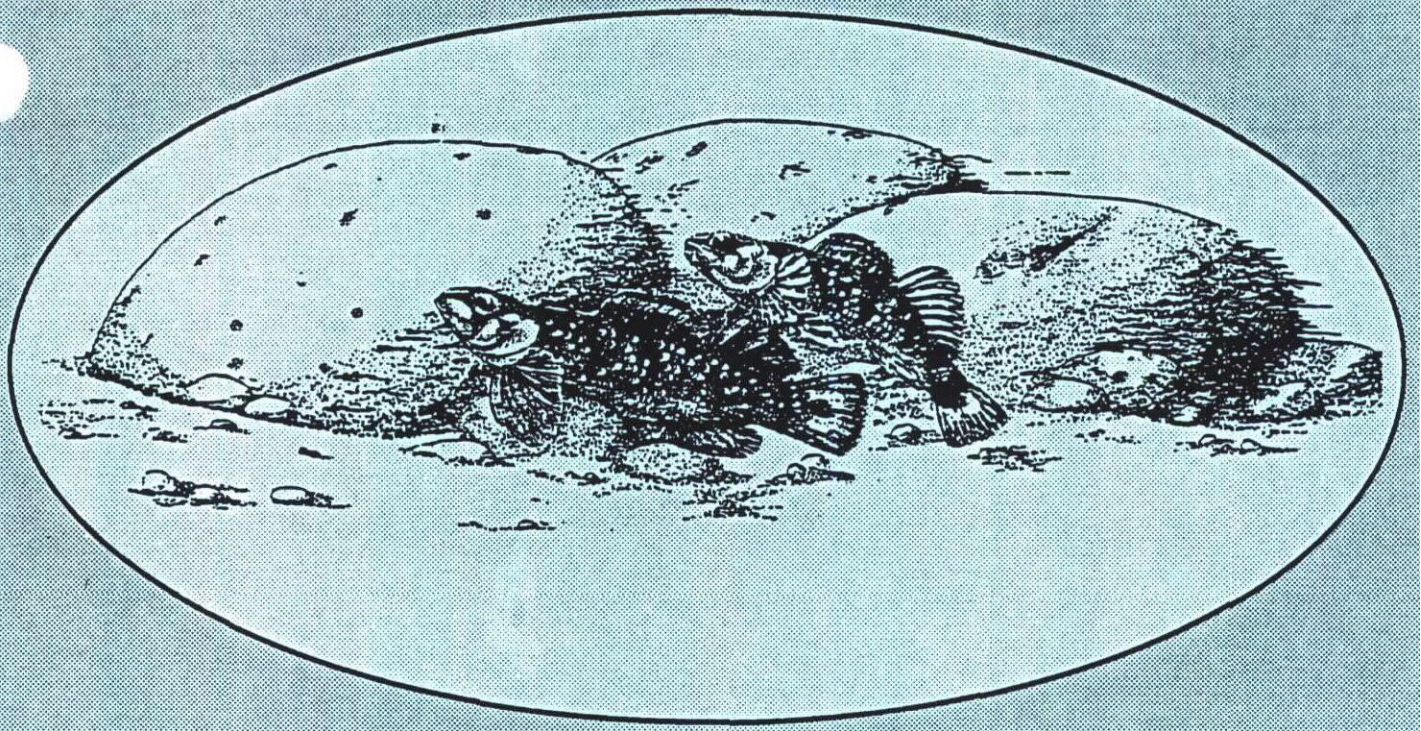
BAYOU DARTER

RECOVERY PLAN



BAYOU DARTER

Etheostoma rubrum

(Revised)

RECOVERY PLAN

(Original Approved: September 8, 1983)

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

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EXECUTIVE SUMMARY

Current Status: The bayou darter is a threatened species which is known only from the Bayou Pierre system of southwestern Mississippi.

Goal: The objective of this plan is to remove the bayou darter from the list of threatened species.

Recovery Criteria: The necessary criteria for delisting the species are:

(1) Evidence of a stable or increasing population over at least a 10-year period in Bayou Pierre and Foster Creek;

(2) Evidence of the continued existence of the bayou darter in White Oak and Turkey Creeks;

(3) Data on the fluvial geomorphic processes operating in the Bayou Pierre system which indicates a trend of no net loss of, or improving, habitat for the species;

(4) An established continuing plan of periodic monitoring of population trends and habitat stability; and

(5) Protection of bayou darter habitat through full implementation of task 4 of this recovery plan.

Actions Needed: To bring about the recovery of this species, it will be necessary to continue population and habitat monitoring programs, identify sources of habitat degradation, and protect darters and their habitat.

