FAN SHELL

RECOVERY PLAN
RECOVERY PLAN

for

Fanshell (Cyprogenia stegaria (=C. irrorata))

Prepared by

Richard G. Biggins
Asheville Field Office
Asheville, North Carolina

for

Southeast Region
U.S. Fish and Wildlife Service
Atlanta, Georgia

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

Date:  
July 9, 1991
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 will only 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:


Additional copies of this plan may be purchased from:

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

The fee for a plan varies depending on the number of pages in the plan.
TABLE OF CONTENTS

PART I:

INTRODUCTION .......................................................... 1
  Description, Ecology, and Life History .................. 1
  Distribution, Reasons for Decline, and Threats
  to Its Continued Existence ................................. 2

PART II:

RECOVERY ............................................................... 6
  A. Recovery Objectives ........................................ 6
  B. Narrative Outline .......................................... 8
  C. Literature Cited ............................................. 13

PART III:

IMPLEMENTATION SCHEDULE ........................................ 15

PART IV:

LIST OF REVIEWERS .................................................. 19
EXECUTIVE SUMMARY FOR THE FANSHELL RECOVERY PLAN

Current Status: The species is listed as endangered. Presently, the fanshell is known from only three reproducing populations--the Green and Licking Rivers in Kentucky and the Clinch River in Tennessee and Virginia. A few apparently nonreproducing populations still survive in some other rivers in the Ohio River basin in Ohio, Indiana, West Virginia, and Illinois.

Habitat Requirements and Limiting Factors: The fanshell inhabits gravel substrate in medium to large rivers of the Ohio River basin. The species' distribution and reproductive capacity has been seriously impacted by the construction and operation of reservoirs and by other impacts on water and substrate quality. Unless new populations are found or created and existing populations are maintained, this species will likely become extinct in the foreseeable future.

Recovery Objective: Downlisting. Because of the lack of available habitat for establishment of all needed populations, recovery is unlikely.

Recovery Criteria: To establish 12 distinct viable populations.

Actions Needed:
1. Utilize existing legislation/regulations to protect species.
2. Search for new populations and monitor existing populations.
3. Develop and utilize an information/education program.
4. Determine species' life history requirements.
5. Determine threats and alleviate those that threaten species' existence.
6. Through reintroduction and protection, establish eight viable populations.
7. Develop and implement cryopreservation protection of species.

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*See next page.
Habitat improvement costs needed for the species' recovery will not be known until the magnitude of specific threats is determined through research.

**Date of Recovery:** Total recovery is unlikely for this species. The downlisting date cannot be estimated at this time. As mussels do not reproduce until about age 5, more than 10 years will be needed to document reproduction and assess viability.
The fanshell (Cyprogenia stegaria (=C. irrorata)), was listed as an endangered species in the Federal Register (55 FR 25591) on June 21, 1990, under the Endangered Species Act of 1973, as amended. This freshwater mussel historically occurred in the Ohio River and many of its large tributaries in Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Kentucky, Tennessee, Alabama, and Virginia. Presently, the fanshell is believed to be reproducing in only three rivers—the Green and Licking Rivers in Kentucky and the Clinch River in Tennessee and Virginia. Additionally, small (apparently nonreproducing) populations (based on the collection of a few old specimens in the 1980s) may still persist in the Muskingum (specimen taken as recently as 1988) and Walhonding River, Ohio; the Kanawha River, West Virginia; the Wabash River system in Illinois and Indiana; the Barren River and Tygarts Creek, Kentucky; and the Tennessee and Cumberland Rivers in Tennessee. The distribution and reproductive capacity of this species has been seriously impacted by the construction of impoundments and navigation facilities, dredging for channel maintenance, sand and gravel mining, and water pollution.

Description, Ecology, and Life History

The fanshell (Cyprogenia stegaria (=C. irrorata)) was described by Rafinesque (1820). The mussel has a medium-sized shell (seldom exceeding 3.2 inches [80 millimeters] in length) that is subcircular in outline (Johnson 1980). The shell exterior has green rays on a light green or yellow surface ornamented with green mottling. The inside surface of the shell (nacre) is usually silvery white.

Because of its rarity, little is known of the mussel’s biology. The species, according to Bates and Dennis (1985), inhabits medium to large rivers. The fanshell has been reported primarily from relatively deep water in gravel substrate with moderate current (Gordon and Layzer 1989).

Specific food habits of the fanshell are unknown, but it likely feeds on food items similar to those consumed by other freshwater mussels. Freshwater mussels are known to feed on detritus, diatoms, phytoplankton, and zooplankton, which they filter out of the water (Churchill and Lewis 1924).

The fanshell’s reproductive biology is unknown, but it probably reproduces like other freshwater mussels. Males release sperm into the water column. The sperm are taken in by the females through their siphons during feeding and respiration. The fertilized eggs are retained in the gills until the larvae (glochidia) fully develop. The glochidia attach and encyst on the gills or fins of the fish host. When metamorphosis is complete, they drop to the streambed as juvenile mussels. The species of host fish utilized by the fanshell is unknown. However, the fanshell’s glochidia are released into the
water in the form of a unique spiral conglutinate. This worm-like shape suggests that a fish that visually searches for its food may be its host (Robert Anderson, Indiana Department of Natural Resources, in litt., 1991).

