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Recovery Plan for Five Tombigbee River Mussels

Curtus' Pearly Mussel (Pleurobema curtum)
Marshall's Pearly Mussel (Pleurobema marshalli)
Judge Tait's Mussel (Pleurobema taitianum)
Penitent Mussel (Epioblasma penita)
Stirrup Shell (Quadrula stapes)

Five Tombigbee River Mussels

Recovery Plan

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Southeast Region
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Executive Summary

Current Status: The range of each of the five species has been reduced to a short stretch of the Tombigbee River and/or a tributary. A survey in 1988 did not find Pleurobema marshalli in the only known habitat that remains.

Goal: Protection of existing populations appears to be the only feasible possibility.

Recovery Criteria: The recovery of any of these species, to a degree that would permit down-listing to threatened, is unlikely due to their few numbers and lack of suitable habitat within their historic range. Protection of existing populations will require protection of the Buttahatchie River (70 RM), the Sipsey River (30 RM), the East Fork Tombigbee River (5 mile stretch), and Gainesville bendway of the Tombigbee River (8 RM). Section 7 of the Endangered Species Act is providing protection on the East Fork. Under Section 6 funding, the Mississippi Department of Wildlife Conservation is conducting status surveys. Protection/enforcement must ensure that no habitat is lost.

Action Needed:
(1) Protect the known habitat
(2) Determine habitat requirements and management needs
(3) Implement management needs
(4) Survey populations to determine trends

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I. INTRODUCTION

Background

The Tombigbee River freshwater mussel fauna once consisted of more than 40 species (Williams 1982). Construction of the Tennessee-Tombigbee Waterway adversely impacted some of these species, as evidenced by surveys conducted by the U.S. Fish and Wildlife Service (Service), the Tennessee Valley Authority, the Mobile District Corps of Engineers, and others. On April 7, 1987, the Service determined the Curtus' mussel, Marshall's mussel, Judge Tait's mussel, penitent mussel, and the stirrup shell, to be endangered species.

The Tombigbee River is the major western tributary of the Mobile Basin with an origin in northeast Mississippi. It is considered divided into upper and lower sections at Demopolis, Alabama (Williams 1982). The upper Tombigbee River beginning near Gainesville, Alabama, was characterized by an increasing number of sand and gravel shoals and decreasing channel size. Construction of the Tennessee-Tombigbee Waterway (Waterway) was completed in 1984 and drastically modified the upper Tombigbee River from a riverine to a largely impounded ecosystem from Town Creek near Amory, Mississippi, downstream.

Construction of the Tennessee-Tombigbee Waterway was accomplished in 1984 by dredging portions of the Tombigbee River to form a navigation channel, by cutting off bendways to straighten the channel, by constructing dams and by cutting a canal to the Tennessee River for barge access and to provide water. This resulted in a series of impoundments that inundated much of the known remaining riverine mussel habitat or left them in several bendways. The accumulation of sediment in these bendways has eliminated them as potential riverine mussel habitat, except for Gainesville bendway. Recent surveys of this bendway indicate the lower half of it has heavy sedimentation. The reach above the confluence of the Noxubee River is still relatively sediment free with a sand and gravel substrate. However, water depth in Gainesville bendway has increased (Paul Yokley, University of North Alabama, pers. comm. 1987) and water flows have decreased as a result of the construction (Yokley 1987).

Description

Curtus' mussel, Pleurobema curtum, was originally described by Lea in 1859 as Unio curtus. Synonyms include Margaron (Unio) curtus by Lea in 1870, as Pleurobema curta by Simpson in 1900, Pleurobema curtum (Lea) by Simpson in 1914, and Obovaria (Pseudoon) curta (Lea) by Frierson in 1927 (Stansbery 1983a). Curtus' mussel is a bivalve mollusk that attains a normal adult size of 50 millimeters (mm) or 2 inches (in) long, 35 mm (1.4 in) high, and 30 mm (1.2 in) wide. The shell varies from green in young shells to a dark greenish-black in older shells. The shell is subtriangular, inflated in front, with a bluish-white, iridescent, thin nacre (Simpson 1914). The shell has near-terminal, prominent umbos. It is elongated posteriorly, with complete heavy hinge dentition (Stansbery 1983a). Specimens of Pleurobema curtum and Obovaria jacksoniana may have a superficial resemblance, presenting a problem of identification rather than one of taxonomy. Females of P. curtum have a thin, sharp, ventral margin on the