Anticipated Date of Recovery: Provided that adequate funds are available to complete the recovery actions listed in the plan, full recovery of the bayou darter can likely be accomplished by 2010.

Total Estimated Cost of Recovery: Implementation of the recovery tasks for which cost estimates have been made total $226,420.00. The cost of tasks accomplished through normal agency operations is not included in this estimate and will increase actual recovery costs for this species.

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I. INTRODUCTION

Background

Etheostoma rubrum (bayou darter) is a threatened species under the Endangered Species Act of 1973, as amended. This determination was made in a final rulemaking published in the Federal Register on September 25, 1975. The species is endemic to the Bayou Pierre and its larger tributaries in Mississippi. The bayou darter was described by Raney and Suttkus (1966).

Description

Etheostoma rubrum is the most diminutive species of the subgenus Nothonotus except for E. tippecanoe (Tippecanoe darter), a species in the Ohio River system. In Bayou Pierre, E. rubrum is most similar to Etheostoma lynceum and is readily distinguished from the other 10 species of Etheostoma known to occur in Bayou Pierre.

Etheostoma rubrum is sexually dimorphic with both sexes having a prominent double basicaudal spot and black subocular bar. The male reaches a larger size and has a narrow, terminal clear area and a subterminal black band of equal width on the caudal fin. The remainder of the caudal fin has a narrow, yellow band with fin rays that are reddish with some yellow. The female has a series of four or five russet or red wavy lines on the caudal fin. Etheostoma lynceum has dark cross bars on the back, dark green blotches or bars on the sides, and the spinous dorsal fin is rust-red at the base. An excellent color photograph of both sexes, taken by Dr. Glenn Clemmer, is contained in Deacon et al. (1979).

Population Status and Distribution

Etheostoma rubrum has been collected only from Bayou Pierre and its tributaries: White Oak Creek, Foster Creek, and Turkey Creek (Figure 1) (Teels et al. 1977; Suttkus and Clemmer 1977; Ross et al. 1989a). The distribution of the bayou darter within its historical range changes as its habitat quantity and quality is altered in response to man's activities in the Bayou Pierre watershed (Suttkus and Clemmer 1977).

Population densities of E. rubrum have been monitored from 1986-88 (Ross et al. 1989b). The density of E. rubrum differed between Bayou Pierre (2.6 fish per square meters (m^2) or 2.17 fish per square yards (yd^2) and Foster Creek (3.4 fish per m^2 or 2.8 fish per yd^2). Only several estimates were obtained for Turkey Creek (0.6 fish per m^2 or 0.50 fish per yd^2). No E. rubrum were collected during this period in White Oak Creek although it has been collected in that tributary. Population density did not differ over the 3 years.