Distribution, Reasons for Decline, and Threats to Its Continued Existence

Since the turn of the century, the fanshell has undergone a substantial reduction in its range. It was historically widely distributed in the Ohio, Wabash, Cumberland, and Tennessee Rivers and their larger tributaries in Pennsylvania, Ohio, West Virginia, Illinois, Indiana, Kentucky, Tennessee, Alabama, and Virginia (Johnson 1980, Kentucky State Nature Preserves Commission 1980, Ahlstedt 1986, Bates and Dennis 1985, Lauritsen 1987, Cummings et al. 1987 and 1988, and Starnes and Bogan 1988). The loss of many historic populations was likely due to the impacts of impoundments, navigation projects, pollution, and habitat alterations, such as gravel and sand dredging, that directly affected the species and reduced or eliminated its fish host.

Based on a review of current literature on the species (see above) and on the following personal communications and letters from knowledgeable individuals and State and Federal agency personnel, it is believed that reproducing populations are now present (see map) in only three rivers—the Clinch River, Hancock County, Tennessee, and Scott County, Virginia; the Green River, Hart and Edmonson Counties, Kentucky; and the Licking River, Kenton, Campbell, and Pendleton Counties, Kentucky (Steven Ahlstedt and John Jenkinson, Tennessee Valley Authority, personal communications, 1988; Robert Anderson and Mark Gordon, Tennessee Cooperative Fishery Research Unit, personal communications, 1988; Carl Becker, Illinois Department of Conservation, in litt., 1988; Charles Bier, Western Pennsylvania Conservancy, in litt., 1989; Richard Connor and William Sinozich, U.S. Army Corps of Engineers, in litt., 1989; Kevin Cummings, Illinois State Natural History Survey Division, in litt., 1989; Ronald Cicerello and Richard Hannan, Kentucky State Nature Preserves Commission, in litt., 1988; Wendal Haag, Ohio State University Museum of Zoology, in litt., 1988; Edward Hansen, Indiana Department of Natural Resources, Division of Fish and Wildlife, in litt., 1989; Michael Hoggarth, Ohio Department of Transportation, in litt., 1990; Patricia Jones, Ohio Department of Natural Resources, in litt., 1988; Richard Neves, Virginia Cooperative Fish and Wildlife Research Unit, in litt., 1988; Brian McDonald and Michael Zeto, West Virginia Department of Natural Resources, in litt., 1988 and 1989; James Sickle, Murray State University, personal communication, 1989; Clarke Shiffer, Pennsylvania Fish Commission, personal communication, 1989; William Tolin, U.S. Fish and Wildlife Service, personal communication, 1988; and Paul Yokley, University of North Alabama, personal communication, 1988). Additionally, small remnant (apparently nonreproducing) populations (based on collections of a
Distribution of the fanshell (Cyprogenia stegaria (=C. irrorata)): All States with historic population records, counties with extant populations, and counties with possible extant populations.

PRESENT POPULATIONS

- REPRODUCING
- NONREPRODUCING
few old individuals in the 1980s) may still persist in the Muskingum River (specimen taken as recently as 1988) in Morgan and Washington Counties, Ohio; the Walhonding River in Coshocton County, Ohio; the Wabash River in White County, Illinois, and Posey and Wabash Counties, Indiana; the East Fork White River, Martin County, Indiana; the Tippecanoe River, Tippecanoe County, Indiana; the Kanawha River, Fayette County, West Virginia; Tygarts Creek, Greenup and Carter Counties, Kentucky; Barren River, Allen and Barren Counties, Kentucky; the Cumberland River, Smith County, Tennessee; and the Tennessee River, Rhea, Meigs, and Hardin County, Tennessee.

The population in the Green River is likely the best of the three remaining reproducing populations. Fresh-dead fanshells of various age classes from juvenile to adult have recently been found (1987 and 1988) in muskrat middens along the Green River (Ronald Cicerello, personal communication, 1988). However, the Green River, which lies partially within the Mammoth Cave National Park, is not free from threats. The river’s mussel fauna have been seriously depleted. Cicerello (personal communication, 1988), based on his 1987 and 1988 surveys of the Green River within and above the Mammoth Cave National Park, believes that about 40 mussel species still survive in the area. Ortmann (1926) reported finding 66 species of mussels in the Green River. The Green River has been degraded by runoff from oil and gas exploration and production sites and by alteration of stream flows by an upstream reservoir.

The Clinch River fanshell population extends over about 86 river miles (Ahlstedt 1986). However, a Tennessee Valley Authority (1988) survey reported that the fanshell comprised less than 1 percent of the mussels collected at 11 Clinch River quantitative sampling sites in 1979 and 1988. The Tennessee Valley Authority (1988) also reported that overall mussel abundance in the Clinch River has decreased from an average of 11.64 mussels per square meter in 1979 to 6.0 mussels per square meter in 1988. The Clinch River also has environmental problems. Charles Sledd (Virginia Department of Game and Inland Fisheries, personal communication, 1988) stated that land use practices along the Clinch River have contributed to a decline in water quality and mussel populations. The Clinch River has experienced some adverse impacts from coal mining, and the river has been subjected to two mussel kills resulting from toxic substance spills from a riverside coal-fired power plant.

The Licking River also supports a reproducing fanshell population (Ronald Cicerello, personal communication, 1989). Live and fresh-dead individuals of several year classes have been collected. However, despite collections made throughout the drainage by Kentucky State Nature Preserves Commission biologists, the species is only known from the lower portion of the Licking River. This population could potentially be threatened by some of the water supply development alternatives presently under preliminary review for the Licking River watershed and by wastewater discharges.
Although the species has minimal commercial value, it does exist in small numbers within some harvested mussel beds, and the species can therefore be taken by mussel fishermen. As there has been a substantial increase in the value of mussel shells, the problem of incidental take is expected to increase.