gravid gill, while O. jacksoniana has a thick, pad-like and round margin on the gravid gill. The shell of female P. curtum is tapered to a round point posteriorly, while the female O. jacksoniana is truncate. Male P. curtum have dark greenish-black shells with small tapered umbos, while male O. jacksoniana have brownish-black shells with medium to full rounded umbos (Stansbery 1983a). It is further separated from similar genera by the lack of colored ova and the lack of shell sculpture.

Marshall's mussel, Pleurobema marshalli, was described by Frierson in 1927 from specimens collected in the Tombigbee River (Stansbery 1983b). Synonyms for this species have not been published. Marshall's mussel is a bivalve mollusk with adults about 60 mm (2.4 in) long, 50 mm (2 in) high, and 30 mm (1.2 in) wide. This shell has a shallow umbonal cavity, a rounded sub-ovate or obliquely elliptical outline that is elongated posteriorly, nearly terminal beaks, and very low pustules or welts on the postventral surface. The nacre is white (Stansbery 1983b).

Judge Tait's mussel, Pleurobema taitianum, was described by Lea as Unio taitianus in 1834 from the Alabama River (Stansbery 1983c). Other synonyms are Margarita taitianus by Lea in 1836, Margaron taitianus by Lea in 1852, Pleurobema taitiana by Simpson in 1900, P. tombigbeanum by Frierson in 1908, and P. taitianum by Simpson in 1914 (Stansbery 1983c). Judge Tait's mussel is a bivalve mollusk with an average adult size of about 50 mm (2 in) long, 45 mm (1.8 in) high, and 30 mm (1.2 in) wide. The shell is brown to brownish-black, obliquely triangular, and inflated, with narrowly pointed beaks directed forward, a very shallow but distinct furrow, pink-tinted nacre, and shallow beak cavities (Stansbery 1983c, Simpson 1914). P. taitianum is very similar to P. rubrum, but differs in being less obtusely triangulate in outline and more equilateral in shape. In P. taitianum, the umbos and furrow is less prominent and the umbonal cavity is very shallow, relative to P. rubrum (Stansbery 1983c).

The penitent mussel, Epioblasma penita, was described by Conrad in 1834 as Unio penitus from the Alabama River (Stansbery 1983d). Other synonyms include Margarita (Unio) penitus by Lea in 1836, Margaron (Unio) penitus by Lea 1852, Truncilla penita by Simpson in 1900, Dysnomia penita by Frierson in 1927, Epioblasma penita by Stansbery in 1976, and Plagiola penita by Johnson in 1978 (Stansbery 1983d). The penitent mussel is a bivalve mollusk with adults about 55 mm (2.2 in) long, 40 mm (1.6 in) high, and 34 mm (1.4 in) wide. The shell is yellowish, greenish-yellow, or tawny, sometimes with darker dots; is rhomboid with irregular growth lines and a radially sculptured posterior (Simpson 1914). The umbos are flattened with the slope angulated; the beaks are prominent and rounded; the posterior margin flattened with a broad posterior ridge; the ligament is very short; the posterior muscular scar is very large and deep; and the nacre is white with iridescence in the spacious umbonal cavity (Conrad 1834). The species is sexually dimorphic with the posterior shell of the female expanded. The posterior margin in females is a diagonal straight line as opposed to the rounded or constricted margin of similar species (Stansbery 1983d).

The stirrup shell, Quadrula stapes, was described as Unio stapes by Lea in 1831, from the Alabama River (Stansbery 1981). Other synonyms are

Margarita (Unio) stapes by Lea in 1836, Margaron (Unio) stapes by Lea in 1852, Quadrula stapes by Simpson in 1900, and according to Stansbery (1981) Orthonymus stapes by Haas in 1969. The stirrup shell is a bivalve mollusk with adults about 55 mm (2.2 in) long, 50 mm (2 in) high, and 30 mm (1.4 in) wide. The shell is yellowish-green, with the green zigzag markings of young individuals becoming brown with age. It is irregularly quadrate, with a sharp posterior ridge, posteriorly truncated, tubercled, and has a silvery white nacre that is thinner and iridescent behind (Simpson 1914). The stirrup shell differs from other closely related species by the presence of a very sharp posterior ridge subtending a narrow posterior slope that extends from the umbo to the posterior extremity of the shell. The umbo is located centrally to scarcely anterior on a shell that is broadly rounded, anteriorly and ventrally, with a narrow, rounded point posteriorly. No other member of the genus is so sharply ridged and narrowly truncated posteriorly (Stansbery 1981).