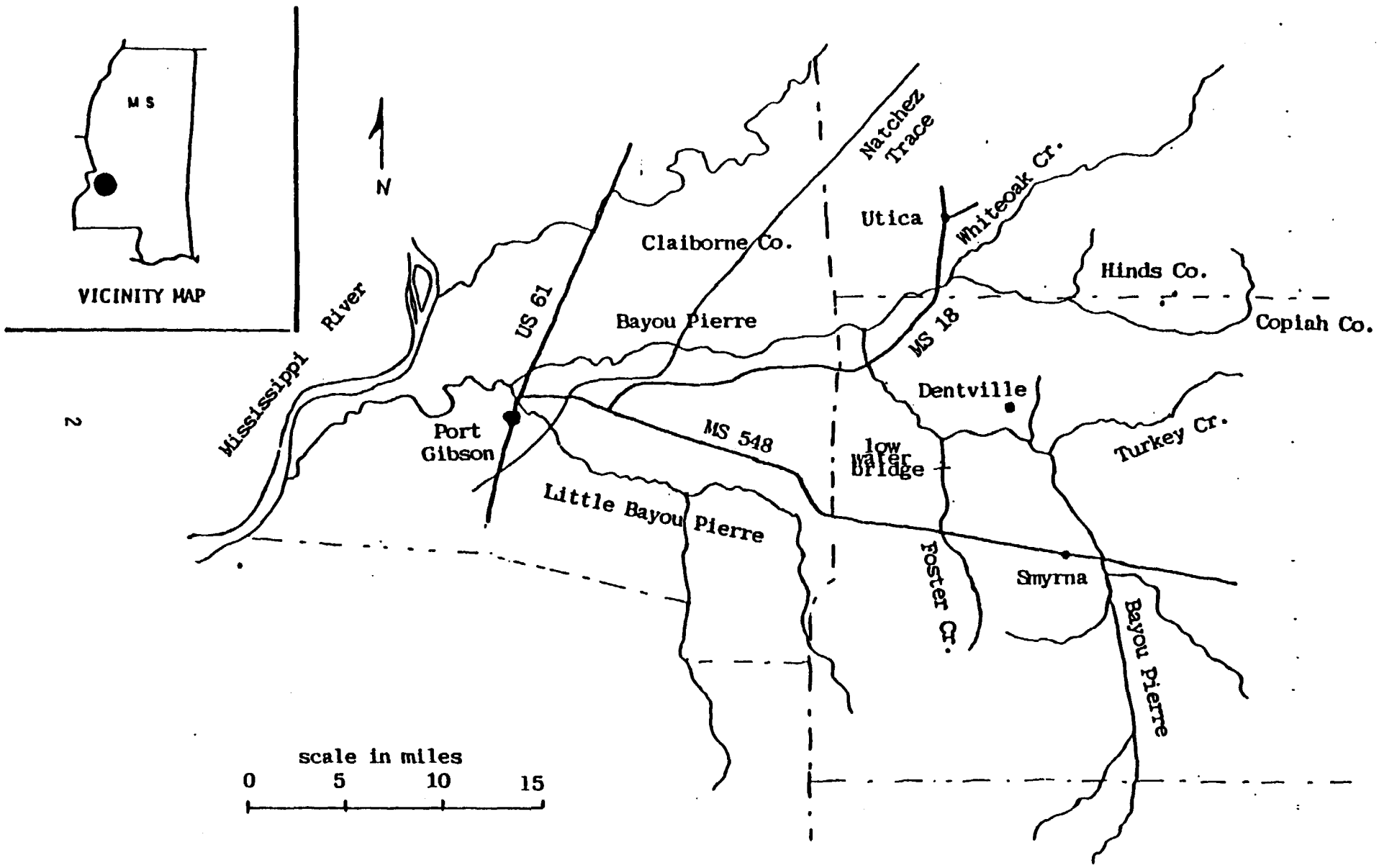

Figure 1. Bayou Pierre River and its White Oak Creek, Foster Creek, and Turkey Creek Tributaries in Mississippi.

Description of The Habitat

The portion of Bayou Pierre System serving as habitat for E. rubrum is a meandering stream with stable gravel riffles or sandstone exposures. The extent and quality of the habitat appears to be related to headcutting. Upstream of the headcutting, very little stream meandering occurs and there is generally a well-developed forest canopy. Silt-laden runoff is not common and the banks tend to narrowly confine the creek (Teels et al. 1977). The upstream distribution of E. rubrum seems to be limited by low water flow during the summer and fall (Ross et al. 1989a,b). Downstream of the headcutting area, stream meandering begins, riffles become numerous and the stream's banks widen considerably. It is in this shallow (less than 15 centimeters or 6 inches deep), meandering section with its riffles and runs and moderate to swift flow that the best E. rubrum habitat occurs (Ross et al. 1989b). No E. rubrum were collected in riffles composed of loose gravel or sand. Occasionally, the species was collected in deeper areas between riffles.

Teels et al. (1977) compared environmental factors within and outside of the E. rubrum range within the Bayou Pierre system. They found that E. rubrum habitat was significantly higher in several parameters including: plankton, stream velocity, specific conductance, dissolved oxygen, and temperature. Data on these and additional parameters were collected by Ross et al. 1989b.

Life History

Reproduction. Ross et al. (1989b) studied the reproductive biology of E. rubrum. Reproductively active females occur from mid-April though mid-August when water temperatures range between 20-30^{0}C (68-86^{0}F). The peak spawning period is from April to late May or early June during a period of rising water temperatures (22-29^{0}C or 72-84^{0}F). Etheostoma rubrum young of the year begin appearing in June.

Reproductively active females averaged 33.6 mm (1.32 in) standard length (SL), while mature males were somewhat larger averaging 36.5 mm SL (1.44 in). Most E. rubrum spawn after their first year (age one+) and do not live beyond age three+. Clutch sizes range from 20-75 ova, with the number increasing as a function of female size. Based on the size classes of ova, a single female likely spawns at least twice per reproductive season.

Growth. Determination of growth rates by Ross et al. (1989b) show that age 1 males averaged 27.5 mm (1.08 in) SL, while age 1 females averaged 28.9 mm (1.14 in). Males showed more rapid growth rates than females during their second year. Average lengths at age 2 were 34.3 mm (1.35 in) for males and 33.8 mm (1.33 in) for females and at age 3 were 42.5 mm (1.67 in) for males and 40.9 mm (1.61 in) for females. Growth of E. rubrum from the prolarval to juvenile stages has not been documented in the field. Ross (in prep.) is gathering laboratory data on growth rates (up to yolk sac absorption) of larval darters.