Most of the fanshell populations are small, and all are geographically isolated from each other. This isolation restricts the natural interchange of genetic material between populations. The small population size also reduces the reservoir of genetic variability within populations. It is likely these populations, with the possible exception of the Clinch River population, are now below the generally accepted level required to maintain long-term genetic viability (Soule 1980).
PART II
RECOVERY

A. Recovery Objectives

The ultimate goal of this recovery plan is to restore viable populations of the fanshell (Cyprogenia stegaria (C. irrata)) to a significant portion of its historic range in the Ohio River system and to remove the species from the Federal List of Endangered and Threatened Wildlife and Plants. However, total recovery of the fanshell may not be possible. Much of the habitat within the species' historic range may be unsuitable for reintroductions. NOTE: A viable population is defined as a reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes. The number of individuals needed to reach a viable population will be determined as one of the recovery tasks.

The fanshell will be considered for reclassification to threatened status when the likelihood of the species' becoming extinct in the foreseeable future has been eliminated by achievement of the following criteria:

1. Through protection of existing populations and through successful establishment of reintroduced populations or the discovery of additional populations, a total of nine distinct viable populations exist. The populations shall be distributed throughout the Ohio River basin as follows: one in the upper Tennessee River system, one in the middle to lower Tennessee River system, one in the Cumberland River system, two in a Kentucky tributary to the Ohio River other than the Cumberland River, one in the Allegheny River system, one in the lower Muskingum or Walhonding River system, one in the Kanawha River system, and one in the Wabash River system.

2. One naturally reproduced year class exists within each of the nine populations. The year class must have been produced within 5 years of the downlisting date. Within 1 year of the downlisting date, gravid females of the species and its host fish must be present in each river.

3. Biological and ecological studies have been completed, and the recovery measures developed and implemented from these studies are beginning to be successful, as evidenced by an increase in population density and/or an increase in the length of the river reach inhabited by each of the nine populations.
The fanshell will be considered for removal from Endangered Species Act protection when the likelihood of the species' becoming threatened in the foreseeable future has been eliminated by the achievement of the following criteria:

1. Through protection of existing populations and successful establishment of reintroduced populations or the discovery of additional populations, a total of 12 distinct viable populations exist. These populations must be separated to the extent that it is unlikely that a single event would eliminate or significantly reduce more than one of these populations. The populations shall be distributed throughout the Ohio River basin as follows: two in the upper Tennessee River system, two in the middle to lower Tennessee River system, one in the Cumberland River system, three in a Kentucky tributary to the Ohio River other than the Cumberland River, one in the Allegheny River system, one in the lower Muskingum or Walhonding River system, one in the Kanawha River system, and one in the Wabash River system.

2. Two distinct naturally reproduced year classes exist within each of the 12 populations. Both year classes must have been produced within 10 years, and one year class within 5 years, of the recovery date. Within 1 year of the recovery date, gravid females of the species and its host fish must be present in each river.

3. Studies of the mussel's biological and ecological requirements have been completed, and recovery measures developed and implemented from these studies have been successful, as evidenced by an increase in population density and/or an increase in the length of the river reach inhabited by each of the 12 populations.

4. No foreseeable threats exist that would likely threaten the survival of any of these eight populations.

5. Where habitat had been degraded, noticeable improvements in water and substratum quality have occurred.
B. Narrative Outline

1. **Preserve present populations and occupied habitat.** Because so few fanshell populations exist, it is essential to the survival and eventual recovery of the species that all existing populations and their habitat be protected.

1.1 **Continue to utilize existing legislation and regulations** (Federal Endangered Species Act, Federal and State surface mining laws, water quality regulations, stream alteration regulations, etc.) to protect the species and its habitats. Prior to and during implementation of this recovery plan, the present fanshell populations can be protected only by the full enforcement of existing laws and regulations.

1.2 **Solicit help in protecting the species and its essential habitats.** Section 7 consultation under the Endangered Species Act, Fish and Wildlife Coordination Act requirements, and other habitat protection programs can assist in protection of the species, but these programs alone cannot recover the fanshell. The assistance of Federal and State agencies, conservation groups, and local governments will be essential. Also, support of the local industrial, business, and farming communities, as well as private citizens, will be needed to meet the goal of recovering the species. Without a commitment from the local people who have an influence on habitat quality in the streams inhabited by the species, recovery efforts will be doomed.

1.2.1 **Meet with appropriate Federal, State, and local government officials and regional and local planners to inform them of our plans to attempt recovery and request their support.** Other agencies, for example the U.S. Soil Conservation Service, have existing programs that benefit aquatic resources. By coordinating recovery efforts with such agencies, the species’ recovery can benefit.

1.2.2 **Meet with local business, mining, logging, farming, and/or industry interests and elicit their support in implementing protective actions.**

1.2.3 **Develop an educational program using such items as slide/tape shows, brochures, etc. Present this material to business groups, civic groups, youth groups, schools, church organizations, etc.** Educational material outlining the Service’s recovery goals must be presented to the public. However, this material should stress the other
benefits of maintaining diverse ecosystems and	he use of mussels as indicators of good
environmental quality.

1.3 Consider and, if determined necessary, use land
acquisition as a means of protecting present and
reintroduced populations.