This recovery plan will use the names as listed in the Federal Register.

Distribution

Historical: Curtus' mussel is historically known from the Tombigbee River near Pickensville, Alabama, and the East Fork Tombigbee River downstream of its confluence with Bull Mountain Creek (Stansbery 1983a). A single record from the Big Black River, Mississippi, is believed incorrect. This is likely an error in transferring collection labels. Recent searches of the Big Black River did not find Curtus' mussel (Hartfield and Rummel 1985).

Marshall's mussel is historically known from the Tombigbee River from just above Tibbee Creek near Columbus, Mississippi, downstream to Epes, Alabama (Stansbery 1983b). Numerous searches of other Gulf Coast rivers and Tombigbee River tributaries did not collect this species.

Judge Tait's mussel was historically known from the Tombigbee River between Columbus, Mississippi, and Demopolis, Alabama; the Alabama River at Claiborne and Selma, Alabama; the lower Cahaba River, Alabama; possibly the Coosa River, Alabama (Williams 1982, Stansbery 1983c); the East Fork Tombigbee above Amory, Mississippi; and the Buttahatchie River in Mississippi (Schultz 1981).

The penitent mussel is historically known from the Tombigbee River from the East Fork downstream to Epes, Alabama; the East Fork Tombigbee River, Mississippi; the Alabama River at Claiborne and Selma, Alabama; the Cahaba River below Centreville, Alabama; and the Coosa River in Alabama and Georgia (Stansbery 1983d, Williams 1982). Live specimens were also collected from a Tombigbee River tributary, the Buttahatchie River in Alabama and Mississippi (Yokley 1978, Schultz 1981).

The stirrup shell was historically found in the Tombigbee River from Columbus, Mississippi, downstream to Epes, Alabama; the Black Warrior River, Alabama; and in the Alabama River (Stansbery 1981, Williams 1982). Recent surveys have found fresh dead specimens near the mouth of the Sipsey River, a tributary to the Tombigbee River in Alabama.

Present: The present range of all five of these species is largely limited to that portion of historic habitat that has not been modified (Figure 1). The last comprehensive search of the Tombigbee River drainage was conducted by Dr. James D. Williams and others in the early 1970s. Since that time, Yokley (1978) has surveyed the Buttahatchie and Sipsey Rivers where he found the penitent mussel and stirrup shell, respectively. A 1984 survey of Tombigbee River tributaries and the Gainesville bendway by Service biologists and Paul Hartfield, Mississippi Department of Wildlife Conservation, found shells of Marshall's mussel, Judge Tait's mussel, the penitent mussel and the stirrup shell. At the time of listing, it was believed that one or more of these species existed in the East Fork, Gainesville bendway of the Tombigbee River or the Buttahatchie and Sipsey Rivers. Recent surveys have cast doubt on the continued existence of any of these species in the East Fork and in Gainesville bendway (Hartfield and Jones 1989a, 1989b). The diversion of flood flows from the eastern tributaries of the East Fork, especially Bull Mountain Creek, combined with less than average rainfall occurring at the time the Waterway was completed appear to have contributed to a significant amount of sedimentation in the East Fork downstream of Mill Creek. None of the three species that were thought to exist in the East Fork were found alive during surveys in 1987 and 1988. One fresh dead penitent mussel was found in 1987 (Hartfield and Jones 1989a) and three fresh dead Curtus' mussels were found in 1989 (Paul Hartfield pers. comm. 1989).