Food. Based on data from Ross et al. (1989b), these darters feed primarily on midges, blackflies, water mites, caddisflies and mayflies. The mayflies and caddisflies had the greatest importance by weight during the summer and fall. The greatest feeding intensity of E. rubrum occurred in April, before spawning. During this time, blackflies and caddisflies dominated the diet by weight and by number.

Factors Affecting the Species

The major threat facing Etheostoma rubrum is man-induced alteration of its habitat. These geomorphic alterations may be caused by human activities in the immediate vicinity of the habitat, by conditions and activities occurring regionally within the basin, by upstream conditions, or by conditions/activities downstream of the habitat. Often, more than one type of activity or condition will be responsible for the historic alteration and deterioration of fluvial environments. Changes resulting from human activities may not become known until many years after the initiation of the activity. Descriptions (with illustrations) of the dynamic effects of these geomorphic processes on the Bayou Pierre system are given in Hartfield (1988) and Hartfield and Ebert (1986).

Three activities which may adversely impact the bayou darter habitat are considered individually:

1. Floodplain/Channel Modification. Projects such as channelization and impoundment may cause extensive changes in erosion/sedimentation conditions. These changes may be transmitted throughout the basin and when combined with land use practices, may significantly change the fluvial and geomorphic environment of the basin (Whitten and Patrick 1980). Floodplain mining operations usually result in additional sediment loads in nearby channels. Channel dredging for navigation or mining purposes is even more deleterious to the stream. The mining of gravel and sand bars results in the

shortening and straightening of the stream channel, increased channel gradient, and concomitant higher water velocities. This, in turn, results in channel degradation or deepening by erosion, the formation of new knickpoints, and the potential for headcutting. Channel degradation also results in streambanks which are too steep and too high for stability. Such banks are susceptible to collapse, further increasing the sediment load in the stream.

2. Petroleum Exploration and Transportation. In 1982, a well was drilled within 1.6 km (1 mi) of Bayou Pierre upstream of the Turkey Creek confluence. A catch basin dike borders the eastern edge of the stream next to the well. An underground transmission line crosses Bayou Pierre about 0.8 km (0.5 mi) downstream of Turkey Creek.

Most construction activities, particularly those which involve significant earthwork, will result in increased sediment loads in nearby streams during the actual construction, and greater water discharges afterwards. Saltwater intrusion from petroleum exploration wells and petroleum spills from wells and pipelines would adversely influence the darter habitat. A severe spill could remove the darter from the downstream portion of the affected stream.

3. Farming and Silviculture. More than 90 percent of Foster Creek is bordered by timber land. Turkey Creek is wooded with the canopy extending to the water's edge in most areas. In the upper reach, well above the darter habitat, there is some open land, including farms adjacent to the stream. Pasture land extends approximately 1 mile upstream from Bayou Pierre. Over 50 percent of Bayou Pierre and White Oak Creek are bordered by open fields and pastures.

Land use practices affect sediment and/or water discharges to the stream system and, in turn, change erosion/sedimentation patterns within the system. The destruction of riparian vegetation encourages bank collapse, increased turbidity and water temperature.

Land uses that encourage extensive use of fertilizers and pesticides pose the threat of increased nutrient loading and higher levels of toxic chemicals. Use of herbicides for timber management has been observed near Foster Creek.

Recovery Actions Already Accomplished

Ross et al. (1989 a,b) have completed a 1 year study of the distribution, microhabitat use, food habits, and reproductive biology of the darter. This study was funded through the Mississippi Department of Wildlife, Fisheries and Parks; by the State of Mississippi; and, by the U.S. Fish and Wildlife Service.

Etheostoma rubrum receives protection from overcollecting by virtue of being listed as a State Endangered Species under Public Notice Number 2779 of the Mississippi Code of 1972. A permit must be issued by the Department of Wildlife, Fisheries and Parks for collection of E. rubrum.

The darter's immediate habitat receives some protection as it has been designated, under the Surface Mining and Reclamation Act of 1977 (Mississippi Bureau of Geology, Mississippi Department of Environmental Quality) as being unsuitable for surface mining. This protection is not adequate, however, because the actions of county supervisors; mines less than 4 acres; and mines active prior to passage of the Act are exempt from its regulatory provisions.