2. Determine threats to the species, conduct research necessary
for the species' management and recovery, and implement
management where needed.

2.1 Conduct life history research on the species to include
such factors as reproduction, food habits, age and
growth, and mortality rates. Only very limited data on
the fanshell's life history exists. Unless the species' life history and environmental requirements (especially its fish host) are defined, recovery efforts may be
inconsequential or misdirected.

2.2 Characterize the species' habitat requirements (relevant
physical, biological, and chemical components) for all
life history stages. The fanshell appears to be
sensitive to habitat degradation. The species coexists
with other mussel species, but it occurs in much fewer
numbers than most of the other species present.
Knowledge of the species' habitat needs and ecological
associations (especially fish host requirements) is
needed to focus management and recovery efforts on the
specific problems within the species' habitat.

2.3 Determine present and foreseeable threats to the
species. Coal mining and oil and gas well development
appear to have been major factors in altering the
species' habitat and in reducing its range. Siltation
from poor land use practices and impoundment have also
had an impact. However, other impacts are also
probable. The nature of and the mechanisms by which
they impact the species and its habitat are not entirely
understood. The extent to which the species can
withstand these adverse impacts is unknown. To minimize
and eliminate these threats where necessary to meet
recovery, the information gathered under Tasks 2.1
and 2.2 must be utilized to target specific problem
areas and determine the specific causative agent(s).

2.4 Investigate the relationships with nonnative bivalves.
Many malacologists believe the Asiatic clam (Corbicula
fluminea) poses a threat to the native mussel fauna.
Another exotic clam, the zebra clam (Dreissena
polymorpha), has recently invaded the Great Lakes, and
some adverse impacts to endemic mussels have been noted.
The zebra clam has not yet been seen in the Ohio River basin. However, as the species has spread quickly in the Great Lakes, it is expected to invade other basins in the near future. The relationship between these nonnative mollusks and the native fauna needs to be understood, and (where feasible) measures should be taken to minimize their impact. It has been suggested (Arthur H. Clarke, Ecosearch Inc., personal communication, 1990) that Corbicula may adversely impact native mussels by consuming a significant portion of their sperm. Clarke suggests that, by concentrating endangered mussels, the loss of sperm would decrease, and reproductive success would increase. A study using nonendangered mussels should be used to test this hypothesis.

2.5 Determine the impact of commercial mussel fishing on the species and eliminate impacts determined to be detrimental to the species. There has been a substantial increase in mussel fishing, and the fanshell exists on some harvested mussel beds. The impact of mussel fishing on the species needs to be assessed and eliminated.

2.6 Based on the biological data and threat analysis, investigate the need for management, including habitat improvement. Implement management, if needed, to secure viable populations. Specific components of the fanshell's habitat may be lacking, and these may limit the species' potential expansion. Habitat improvement programs may be needed to alleviate limiting factors.

2.7 Determine number of individuals required to maintain a viable population. Theoretical considerations by Franklin (1980) and Soule (1980) indicate that 500 breeding individuals represent a minimum population level (effective population size) that would contain sufficient genetic variation to enable that population to evolve and respond to natural habitat changes. The actual population size in a natural ecosystem necessary to provide 500 breeding individuals can be expected to be larger than this number, possibly by as much as 10 times. The factors that will influence effective population size include sex ratio, length of species' reproductive life, fecundity, and extent of exchange of genetic material within the population, plus other life history aspects. Some of these factors can be addressed under Task 2.1, while others will need to be addressed as part of this task.

3. Search for additional populations and/or habitat suitable for reintroduction efforts. Much of the species' potential
available habitat has been surveyed in recent years. An extensive 4-year survey of the Wabash River system in Indiana and Illinois has recently been completed, and the Tennessee River system has also received considerable attention in the last few years. However, it is possible that some relic populations were missed. Further study may yield additional populations; and, more importantly, suitable habitat for transplants could be identified during these surveys.

4. Determine, through research, the feasibility of augmenting extant populations and reestablishing the fanshell into historic habitat and reintroduce where feasible. The historic distribution of the fanshell is unknown, but available records indicate that the species was once widespread in the Ohio River system. Streams for possible reintroductions will be selected based on present and expected future habitat and water quality.

4.1 Determine the need, appropriateness, and feasibility of augmenting and expanding existing populations. Most of the populations are likely below the number needed to maintain long-term viability. These populations may be able to expand naturally if environmental conditions are improved. However, some populations may be too small and may need to be supplemented to reach a viable size. Populations for this task will be selected based on present population size, habitat quality, and the likelihood of long-term benefits from the task.

4.2 Develop a successful technique for reestablishing and augmenting populations. Sufficient specimens of the mussel are not presently available to allow for translocation of enough adults to establish populations. Propagation and reintroduction techniques should be developed for the species to help ensure success.

4.3 Coordinate with appropriate Federal and State agency personnel, local governments, and interested parties to identify streams suitable for augmentation and reintroduction and those most easily protected from further threats.

4.4 Reintroduce the species into its historic range and evaluate success. Using techniques developed in Task 4.2, introduce and monitor success.