The water level in Gainesville bendway is 30-61 centimeters (cm) or 2 to 3 feet (ft) higher than it was before the Waterway and the water flow rates have decreased (Yokley 1987 and Hartfield and Jones 1989b). A survey in 1988 did not find any of the four listed species that were expected to exist in this area (Hartfield and Jones 1989b). The habitat below the confluence of the Noxubee River has a heavy layer of sediment, while that above this point remains relatively free of sediment. This area continues to receive the normal flow of the river except during lockage when there is a reverse flow effect.

In 1987, a survey of the lower Buttahatchie River found the penitent mussel and Judge Tait's mussel alive on gravel shoals (Paul Hartfield pers. comm. 1987). The Sipsey River has not been extensively surveyed in recent years. Of the five species, only the stirrup shell and Judge Tait's mussel have been recorded from the Sipsey River.

Ecology and Life History

The reproductive cycle of freshwater mussels is similar among all species. During the spawning period, males discharge sperm into the water column, and the sperm are taken in by females during siphoning. Eggs are fertilized in the suprabranchial cavity or gills, which also serve as marsupia for larval development to mature glochidia. Members of the Unionidae exhibit two reproductive modes based on the length of time glochidia are retained in the gills of females. Fertilization occurs in the spring in tachytictic mussels (short-term breeders) and glochidia are released during spring and summer. In bradytictic species (long-term

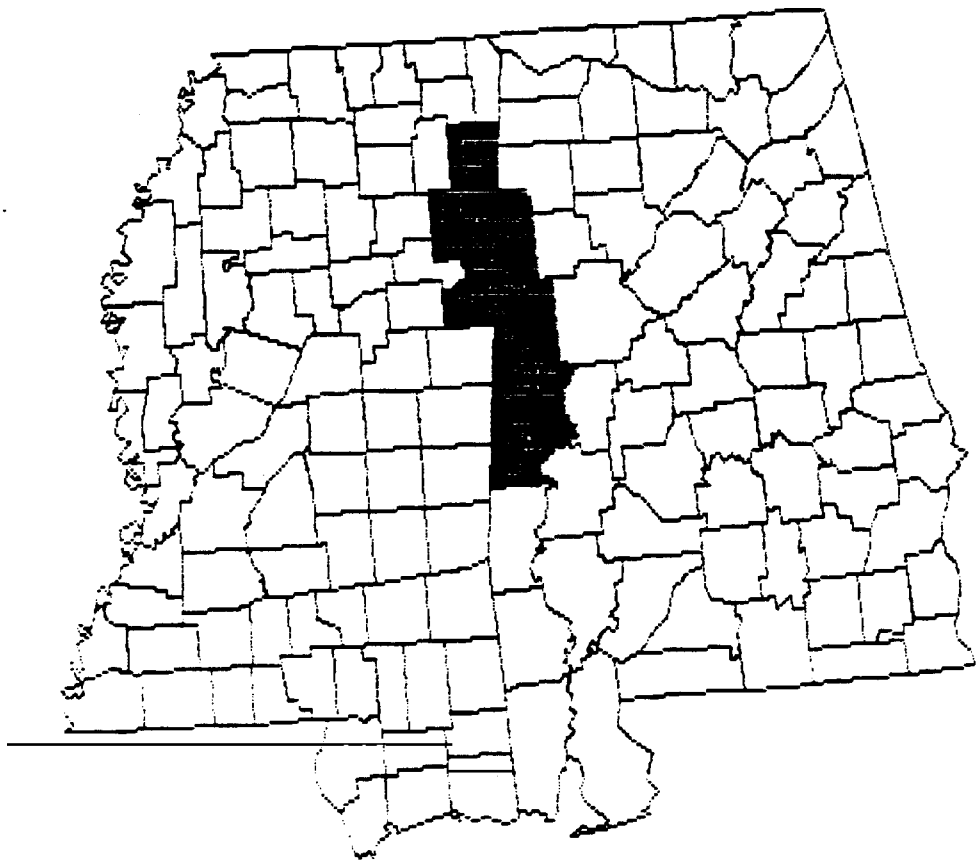

Figure 1. Distribution of Tombigbee Mussels

breeders), fertilization occurs in mid-summer and fall, and glochidia are released the following spring and summer. Upon release into the water column, mature glochidia attach to the gills and fins of appropriate host fishes to encyst, metamorphose to the juvenile stage and drop to the substrate.