The Mississippi Landowner Contact Program has registered seven of twelve tracts bordering Foster Creek since the first recovery plan for this species was prepared. The registration agreements provide for a wooded 30.5 m (100 ft) vegetation buffer along the stream. This program is a cooperative effort between the Mississippi Department of Wildlife, Fisheries and Parks and The Nature Conservancy.

II. RECOVERY

A. Recovery Objective

The objective of this plan is to remove E. rubrum from the list of threatened species. The criteria for delisting the species are:

(1) Evidence of a stable or increasing population and habitat over at least a 10-year period in Bayou Pierre and Foster Creek;

(2) Evidence of the continued existence of the bayou darter in White Oak and Turkey Creeks;

(3) Data on the fluvial geomorphic processes operating in the Bayou Pierre system which supports the delisting of the species;

(4) An established continuing plan of periodic monitoring of population trends and habitat stability; and

(5) Protection of E. rubrum habitat through full implementation of task 4.

A reasonable estimate of the time required for recovery actions to be accomplished includes:

A 10-year period to fund and complete the geomorphic, habitat and population studies identified in the Recovery Plan and to implement corrective actions justified by the study results; and

another 10 years to document that the recovery criteria have been satisfactorily met.

The estimated date for recovery completion, based upon the above assumptions, is 2010.

B. Narrative Outline

1. Monitor occupied habitat and population trends. This task will lead to monitoring the quantity of available darter habitat, the density of E. rubrum in those habitats, and the total range of the species. Trends will be monitored by repeating the habitat surveys (Task 1.1) once every 5 years, the population surveys (Task

1.2) once every 2 years and the distribution survey (Task 1.3) once every 5 years. This task will continue through completion of the recovery effort and on a recurring basis after recovery has been achieved.

1.1 Monitor the average area of suitable habitat in Foster Creek and Bayou Pierre. While some E. rubrum habitats are rather stable in location, many areas of suitable habitat vary in size and location on a seasonal basis, especially in areas of active headcutting. Because of this dynamic change, the construction of detailed maps of riffle/run habitats is impractical. Also, many sections of Bayou Pierre lack an obvious pool-riffle morphology. Thus, the general availability of suitable habitat (operationally defined as the habitat used by juvenile and adult E. rubrum) could best be determined by measuring the area of suitable habitat in randomly chosen stream reaches. The sampling effort could be stratified by stream order, so more sampling effort could be allocated to mid-reach streams.

1.2 Monitor population density. The density of E. rubrum (number per m^2) by age class should be determined during summer and fall low flow periods through its currently occupied range at 2-year intervals. Sample sites should be randomly chosen from all sites currently occupied E. rubrum. Sampling effort should be stratified by water body, based on the relative length of stream reaches in which E. rubrum are known to occur. Density can be estimated with a depletion statistic (e.g. Cowx 1983) based on the decline in the catch, per standardized sampling effort, within an enclosed area. An estimate of E. rubrum abundance in Bayou Pierre and Foster Creek can be obtained by multiplying the average fish density by the average area of suitable habitat per 100 m (109.4 yd) of stream reach and then multiplying this by the total stream length known to be occupied by E. rubrum.

1.3 Monitor distribution. Significant changes in distribution observed during the conduct of task 1.2 should be noted and efforts made to identify possible causes of the changes.

2. Obtain additional biological information essential to management of the species. Studies of microhabitat use, degree and direction of migrations and downstream drift

will be necessary to allow adequate protection of the species.

2.1 Sample microhabitats for presence of larval and juvenile E. rubrum. Very little is known about the habitat requirements of larval and post-larval stages of E. rubrum. Yet, as has been recognized by many fish ecologists, events occurring during the egg to post-larval stages may largely control subsequent population success.

During the May-July reproductive period, a complete range of microhabitats should be sampled using collecting gear appropriate for capturing larval fishes. The sampling should be concentrated on the areas of Bayou Pierre and Foster Creek known to support reproductively mature E. rubrum.

2.2 Determine the degree and direction of movement and home range of all sizes of E. rubrum in Bayou Pierre and Foster Creek. Home range and movement have not been studied for E. rubrum. Because of the extreme habitat specificity, dispersal of darters between streams or even within a stream system appears to be quite limited. However, preliminary observations (Ross et al. 1989b) suggest that a downstream movement of juvenile E. rubrum may be occurring. Catches of E. rubrum at downstream sites in Bayou Pierre (for example, areas in Claiborne County) are greatest in late summer and the majority of individuals are young-of-the-year. Adult E. rubrum are uncommon in these downstream areas suggesting either a loss of adults or, more likely, downstream drift of larval fish. Long-term management of E. rubrum may require restocking of individuals into streams or areas of streams where they might have been extirpated by man-caused events. It is very important, to understand the mechanisms and potential of natural dispersal before any attempts at restocking take place.