4.5 Implement the same protective measures for introduced populations that were outlined for established populations.

5. Develop and implement cryogenic techniques to preserve the species' genetic material until such time as conditions are
suitable for reintroduction. The fanshell populations that remain, except (possibly) for the Clinch, Green, and Licking River populations, may not be reproducing. Artificial propagation techniques may be able to provide juvenile mussels for transplants. However, present habitat conditions may not be suitable in all rivers at this time for reintroduction to succeed. Cryogenic preservation of the species could maintain genetic material (much like seed banks for endangered plants) from all the extant populations until such time as the habitat becomes suitable for reestablishment of the species. Additionally, if a population were lost to a catastrophic event, such as a toxic chemical spill, cryogenic preservation could allow for the eventual reestablishment of the population using the genetic material preserved from that population.

6. Develop and implement a program to monitor population levels and habitat conditions of presently established populations as well as newly discovered, introduced, or expanding populations. During and after recovery action implementation, the status of the species and its habitat must be monitored to assess any progress toward recovery. This should be conducted on a biennial schedule.

7. Annually assess overall success of the recovery program and recommend action (modify recovery objectives, delist, continue to protect, implement new measures, or conduct other studies, etc.). The recovery plan must be evaluated periodically to determine if it is on track and to recommend future actions. As more is learned about the species, recovery objectives may need to be modified.
C. Literature Cited


Tennessee Valley Authority. 1988. Biological Assessment of Columbia Dam Alternatives, Duck River, Tennessee, Tennessee Valley Authority. 28 pp., plus Appendices A-C.

PART III
IMPLEMENTATION SCHEDULE

Priorities in column one of the following implementation schedule are assigned as follows:

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

2. 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.

3. Priority 3 - All other actions necessary to meet the recovery objective.

Key to Acronyms Used in This Implementation Schedule

ADCNR - Alabama Department of Conservation and Natural Resources
FWE - Fish and Wildlife Enhancement
FWS - U.S. Fish and Wildlife Service
ILDOC - Illinois Department of Conservation
ILSNHSD - Illinois State Natural History Survey Division
INDNR - Indiana Department of Natural Resources
KDFWR - Kentucky Department of Fish and Wildlife Resources
KSNPC - Kentucky State Nature Preserves Commission
NPS - National Park Service
ODNR - Ohio Department of Natural Resources
PDER - Pennsylvania Department of Environmental Resources
PFC - Pennsylvania Fish Commission
TDOC - Tennessee Department of Conservation
TNC - The Nature Conservancy
TVA - Tennessee Valley Authority
TWRA - Tennessee Wildlife Resources Agency
VDGIF - Virginia Department of Game and Inland Fisheries
VNHP - Virginia Natural Heritage Program
WVDNR - West Virginia Department of Natural Resources
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<td>2</td>
<td>1.2.1, 1.2.2</td>
<td>Meet with local governmental officials and business interests and elicit their support for recovery.</td>
<td>3</td>
<td>3, 4, 5</td>
<td>FWE</td>
</tr>
<tr>
<td></td>
<td>1.2.3</td>
<td>Develop information and education program and present.</td>
<td>Ongoing</td>
<td>3, 4, 5</td>
<td>FWE</td>
</tr>
<tr>
<td>2</td>
<td>1.3</td>
<td>Consider use of land acquisition to protect the species.</td>
<td>Ongoing</td>
<td>3, 4, 5</td>
<td>FWE</td>
</tr>
<tr>
<td>1</td>
<td>2.1, 2.2, 2.3, 2.4</td>
<td>Conduct research necessary for species management and recovery;</td>
<td>4</td>
<td>3, 4, 5</td>
<td>FWE</td>
</tr>
<tr>
<td>PRIORITY #</td>
<td>TASK #</td>
<td>TASK DESCRIPTION</td>
<td>TASK DURATION</td>
<td>RESPONSIBLE PARTY</td>
<td>COST ESTIMATES ($000'S)</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>---------------</td>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>habitat, augment populations, and protect any populations established.</td>
<td>3 years</td>
<td>3, 4, 5 FWE</td>
<td>See *1. 5.0 5.0 5.0</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Develop and implement cryopreservation.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>Develop and implement a monitoring program.</td>
<td>Ongoing</td>
<td>3, 4, 5 FWE</td>
<td>See *1. --- 8.0</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>Annually assess recovery program and modify program and plan where required.</td>
<td>Ongoing</td>
<td>3, 4, 5 FWE</td>
<td>See *1. 0.5 0.5 0.5</td>
</tr>
</tbody>
</table>

*1 - ADCNR, ILDOC, ILSNHSD, INDNR, KDFWR, KSNPC, NPS, ODNR, PDER, PFC, TDOC, TNC, TVA, TWRA, VDGIF, VNHP, and WVDNR
## Implementation Schedule

<table>
<thead>
<tr>
<th>Priority #</th>
<th>Task #</th>
<th>Task Description</th>
<th>Task Duration (Years)</th>
<th>Responsible Party</th>
<th>Cost Estimates ($000's)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>i.e., habitat requirements, biology, and threat analysis.</td>
<td>1 year</td>
<td>FWS Region</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td></td>
<td>2.6</td>
<td>Based on biological and threat analysis, investigate need for management and implement where needed.</td>
<td>1 year</td>
<td>FWS Region</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Search for additional populations and suitable habitat.</td>
<td>1 year</td>
<td>FWS Region</td>
<td>3, 4, 5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Develop techniques, select sites, reintroduce the species back into historic</td>
<td>Ongoing</td>
<td>FWS Region</td>
<td>3, 4, 5</td>
</tr>
</tbody>
</table>

Priority 1, 2, or 3 (depending on result of 2.1, 2.2, 2.3, and 2.4).
PART IV
LIST OF REVIEWERS

