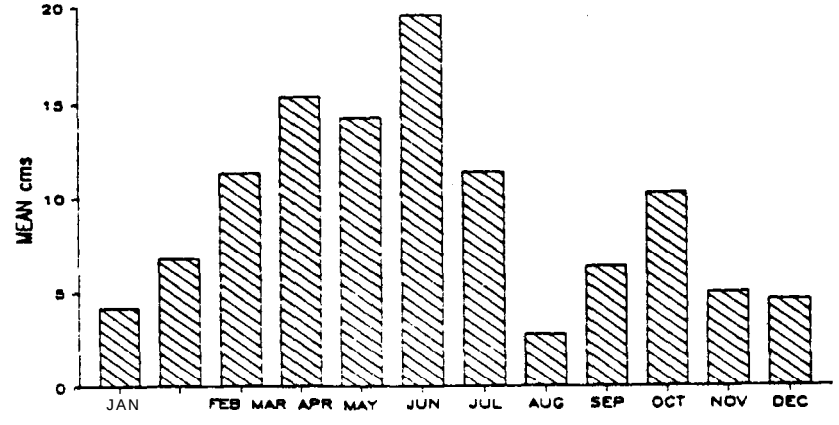
COTTONWOOD RIVER near PLYMOUTH, KANSAS

1963 — Present



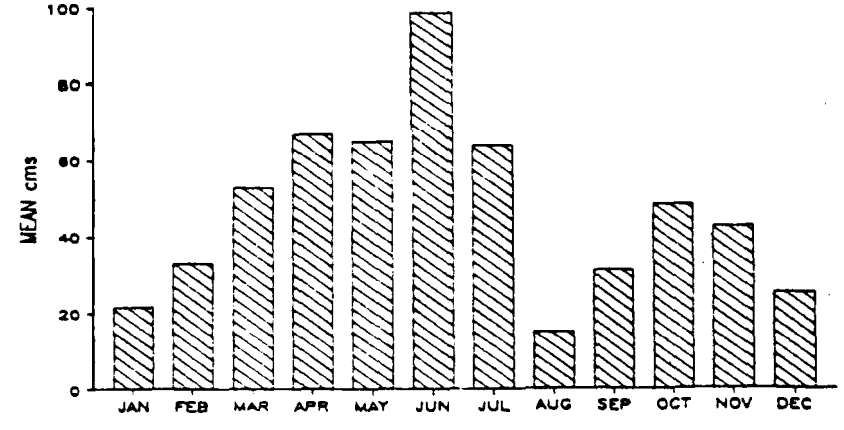
NEOSHO RIVER near AMERICUS. KANSAS

1963 — Present



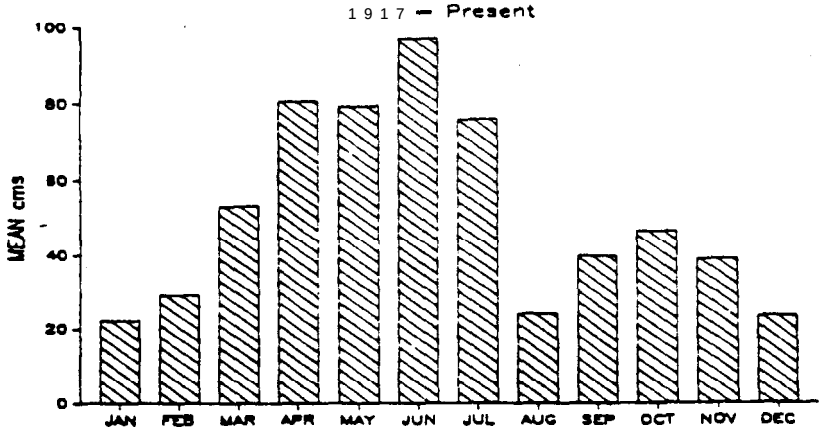
NEOSHO RIVER at BURLINGTON, KANSAS

1961 — Present



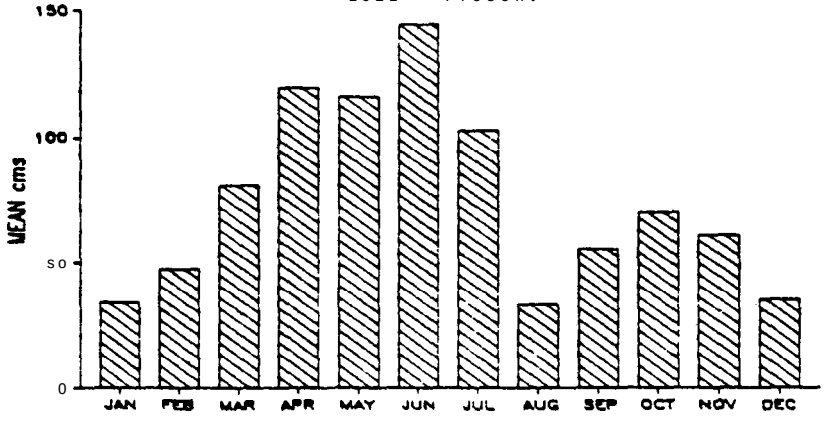
NEOSHO RIVER near IOLA, KANSAS

1917 – Present



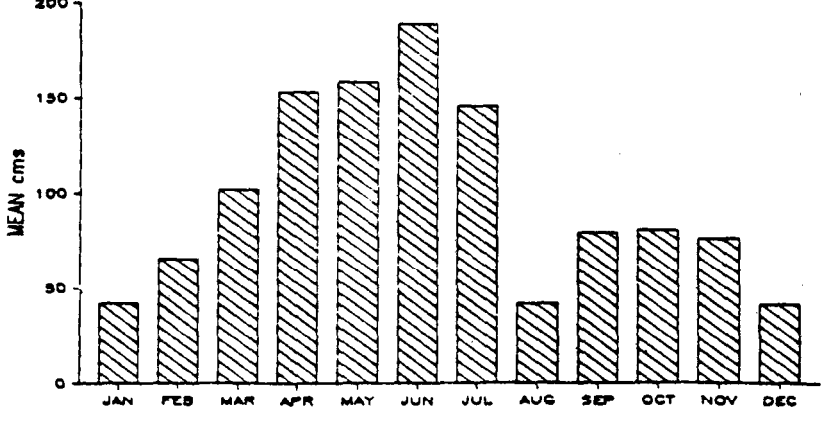
NEOSHO RIVER near PARSONS, KANSAS

1921 – Present



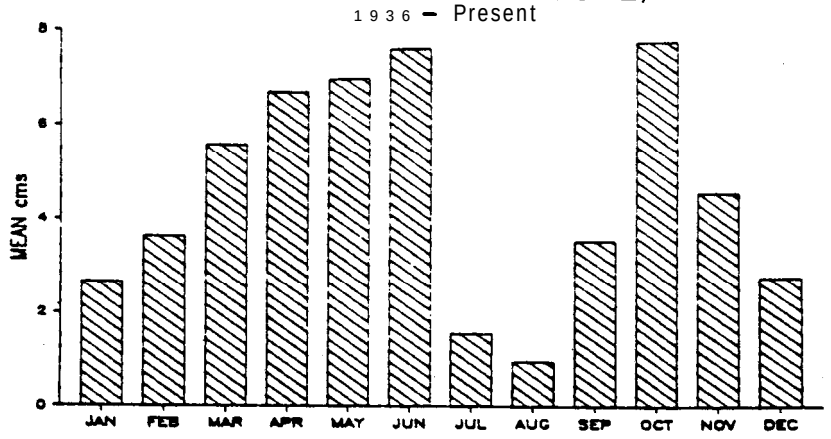
NEOSHO RIVER near COMMERCE, OKLAHOMA

1939 – Present (incomplete)



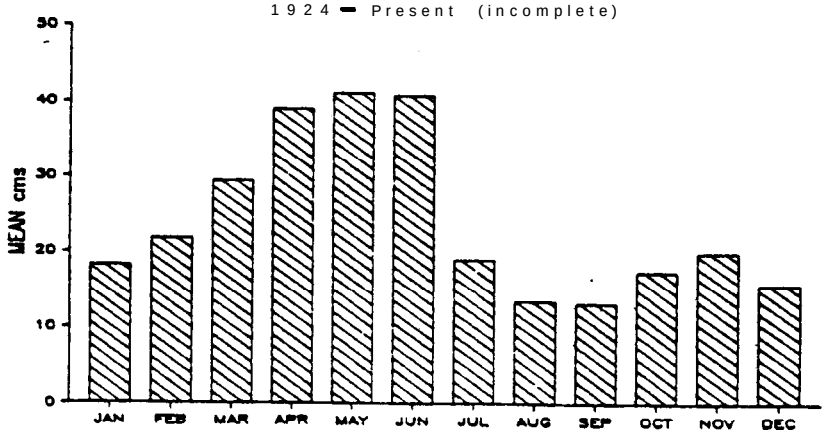
LIGHTNING CREEK near McCUNE, KANSAS

1936 – Present



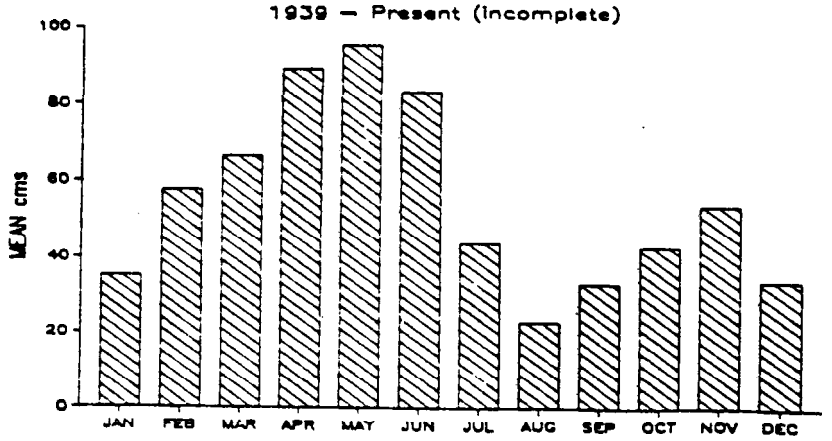
SPRING RIVER near WACO, MISSOURI

1924 – Present (incomplete)



SPRING RIVER near OUAPAW, OKLAHOMA

1939 – Present (Incomplete)



APPENDIX C

This recovery plan was made available to the public for comment as required by the 1988 amendments to the Endangered Species Act of 1973. The public comment period was announced in the Federal Resister (56 F.R. 6678) on February 19, 1991, and closed on April 22, 1991. Over 100 press releases were sent to the print media located in Kansas, Missouri, and Oklahoma.

During the public comment period, 11 letters were received. The comments provided in these letters were considered, and incorporated as appropriate. Comments addressing recovery tasks that are the responsibility of an Agency other than the U.S. Fish and Wildlife Service were sent to that Agency as required by the 1988 amendments to the Act.