3. Identify factors causing degradation of the E. rubrum habitat. The purpose of this task should be to ascertain those factors which may degrade the darter habitat. This effort will focus upon the monitoring of water quality, identification of herbicides and pesticides used within the watershed which threaten the darter and its habitat, and identification of sources of allochthonous materials. The cause, impacts and

remedies to headcutting are a major concern (Task 3.3.2).

3.1 Monitor water quality. At numerous localities throughout the stream system, Ross et al. (1989b) measured dissolved oxygen, temperature, conductivity, turbidity, and pH. Streams in the Bayou Pierre system generally had acceptable water quality. There were no apparent differences in water quality between those collections with and without bayou darters. This effort will be repeated at 5-year intervals to determine if water quality has declined.

3.2 Investigate the potential impacts of toxic contaminants to E. rubrum population. Potential adverse effects of land use practices in the Bayou Pierre watershed are not known. This must be understood to allow assessment of the significant factors affecting the species.

3.2.1 Determine if toxic contaminants are present in the Bayou Pierre watershed. Through a rapid bioassessment procedure (Microtox), screen sites in the Bayou Pierre watershed to determine if toxic contaminants exist.

3.2.2 Conduct food chain toxicity studies. If toxic contaminants exist in the watershed, perform additional bioassay procedures using surrogate species to determine potential impacts on various components of the food chain.

3.2.3 Determine specific toxic chemicals in food chain. If toxic contaminants exist in the food chain, collect sediments/soils/biota and perform residue analysis to determine compounds responsible for toxicity.

3.3 Identify the sources of allochthonous materials adversely affecting the Bayou Pierre system. Man-caused silt deposition has been implicated by many investigators

as a threat to the continued survival of E. rubrum. A plan will be developed to identify the sources of high turbidity, silt, toxic contaminants, and other materials shown to be degrading E. rubrum habitat.

3.3.1 Inspect habitat for sources of degradation. The Mississippi Research and Development Center, under a contract with the Mississippi Department of Wildlife, Fisheries and Parks, designed a geographic database to produce a current picture of land and water use in the Bayou Pierre drainage system. The database places an emphasis on real or potential habitat degradation (Davis and Smith 1987). A set of maps depicting various combinations of variables in the geographic database was prepared. A comprehensive set of tabular data was also submitted to quantify the database and to provide information on the current condition of the drainage system. This effort should be repeated every 5 years.

3.3.2 Identify the fluvial geomorphic processes operating in the Bayou Pierre system. Field evidence indicates that human-induced geomorphic processes, including headcutting, has occurred within this system and has resulted in accelerated erosion and sedimentation. Historic aerial photography and topographic maps will be examined to identify the following: historic geomorphic processes occurring in the system, possible causes of these processes in terms of human activities and natural phenomena, the relations between the processes and regional/site geology, and the dynamics of these processes. These

studies would benefit from counsel and coordination with the Corps of Engineers, since the geomorphic processes operating in the Bayou Pierre system may be affected by fluvial conditions and processes downstream in the Mississippi River. Also, the Bureau of Geology, Mississippi Department of Environmental Quality, should be consulted in regard to the history of surface mining of bar gravels on these streams.

4. Protect darters and their habitat. Steps must be taken to eliminate or reduce the threat of habitat degradation noted in Task 3.

   4.1 Implement measures to minimize the adverse impacts of further headcutting. Working with the Corps of Engineers, identify alternative solutions to this problem and take corrective action as appropriate.

   4.2 Implement additional conservation measures to assure habitat stability. The following measures should be utilized to ensure the conservation of bayou darter habitat.

      4.2.1 Establish and implement a plan with the Soil Conservation Service to assist landowners in stabilizing banks and reducing sediment loading. Technology is available to prevent erosion, loss of valuable soils, and to reduce agricultural land loss from excessive meandering of the streams. A plan is needed to advise pasture owners, farmers and other agricultural interests and suggest before-the-fact action to minimize erosion.

      4.2.2 Create and maintain buffer zones. Establish and implement a plan with the U.S. Forest Service and the Mississippi Forestry Commission to encourage wooded buffer zones. Minimizing adverse impacts of allochthonous materials requires many innovative techniques. Forested areas, properly managed, are the most stable alternative available. Buffer zones are needed to maintain the physical requirements of E. rubrum habitat and to

reduce erosion and the resulting silt load in the creeks.