Mr. Max Henschen
4307 Greenway Drive
Indianapolis, Indiana 46220

Mr. Kevin Cummings
Illinois State Natural History
Survey Division
607 E. Peabody Drive
Champaign, Illinois 61820

Mr. Charles D. Kelley, Director
Division of Game and Fish
Alabama Department of Conservation and
Natural Resources
64 N. Union Street
Montgomery, Alabama 36130

Ms. Sally Van Meter
Deputy Director for Resource Protection
Ohio Department of Natural Resources
Fountain Square
Columbus, Ohio 43224

Mr. Richard E. Moseley, Jr., Chief
Division of Natural Areas and Preserves
Ohio Department of Natural Resources
Fountain Square
Columbus, Ohio 43224

Mr. Warren W. Tyler, Director
Environmental Protection Agency
P.O. Box 1049
Columbus, Ohio 43216-1049

Mr. Ron Potesta, Deputy Director
West Virginia Department of
Natural Resources
1800 Washington Street, East
Charleston, West Virginia 25305

Mr. Nicholas DeBenedictis, Secretary
Pennsylvania Department of
Environmental Resources
Press Office
9th Floor, Fulton Building
Box 2063
Harrisburg, Pennsylvania 17120
Mr. John Bacone, Head  
Division of Nature Preserves  
Indiana Department of Natural Resources  
608 State Office Building  
Indianapolis, Indiana  46204

Mr. Donald Houchin  
County Courthouse  
P.O. Box 253  
Brownsville, Kentucky  42210

Colonel David E. Peixotto  
District Engineer  
U.S. Army Corps of Engineers  
P.O. Box 59  
Louisville, Kentucky  40201-0059

Mr. Roy Baker  
County Executive  
Hancock County Courthouse  
Sneedville, Tennessee  37869

Mr. Bud Bristow  
Executive Director  
Virginia Department of Game and  
Inland Fisheries  
4010 W. Broad Street, Box 11104  
Richmond, Virginia  23230

Mr. David Whitehurst, Chief  
Fish Division  
Virginia Department of Game and  
Inland Fisheries  
4010 W. Broad Street, Box 11104  
Richmond, Virginia  23230

Ms. Sue Bruenderman  
Aquatic Nongame Biologist  
Virginia Department of Game and  
Inland Fisheries  
Route 2, Box 54706  
Ashland, Virginia  23005

Mr. Keith J. Buttleman, Administrator  
Virginia Council on the Environment  
903 Ninth Street Office Building  
Richmond, Virginia  23219
Mr. Elbert T. Gill, Jr., Commissioner
Tennessee Department of Conservation
701 Broadway
Nashville, Tennessee  37219-5237

Mr. Gary Myers, Executive Director
Tennessee Wildlife Resources Agency
Ellington Agricultural Center
P.O. Box 40747
Nashville, Tennessee  37204

Mr. Richard Becker
Environmental Officer
Housing and Urban Development
710 Locust Street, SW., #300
Knoxville, Tennessee  37902

Mr. Jerry Lee
U.S. Soil Conservation Service
U.S. Courthouse, Room 675
801 Broadway
Nashville, Tennessee  37203

Mr. Edward G. Oakley
Division Administrator
Federal Highway Administration
249 Cumberland Bend Drive
Nashville, Tennessee  37228

Mr. John E. Alcock
Regional Forester
U.S. Forest Service
1720 Peachtree Road, NW.
Atlanta, Georgia  30367

Mr. Jack E. Ravan
Regional Administrator
Environmental Protection Agency
345 Courtland Street, NE.
Atlanta, Georgia  30365

Director
Office of Hydropower Licensing
Federal Energy Regulatory Commission
825 North Capitol Street, NE.
Washington, D.C.  20426

Tennessee State Clearinghouse
1800 James K. Polk Building
501 Deadrick Street
Nashville, Tennessee  37219
Southeast Region  
U.S. Geological Survey  
75 Spring Street, #772  
Atlanta, Georgia 30303

Head of Engineering  
Project Planning and Engineering Branch  
Department of Housing and Urban Development  
Renewal Assistance Administration  
Room 9268  
Washington, DC 20413

Mr. A. Stephen Reeder, Commissioner  
Kentucky Department of Highways  
Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. Peter W. Pfeiffer, Director  
Kentucky Department of Fish and Wildlife Resources  
Department of Fisheries  
Arnold L. Mitchell Building  
#1 Game Farm Road  
Frankfort, Kentucky 40601

Mr. G. Floyd Hughes, Jr., Director  
Kentucky Department of Highways  
Division of Environmental Analysis  
419 Ann Street  
Frankfort, Kentucky 40601

Mr. Fran Curci, Commissioner  
Kentucky Department of Parks  
10th Floor - Capital Plaza Building  
Frankfort, Kentucky 40601

Ms. Charlotte Baldwin, Secretary  
Kentucky Natural Resources and Environmental Protection Cabinet  
Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. Charles W. Martin  
Acting Commissioner  
Kentucky Department for Surface Mining Reclamation and Enforcement  
Capital Plaza Tower, 3rd Floor  
Frankfort, Kentucky 40622
Colonel James P. King  
U.S. Army Corps of Engineers  
Nashville District  
P.O. Box 1070  
Nashville, Tennessee 37202-1070

Mr. William H. Redmond  
Regional Natural Heritage Project  
Tennessee Valley Authority  
Norris, Tennessee 37828