If the environmental conditions are favorable, the juvenile mussel will survive and develop. Freshwater mussels are long lived - up to 50 years or more. They usually reach sexual maturity in 2-4 years.

Reasons for Decline and Continued Threats

The primary cause of population decline for all five species is habitat modification for navigation. Construction of the Waterway adversely impacted these mussels by physical destruction during dredging, increasing sedimentation, reducing water flow, and suffocating juveniles with sediment (Stein 1971, Stansbery 1980, Williams 1982). The Tombigbee River was converted from a free-flowing riverine system into a series of impoundments by the Waterway. The historic habitat in the Alabama River system has been similarly modified by channelization and impoundment.

The remaining habitat in the mainstem Tombigbee River occurs in several bendways resulting from channel cuts. These bendways have experienced reduced flows and increased sediment accumulation. A large gravel bar (Laws Bar) in the bendway at Columbus, Mississippi, has several inches of sediment despite some continued water flow. Big Creek bendway near Pickensville, Alabama, requires periodic dredging to keep the lower end open to pleasure boats. The upper end has been blocked by the U.S. Army Corps of Engineers to slow the sedimentation process. Sediment is up to several feet deep in Big Creek bendway. Both of these bendways were expected to continue supporting riverine mussel species.

The one remaining bendway that provides riverine mussel habitat is below Gainesville spillway. Even with the constant spillway flows, there is increased deposition of gravel and other material in mid-stream at the confluence of the Noxubee River. As discussed earlier, Gainesville bendway has an accumulation of sediment from the confluence of the Noxubee River downstream. Should Gainesville bendway continue to accumulate sediment as have other bendways, the continued existence of Marshall's mussel will be very doubtful. Such an event would also limit the known habitat for the stirrup shell to the Sipsey River.

The continued existence of four of these species appears to depend upon habitat in tributaries of the Tombigbee River and the species' ability to complete their life cycle in smaller streams. The Sipsey River is threatened by a project to accomplish channel improvement over 135 kilometers (km) or 84.5 miles (mi), including 51.2 km (32 mi) of clearing and snagging (U.S. Army Corps of Engineers 1981). The Buttahatchie River is threatened by a 94.4 km (59 mi) channel improvement project. The East Fork Tombigbee River is threatened by an 84.8 km (53 mi) clearing and snagging project, sand and gravel mining, the continued diversion of flood flows, and by water removal for municipal use. Such

modifications adversely impact mussels by alteration of the substratum, increased sedimentation, altered water flows, and direct mortality from dredging and snagging.

Water diversion continues to threaten these species, especially in the East Fork Tombigbee River. The Waterway canal section significantly altered water flows from eastern tributaries of the East Fork. Minimum flow structures were built into the Waterway to maintain flows in tributaries from which higher flushing flood flows were diverted. At least one municipality proposes to use the East Fork as a water supply and remove up to 136 million liters or 30 million gallons (gal) per day. Unless the Waterway canal structures continually release the planned amounts of water, the withdrawal of such a large quantity of municipal water would very likely jeopardize the mussels in the East Fork. Should any other water withdrawal occur, there must be corresponding water releases from the Waterway to avoid adverse impacts to mussels. The accumulation of sediment in the East Fork downstream of Mill Creek is likely due to the diversion of flushing flows by the Waterway canal cut from Bull Mountain Creek through the Lock B spillway some 6.4 km (4 mi) downstream (U.S. Army Corps of Engineers 1988).

Runoff of fertilizers and pesticides into these tributaries may adversely impact freshwater mussels. Such runoff can exceed the assimilation ability of the stream and result in algal blooms and excesses of other aquatic vegetation. This condition can produce eutrophication and result in the death of mussels. Pesticides washed into the stream are ingested by filter feeders while being transported downstream. Pesticide-laden silt particles eventually settle to and become part of the substratum, increasing the concentration of pesticides in mussel habitats.

The host species for these five mussels are unknown. Should the hosts be large river species that infrequently enter the tributaries, the future existence of these five mussels is very precarious. A migratory fish host species also faces the additional problem of impoundment structures impeding access to the mussels' habitat.

The low population levels cause increased difficulty for successful reproduction. When individuals are scattered, the opportunity for a female to siphon sperm and fertilize eggs is diminished. This results in fewer gravid females in proximity to the host species. With low population levels, any event that impacts one of these species is of major significance.