4.2.2.1 Establish wooded buffer zones along Bayou Pierre, Foster Creek, Turkey Creek. Such can be accomplished through development of cooperative agreements with landowners, purchase of easements, or acquisition of land. Native vegetation should be maintained or restored by allowing natural succession in a minimum of a 30.5m (100 ft) wide buffer zone along both banks of the mainstream of these creeks.

4.2.2.2 Implement soil conservation measures to stabilize Bayou Pierre, Foster Creek, and Turkey Creek watershed. Through cooperative agreements with landowners, assure that contour planting and soil-holding crops be utilized in a 0.8 km (0.5 mi) wide buffer (or to the outer edge of the watershed, whichever is less). This measure is necessary to reduce silt load, resulting from existing agricultural practices, in the most vulnerable darter habitat.

4.2.2.3 Identify bayou darter habitat and drainages into it as sensitive to survafe mining and therefore unsuitable for surface mining. All areas of bayou darter habitat and portions of the Bayou Pierre watershed that drain into them should be delineated as sensitive to surface mining and submitted to the Mississippi Bureau of Geology. These areas will then be defined as unsuitable for surface mining by the Bureau and given special consideration when applications for surface mining are received.

4.2.3 Ensure that all sand and gravel operations within bayou darter habitat be conducted according to EPA standards, Bureau of Pollution Control standards, and the Mississippi Surface Mining Act of 1977. A plan should be developed to monitor sand and gravel operations in the Bayou Pierre system. Steps should be taken to achieve compliance with EPA and State standards as specified in Mississippi Department of Environmental Quality; Water Quality Criteria for Intra-State, Interstate and Coastal Waters (adopted February 25, 1982), and Mississippi Surface Mining and Reclamation Act standards.

4.2.4 Negotiate a cooperative agreement with County board of supervisors and State highway departments to reduce erosion. A cooperative agreement should be obtained with County and State highway departments to ensure that road maintenance measures will be established and utilized to reduce direct erosion of embankments into the drainage system. This must include all maintenance efforts with a potential of increasing silt loading in E. rubrum habitat.

4.2.5 Investigate existing legislation and develop necessary legislation for buffer zones and easements. Unknown provisions within existing laws may allow and even encourage participation in the special plans drawn up under task 4.2.1 through 4.2.2.2. One such example is Mississippi Natural Heritage Act of 1978. This law establishes at least two procedures by which landowners may protect significant natural areas without giving up title to their land. A listing and knowledge of other applicable statutes would greatly enhance a successful quest for easing the threat immediately along the watercourse. If necessary laws do not now exist, then they should be drawn up and submitted to the appropriate legislative body.

4.3 Develop and implement specific protection measures for the most essential E. rubrum habitat. Funds available through the Land and Water Conservation Fund, the Mississippi Wildlife Heritage Committee, and The Nature Conservancy are potential sources of

revenue to achieve responsible stewardship. These funds could possibly be used for purchasing habitat and subsidizing the proper management of the Bayou Pierre watershed. Emphasis should be placed upon no-penalty conservation efforts. Encouraging a soil bank type of philosophy by subsidy would eliminate considerable bank erosion problems in the lower Bayou Pierre area.

4.4 Prepare for an emergency translocation effort. The establishment of new E. rubrum populations in currently unoccupied habitat will be utilized as a part of this recovery effort only if a major perturbation makes such an action necessary to ensure the continued survival of the species.

4.4.1 Identify potential transplant sites. Information obtained in the implementation of task 1 and 2 above and Ross et al. (1989a, 1989b) will be used to identify potential transplant sites in nearby streams currently lacking E. rubrum populations. A statistical comparison of habitat parameters will be made between known occupied sites and these potential sites. This will be done in an effort to determine why a particular unoccupied habitat is not utilized. The treatment of the data will be such that a method of quantifying detrimental and limiting factors is developed. The outcome of this task will be a list of acceptable translocation sites.

4.4.2 Prepare a plan for a possible emergency translocation effort. The purpose of this task is to plan the effort to establish the new populations. This will include: (a) a detailed transportation and release plan, and (b) a procedure to minimize stress.

4.5 Assure full implementation of the EPA pesticide labeling program in the Bayou Pierre watershed. This program has the potential for positive benefits to the darter by limiting pesticide exposure.

4.6 Establish a publicity program to encourage preservation of the Bayou Pierre system. A broad spectrum appeal to preserve the Bayou Pierre system as a scenic and natural treasure needs to be planned. A means of showing the aesthetic value of

the stream is needed. The concept should be one of a holistic approach, not solely the preservation of a single species.