Mr. David Yancy  
Kentucky Department of Fish and Wildlife Resources  
Arnold L. Mitchell Building  
#1 Game Farm Road  
Frankfort, Kentucky 40601

Mr. Richard Hannan, Director  
Kentucky State Nature Preserves Commission  
407 Broadway  
Frankfort, Kentucky 40475

Mr. Paul Schmierbach, Manager  
Environmental Quality  
Tennessee Valley Authority  
Room 201, Summer Place Building  
Knoxville, Tennessee 37902

Division Administrator  
Federal Highway Administration  
P.O. Box 536  
Frankfort, Kentucky 40601

Mr. Randall Giessler  
U.S. Soil Conservation Service  
333 Waller Avenue, Room 305  
Lexington, Kentucky 40504

Mr. George C. Miller, Director  
Knoxville Field Office  
Office of Surface Mining Reclamation and Enforcement  
530 Gay Street, Suite 500  
Knoxville, Tennessee 37902

Ms. Wanda Rachels, Director  
Atlanta Support Office  
Department of Energy  
730 Peachtree Street, NE., Suite 876  
Atlanta, Georgia 30308
Mr. Kenneth C. Imes, Commissioner  
Department for Natural Resources  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
5th Floor, Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. T. Michael Taimi, Commissioner  
Department for Environmental Protection  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
18 Reilly Road  
Frankfort, Kentucky 40601

Mr. H. Stanley Head, Director  
Division of Conservation  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
691 Teton Trail  
Frankfort, Kentucky 40601

Mr. Elmore C. Grim, Commissioner  
Department for Surface Mining Reclamation and Enforcement  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
5th Floor, Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. Bill Adams, Director  
Division of Field Services  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
5th Floor, Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. Donald Harker, Director  
Division of Water  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
5th Floor, Capital Plaza Tower  
Frankfort, Kentucky 40601

Mr. William Davis, Director  
Division of Environmental Services  
Kentucky Natural Resources and  
Environmental Protection Cabinet  
5th Floor, Capital Plaza Tower  
Frankfort, Kentucky 40601
Mr. Don R. McCormick  
Kentucky Department of Fish and Wildlife Resources  
#1 Game Farm Road  
Frankfort, Kentucky  40601

Mr. Wm. Horace Brown, Chairperson  
Environmental Quality Commission  
18 Reilly Road, Ash Annex  
Frankfort, Kentucky  40601

Mr. Donald C. Haney  
Director and State Geologist  
Geological Survey  
311 Breckinridge Hall  
University of Kentucky  
Lexington, Kentucky  40506

Mr. Lou Karibo, Commissioner  
Kentucky Department of Parks  
10th Floor Capital Plaza Building  
Frankfort, Kentucky  40601

Mr. Dan Eagar  
Program Administrator  
Tennessee Department of Conservation  
701 Broadway  
Nashville, Tennessee  37203

Mr. Frank Pridemore  
Superintendent  
Mammoth Cave National Park  
Mammoth Cave, Kentucky  42259

Regional Director  
Federal Railroad Administration  
Department of Transportation  
Suite 440, North Tower  
1720 Peachtree Road, NW.  
Atlanta, Georgia  30309

Mr. Steven A. Ahlstedt  
Field Operations  
Division of Water Resources  
Forestry Building  
Norris, Tennessee  37828

Dr. Arthur E. Bogan  
Department of Malacology  
Academy of Natural Sciences  
Nineteenth and the Parkway  
Philadelphia, Pennsylvania  19103
Mr. Vince Lang  
County Judge  
Box 486  
Munfordville, Kentucky 42765

Mr. Robert Aikman  
Rhea County Executive  
County Courthouse  
Dayton, Tennessee 37321

Mr. Raymond Bivens  
Meigs County Executive  
County Courthouse  
Decatur, Tennessee 37322

Board of County Commissioners  
White County Courthouse  
Carmi, Illinois 62821

Board of County Commissioners  
Wabash County Courthouse  
Mt. Carmel, Illinois 62863

Board of County Commissioners  
Wabash County Courthouse  
Wabash, Indiana 46992

Board of County Commissioners  
Martin County Courthouse  
Shoals, Indiana 47581

Board of County Commissioners  
Tippecanoe County Courthouse  
Lafayette, Indiana 47901

Board of County Commissioners  
Posey County Courthouse  
Mount Vernon, Indiana 47620

Mr. Floyd J. Marita  
Regional Forester  
U.S. Forest Service  
310 W. Wisconsin Avenue  
Milwaukee, Wisconsin 53203

Chief of Engineers  
Department of the Army  
Corps of Engineers  
210 N. 12th Street  
St. Louis, Missouri 63101
Chief of Engineers  
Department of the Army  
Corps of Engineers  
700 Federal Office Building  
Kansas City, Missouri  64106

Chief of Engineers  
Department of the Army  
Corps of Engineers  
6014 U.S. Post Office and Courthouse  
Omaha, Nebraska  68102

Chief of Engineers  
Department of the Army  
Corps of Engineers  
111 North Canal Street, Suite 600  
Chicago, Illinois  60606

Chief of Engineers  
Department of the Army  
Corps of Engineers  
P.O. Box 1027  
Detroit, Michigan  48231

Chief of Engineers  
Department of the Army  
Corps of Engineers  
Clock Tower Building  
Rock Island, Illinois  61201

Chief of Engineers  
Department of the Army  
Corps of Engineers  
1135 U.S. Post Office and Customhouse  
St. Paul, Minnesota  55101