Conservation Efforts

The Mobile District, U.S. Army Corps of Engineers constructed two gravel bars in the upstream end of the bendway below Columbus Dam to replace riffle habitat destroyed by construction of the Waterway. Supplemental flow structures were constructed at Bay Springs Lock, Lock E, and at Red Bud, Mackeys, Mud and Bull Mountain Creeks to ensure continued water flows to the East Fork Tombigbee River and the unimpounded portion of its eastern

tributaries. A spillway was constructed on Gainesville Pool to let all river flows except lockage go down the bendway and maintain mussel habitat.

As discussed earlier, the habitat in the East Fork has accumulated sediment at least partially as a result of the lack of flushing flows from the eastern tributaries and of upstream channel maintenance. Gainesville bendway has an accumulation of sediment in the lower portion despite the continued flow from the spillway. It is too early to tell if the artificial gravel bars will become suitable for riverine mussels. It is doubtful there are enough individuals of at least four of these species to attempt relocation and reestablishment on the artificial bars. Without some management of the East Fork and Gainesville bendway to ensure the continued survival of these listed mussels, there is little use for the artificial gravel bars in the recovery of these species.

II. RECOVERY

A. Objective:

The recovery objective is to prevent the extinction of Curtus' mussel, Marshall's mussel, Judge Tait's mussel, the penitent mussel, and the stirrup shell by protecting the remaining range of these species. The recovery of any of these species, to a degree that would permit down-listing to threatened, is unlikely due to their few numbers and lack of suitable habitat within their historic range.

B. Narrative Outline

1. Protect the habitats where these species occur. The known range of each of these species is the known range in the Tombigbee River in the early 1970's minus the portion modified by construction of the Waterway.

   1.1 Continue to use existing statutes to protect the four areas where one or more of these species occur. The East Fork Tombigbee River from the Lock B spillway in Monroe County, Mississippi, upstream to the confluence with Bull Mountain Creek in Itawamba County, Mississippi, still contains Curtus' mussel and the penitent mussel and may still contain Judge Tait's mussel. The Buttahatchie River from the mouth to a point near Henson Springs, Alabama, approximately 112 km (70 mi) upstream is known to contain the penitent mussel and Judge Tait's mussel in a portion or all of this reach. The Sipsey River from the mouth to an upstream point near Lewiston, Alabama, is known to contain the stirrup shell and Judge Tait's mussel. A Tombigbee River bendway below the Gainesville Dam spillway is the only other remaining habitat, and it may still contain Marshall's mussel, the stirrup shell, Judge Tait's mussel, and the penitent mussel. The Endangered Species Act, the Fish and Wildlife Coordination Act, and other environmental statutes provide a measure of protection for these species. Cooperation among agencies to protect the known habitat from channelization, construction, development, flood control projects and water removal, and to consider environmental concerns during the early planning phase of projects is necessary. All existing and new projects in this known range and upstream areas must be carefully studied and designed to prevent any adverse impact to these endangered species.

   Two of the Tombigbee River bendways expected to provide habitat for these mussels have accumulated several inches of sediment. Two of the remaining four sites may no longer support one or more of these species. The other two sites are threatened by authorized channel modification projects. Without protection of all four of these remaining areas, one or more of these species will go extinct. Only one of the

five species was known from all four sites. Two of the five species are known from only one of the sites. The other two species are known from only two sites. With the exception of the penitent mussel in the Buttahatchie River, all of these species are extremely rare.

1.2 Conduct status surveys to determine the current range of these species. The range of these five species has not been determined in more than 10 years. Considerable habitat modification has occurred within the present known range. Status surveys to determine the current range and abundance are necessary before starting subsequent recovery actions. The surveys must be conducted by knowledgeable malacologists that can identify the mussel and immediately return it to the original position in the substratum. The four areas identified in 1.1 and other areas with similar habitat in the Tombigbee and Alabama River systems should be surveyed.

Species can only be protected and managed if we know the current range and population trends. As discussed in 1.1, these species are very uncommon, with one exception, and one of them could be extinct. Knowledge of their current status is mandatory to prevent further decline of the surviving species.