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III. IMPLEMENTATION SCHEDULE

The following Implementation Schedule outlines actions and costs for the Etheostoma rubrum recovery program. It is a guide for meeting the objectives elaborated in Part II of this plan. This schedule indicates the general category for implementations, recovery plan tasks, corresponding outline numbers, task priorities, duration of tasks, (continuous denotes a task that should continue on an annual basis), which agencies are responsible to perform these tasks, and lastly, estimated costs for U.S. Fish and Wildlife Service tasks. These actions, when accomplished, should bring about the recovery of Etheostoma rubrum and protect its habitat. The following key is for the implementation schedule, columns 1 & 4.

General Category (Column 1):

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management technique
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contamination
13. Reintroduction
14. Other information

Acquisition - A

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

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Recovery Action Priorities (Column 4):

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

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.

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

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Duration	Region	Division	Other	Cost Estimates	Comments/ Notes
R2	Monitor average habitat area	1.1	2	Less than 1 year	4	FWE	MDWFP	$16,300	Repeat once every 5 years.
R1	Monitor population density	1.2	2	Less than 1 year	4	FWE	MDWFP	6,700	Repeat once every 5 years.
R6	Monitor distribution	1.3	2	Less than 1 year	4	FWE	MDWFP		Normal operations cost.
R3	Sample microhabitats	2.1	3	Less than 1 year	4	FWE	MDWFP	19,900	
R8	Study movement and home range	2.2	3	1 year	4	FWE	MDWFP	15,000	
R12	Monitor water quality	3.1	2	Less than 1 year	4	FWE	MDWFP MBPC	4,830	Repeat every 5 years.
R12	Determine presence of toxins in watershed	3.2.1	2	Less than 1 year	4	FWE	MDWFP MBPC	8,000	
R12	Conduct food chain toxicity studies	3.2.2	2	Less than 1 year	4	FWE	MDWFP	8,000	
R12	Determine specific toxicants	3.2.3	2	Less than 1 year	4	FWE	MDWFP	10,000	
H3 R2	Identify sources of degradation	3.3.1	3	1 year	4	FWE	MDWFP	6,000	Repeat once every 5 years.
R2 H3	Study fluvial geomorphic processes	3.3.2	2	1 year	4	FWE	MDWFP USACE MBG MDEQ	29,000	

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Duration	Region	Division	Other	Cost Estimates	Comments/ Notes
M3	Prevent further headcutting	4.1	2	Continuous	4	FWE	NDWFP USACE		Costs to be determined.
M3	Establish and implement SCS plan to reduce sediment loading	4.2.1	3	Continuous	4	FWE	SCS		Normal operations cost.
M3	Establish wooded buffer zones	4.2.2.1	2	Continuous	4	FWE	NDWFP FHC		Normal operations cost.
M3	Implement soil conservation measures	4.2.2.2	3	Continuous	4	FWE	NDWFP SCS		Normal operations cost.
M3	Identify drainage areas	4.2.2.3	3	Continuous	4	FWE	NDWFP SCS		Normal operations cost.
03 M3	Ensure sand and gravel operations comply with State and Federal regulations	4.2.3	3	Continuous	4	FWE	NDWFP EPA USACE NDG NDEQ NDPC		Normal operations cost.
M3	Obtain cooperative agreement to reduce erosion from highways	4.2.4	3	Continuous	4	FWE	NDWFP DSCC DSLC DSCLC		Normal operations cost.
M3	Legislation for buffer zones and easements	4.2.5	3	Indefinite	4	FWE	NDWFP		Normal operations cost.
M3	Protection measures for essential darter habitat	4.3	3		4	FWE	NDWFP		Costs to be determined.
M2	Plan transplant effort	4.4	3	1 year	4	FWE	NDWFP	$1,200	

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Duration	Region	Division	Other	Cost Estimates	Comments/ Notes
03	Assure full implementation of EPA pesticide labeling program in the watershed.	4.5	2	Continuous	4	FWE	EPA MBPC		Normal operations cost.
01	Publicity program for preservation of the Bayou Pierre system	4.6	3	Indefinite	4	FWE	MDWFP		Normal operations cost.

List of Abbreviations

Fish and Wildlife Enhancement - FWE
Mississippi Department of Wildlife, Fisheries and Parks - MDWFP
Soil Conservation Service - SCS
The Nature Conservancy - TNC
Board of Supervisors, Copiah County - BSCC
Board of Supervisors, Lincoln County - BSLC
Board of Supervisors, Claiborne County - BSCLC
Environmental Protection Agency - EPA
U.S. Army Corps of Engineers - USACE
Mississippi Bureau of Geology - MBG
Mississippi Department of Environmental Quality - MDEQ
Mississippi Bureau of Pollution Control - MBPC

APPENDIX 1.

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