National Park Service  
Interior Building  
P.O. Box 37127  
Washington, DC  20013-7127

Mr. Don H. Castleberry  
Regional Director  
National Park Service  
1709 Jackson Street  
Omaha, Nebraska  68102

Mr. Valdas V. Adamkus, Administrator  
U.S. Environmental Protection Agency  
230 S. Dearborn  
Chicago, Illinois  60604
Mr. Morris Kay, Administrator
U.S. Environmental Protection Agency
726 Minnesota Avenue
Kansas City, Kansas 66101

Dr. Lorin Nevling, Chief
Illinois State Natural History
Survey Division
Department of Energy and
Natural Resources
607 E. Peabody
Urbana, Illinois 61820

Illinois Department of Transportation
2300 S. Dirksen Parkway
Springfield, Illinois 62764

Mr. Donald R. Vonnahme, Director
Illinois Division of Water Resources
2300 S. Dirksen Parkway
Springfield, Illinois 62764

Mr. Richard J. Carlson, Director
Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Mr. Robert W. Gorden, Head
Aquatic Biology Section
Illinois State Natural History
Survey Division
172 Natural Resources Building
607 E. Peabody Drive
Champaign, Illinois 61820

Mr. Harold H. Wilson, Chairman
State Soil and Water Conservation
Committee
Indiana Department of Natural Resources
Room 7, AGAD Building
Purdue University
West Lafayette, Indiana 47907

Director
Ohio Department of Natural Resources
Fountain Square
Columbus, Ohio 43224
Mr. Robert Goettemoeller, Chief  
Division of Water  
Ohio Department of Natural Resources  
Fountain Square  
Columbus, Ohio 43224

Mr. Max E. Duckworth, Chief  
Division of Wildlife  
Ohio Department of Natural Resources  
Fountain Square  
Columbus, Ohio 43224

Dr. Charles C. King, Executive Director  
Ohio Biological Survey  
980 Biological Sciences Building  
Ohio State University  
484 W. 12th Avenue  
Columbus, Ohio 43210

Dr. Robert F. Carline  
Unit Leader  
Pennsylvania Cooperative Fish and  
Wildlife Research Unit  
Ferguson Building  
Pennsylvania State University  
University Park, Pennsylvania 16802

Mr. Joshua C. Whetzel, Jr., Chairman  
Western Pennsylvania Conservancy  
316 Fourth Avenue  
Pittsburgh, Pennsylvania 15222

Mr. Willis H. Hertig, Jr., Director  
West Virginia Department of  
Natural Resources  
1800 Washington Street, East  
Charleston, West Virginia 25305

Mr. Bernard F. Dowler  
Assistant Chief  
Warmwater Fisheries  
West Virginia Department of  
Natural Resources  
1800 Washington Street, East  
Charleston, West Virginia 25305

West Virginia Highlands Conservancy  
P.O. Box 306  
Charleston, West Virginia 25321
Board of County Commissioners
Gibson County Courthouse
Princeton, Indiana 47670

Chief of Engineers
Department of the Army
Corps of Engineers
Pulaski Building
200 Mass Avenue, NW.
Washington, DC 20314

Mr. David W. Robinson
Chief of Water Resources
West Virginia Department of Natural Resources
1800 Washington St., East
Charleston, West Virginia 25305

Mr. Robert Aldemeyer
County Judge
County Courthouse
Covington, Kentucky 41011

Mr. Ken Paul
County Judge
County Courthouse
Newport, Kentucky 41072

Mr. David Pribble
County Judge
County Courthouse
Falmouth, Kentucky 41040

Mr. James E. Claxon
County Judge
County Courthouse
Greenup, Kentucky 41144

Mr. Joe Kitchen
County Judge
County Courthouse
Grayson, Kentucky 41143

Mr. Robert James, President
Morgan County Commission
94 S. Fifth Street
McConnelsville, Ohio 43756

Mr. Dick Young, President
Washington County Commission
205 Putnam Street
Marietta, Ohio 45750
Dr. G. Thomas Watters  
Museum of Zoology  
Ohio State University  
1813 N. High Street  
Columbus, Ohio 43210-1394

Federal Highway Administration  
Office of Environmental Policy  
Environmental Analysis Division  
400 Seventh Street, SW., Room 3240  
Washington, DC 20590

Directorate for Biological, Behavioral,  
and Social Sciences  
National Science Foundation  
1800 G Street, NW., Room 215  
Washington, DC 20550

Mr. Dennis Sanders  
Virginia Department of Transportation  
P.O. Box 1768  
Bristol, Virginia 24203

Mr. William Beuter  
Virginia Department of Transportation  
Environmental Division  
1201 E. Broad Street  
Richmond, Virginia 23219

Dr. James Layzer  
U.S. Fish and Wildlife Service  
Tennessee Cooperative Fishery Research Unit  
Tennessee Technological University  
Box 5114  
Cookeville, Tennessee 38505

Dr. Mark Gordon  
U.S. Fish and Wildlife Service  
Tennessee Cooperative Fishery Research Unit  
Tennessee Technological University  
Box 5114  
Cookeville, Tennessee 38505

World Conservation Monitoring Centre  
219c Huntingdon Road  
Cambridge  
CB3 0DL  
United Kingdom
Environmental Assessment Section
Kentucky Natural Resources and
Environmental Protection Cabinet
Department for Natural Resources
Division of Abandoned Lands
618 Teton Trail
Frankfort, Kentucky 40601