2. Determine habitat requirements and management needs and correct as necessary and feasible. Effective habitat management (and possible reintroductions) cannot be accomplished until the environmental and biological requirements for each species have been determined.

Protection of individuals is not sufficient to ensure continued survival of the species. All aspects of the life cycle and habitat requirements must be known and protected. The very limited range, unknown life history requirements, and the on-going and planned habitat modifications could easily eliminate a critical link in the life history requirements due to our lack of knowledge. Such an event would mean certain extinction, even with individuals of the species surviving.

2.1 Determine habitat requirements of each species. Habitat requirements for each species, including river flows, water quality characteristics, substrate types and related fauna should be determined. Habitat requirements must also consider the requirements of the fish hosts. Unless we know the fish host(s) and habitat requirements of the mussel and the host(s), the species could go extinct due to our failure to protect a critical requirement or to take a management action.

2.2 Conduct life history studies with emphasis on fish host identification. Most freshwater mussels require a fish species as a host for the glochidia in their life cycles. Protection of the fish host and its access to the mussels is

critical to the mussel species' survival. This task will seek to identify the host species. Loss of the fish host(s) means certain extinction. Identity of the host(s) is mandatory if we are to maintain these mussels.

2.3 Determine ecological requirements and associations. This task will determine minimum in-stream flow rates required throughout the year, preferred habitat types, and species associations at each stage of the life cycle. Determining preferred habitat types and species associations may be difficult due to the rarity of these species. Because of this problem, minimum in-stream flow rates for closely related species will be presumed to be the minimum for each of these species. Water flows in the Tombigbee system have been diverted and impounded. Knowledge of ecological requirements and associations is necessary in making management decisions to prevent extinction.

3. Monitor existing populations at not more than 3-year intervals and recommend additional actions as needed. Once the status of each species is known, it must be periodically monitored to track population trends and evaluate recovery efforts. As in 1.2, a knowledgeable malacologist must conduct this task to minimize impacts to individuals and the population. Without periodic monitoring, these very uncommon species could go extinct due to the Service's failure to take a corrective action simply because we lacked the information.

4. Solicit the assistance of the States, other Federal agencies, municipalities and conservation organizations in protecting the remaining habitat of these species. Encourage the States, other Federal agencies (especially the Corps of Engineers), and municipalities to consider the status of these species in project planning and to provide protection to the remaining habitat. Encourage government and conservation organizations to assist in making the public aware of the plight of these endangered species. These species are so uncommon that a single action by an uninformed agency could eliminate them. The assistance of all entities that may affect any one of the species is required to prevent extinction.

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III. IMPLEMENTATION SCHEDULE

KEY TO COLUMNS 1 & 4

General Category (Column 1):

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
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

Priority (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 or extinction.

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

IMPLEMENTATION SCHEDULE

General Category	Plan Task	Task Number	Priority	Task Duration	Region	Program	Other	FY 89	FY 90	FY 91	Comments/ Notes
O-2 O-3	Use existing statutes to protect known habitat	1.1	1	Continuous	4	FWE LE	MDWC ADCNR	2,000			
I-1	Status survey to determine current range	1.2	1	4 years	4	FWE	ADCNR MDWC COE	25,000	25,000	25,000	State Grant project
R-3	Determine habitat requirements	2.1	1	4 years	4	FWE Research	ADCNR MDWC COE	25,000	25,000	25,000	
R-3	Conduct Life History Studies	2.2	1	5 years	4	FWE Research	ADCNR MDWC COE	100,000	100,000	100,000	
R-3	Determine Ecological requirements	2.3	1	2 years	4	FWE Research	ADCNR MDWC COE	100,000	100,000	100,000	
I-1	Monitor populations	3.0	1	Continuous	4	FWE	MDWC ADCNR	20,000	20,000	20,000	
O-2 O-3	Solicit assistance of other agencies	4.0	1	Continuous	4	FWE	MDWC ADCNR COE EPA				

FWE = Fish and Wildlife Enhancement
LE = Law Enforcement
Research = Division of Research
MDWC = Mississippi Department of Wildlife Conservation
ADCNR = Alabama Department of Conservation & Natural Resources
COE = Corps of Engineers
EPA = Environmental Protection Agency

IV. Appendix

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