RECOVERY PLAN

Cumberland Pigtoe Mussel

U.S. Fish and Wildlife Service

RECOVERY PLAN

for

Cumberland Pigtoe Mussel (*Pleurobema gibberum*)

Prepared by

Richard G. Biggins
Asheville Field Office
Asheville, North Carolina

and

Robert M. Anderson
Indiana Department of Natural Resources
Indianapolis, Indiana

for

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

Approved: _____
James W. Pulliam, Jr.
Regional Director, U.S. Fish and Wildlife Service

Date: August 13, 1992

Recovery plans delineate reasonable actions that 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 or the official positions or approvals of any individuals or agencies, other than the U.S. Fish and Wildlife Service, involved in the plan formulation. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1991. Cumberland Pigtoe Mussel (Pleurobema gibberum) Recovery Plan. Atlanta, Georgia. 20 pp.

Additional copies of this plan may be purchased from:

Fish and Wildlife Reference Service
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Bethesda, Maryland 20814
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EXECUTIVE SUMMARY

Current Status: The Cumberland pigtoe mussel is listed as endangered. This species is endemic to the Caney Fork River system (a Cumberland River tributary) in Grundy, Van Buren, Warren, and White Counties, Tennessee. Although presumably once widely distributed in the Caney Fork system, the species is presently known from short river reaches in only four Caney Fork River tributaries.

Habitat Requirements and Limiting Factors: The Cumberland pigtoe inhabits medium-sized rivers with fast-flowing water in areas with predominately gravel, sand, and cobble substratum. The species has been and continues to be impacted by water quality deterioration resulting from siltation contributed by coal mining and poor land use practices, by other water pollutants, and by impoundments.

Recovery Objective: Delisting.

Recovery Criteria: Establish four distinct viable populations to downlist. Establish six distinct viable populations to delist.

Actions Needed:

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

Cost (1,000's):

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Need 7	Total
1992	12.5	30.0	25.0	25.0	7.0	40.0	5.0	144.5
1993	25.0	30.0	20.0	25.0	7.0	40.0	5.0	152.0
1994	25.0	8.0	2.0	25.0	7.0	40.0	5.0	112.0
1995	25.0	0.0	2.0	0.0	7.0	20.0	2.0	56.0
1996	?	8.0	2.0	0.0	7.0	15.0	2.0	34.0
1997	?	0.0	2.0	0.0	7.0	15.0	2.0	26.0
1998	?	8.0	2.0	0.0	7.0	5.0	2.0	24.0
1999	?	0.0	2.0	0.0	7.0	0.0	2.0	11.0
2000	?	8.0	2.0	0.0	7.0	5.0	2.0	24.0
2001	?	0.0	2.0	0.0	7.0	0.0	2.0	11.0
2002	?	8.0	2.0	0.0	7.0	5.0	2.0	24.0
Total:	87.5*	100.0	63.0	75.0	77.0	185.0	31.0	618.5*

*Total recovery costs, including 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: The delisting and downlisting dates 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.

PART I

INTRODUCTION

The Cumberland pigtoe mussel (Pleurobema gibberum) was listed as an endangered species under the Endangered Species Act of 1973, as amended, on May 7, 1991 (U.S. Fish and Wildlife Service 1991). This species is endemic to the Caney Fork River system (a Cumberland River tributary) in Grundy, Van Buren, Warren, and White Counties, Tennessee. Although presumably once widely distributed in the Caney Fork system, the species now occurs in short reaches of only five Caney Fork River tributaries. The species has been and continues to be impacted by water quality deterioration resulting from siltation contributed by coal mining and poor land use practices, by other water pollutants, and by impoundments.

Description, Ecology, and Life History

The Cumberland pigtoe mussel (Pleurobema gibberum), which was described by Lea (1838), is apparently endemic to the Caney Fork River system above Great Falls (Rock Island Dam is now located at the Great Falls), Cumberland River basin, Tennessee (Anderson 1990, Gordon and Layzer 1989). This small freshwater mussel (rarely exceeds 60 millimeters in length) has a triangular, compressed, somewhat heavy shell. The shell's outer surface on young individuals is a yellowish-brown color; adults have a dark mahogany shell. The inside of the shell is a distinctive peach to orange color (Anderson 1990).

Because of its rarity, little is known of the mussel's biology. The species inhabits small to medium-sized rivers. Anderson (1990) found it inhabiting fast-flowing water in areas with predominately gravel, sand, and cobble substratum. Some sites where the species was collected had beds of macrophitic plants, but the mussel was usually found between, not within, these beds. Water depth ranged from about 10 centimeters to 1 meter. Anderson (1990) did not find any living specimens in pools or heavily silted areas.

Specific food habits of the Cumberland pigtoe 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 (Churchill and Lewis 1924), which they filter out of the water.

The Cumberland pigtoe's reproductive biology is largely 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. Anderson (1990) observed gravid females (with bright red marsupial gills) on July 18, 1987. Although he observed live Cumberland pigtoes at other times of the year, no other gravid specimens were collected. After the mussels release glochidia into

the water, they attach and encyst on the gills or fins of a host, generally a fish. When metamorphosis is complete, they drop to the streambed as juvenile mussels. The species of host fish utilized by the Cumberland pigtoe and the habitat utilized by the juveniles are unknown.

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

Based on historic mussel collection records from the Cumberland River system (Anderson 1990, Gordon and Layzer 1989), the Cumberland pigtoe is restricted to the Caney Fork River basin above Great Falls. Within this isolated river basin, the species has been reported from only five Caney Fork River tributaries. However, historic mussel collection records from the upper Caney Fork system are very limited. This mussel's preferred habitat is riffle areas with sand and gravel with occasional mud and cobble substratum (Anderson 1990, Gordon and Layzer 1989). Prior to the construction of Rock Island Reservoir in the 1910s, this habitat type was more common; the species was likely much more widely distributed within the Caney Fork system than available records indicate.

The species once likely occurred in the main stem of the Caney Fork River, and it was historically collected from Hickory Creek and the Collins River. Anderson (1990) surveyed both areas. He found the species in the Collins River but did not collect any specimens at his four sampling stations in the lower Hickory Creek system. However, Widlak (U.S. Fish and Wildlife Service, personal communication, 1992) reported that a population was located in 1992 in the upper portion of Hickory Creek above the area searched by Anderson (1990). Anderson (1990) did not find the species in any unimpounded reaches of the Caney Fork River. It is believed that the species has now been extirpated from the Caney Fork River and lower Hickory Creek.

Presently, the species is restricted to isolated populations in short reaches of five Caney Fork tributaries--Barren Fork, Warren County; Calfkiller River, White County; Cane Creek, Van Buren County; Hickory Creek, Warren County; and Collins River, Warren and Grundy Counties (Anderson 1990, Widlak 1992). Anderson (1990) also surveyed other Caney Fork tributaries, and he did not find the mussel in Big Creek, Big Hickory Creek (Widlak [1992] later reported a population from this creek), Charles Creek, Dry Branch Barren River, Falling Water River, Firescald Creek, Fultz Creek, Little Hickory Creek, Mountain Creek, Pine Creek, Rocky River, Sink Creek, Smith Fork, Smith Fork Creek, and West Fork Hickory Creek.

The five extant populations are impacted by such factors as impoundments and the general deterioration of water quality resulting from domestic and industrial waste outfalls. Nonpoint pollution sources have limited the distribution of mussels, including the Cumberland pigtoe, in the Caney Fork system. Runoff from surface and deep coal mining operations affects areas of the Collins River, Caney

Fork River, Rocky River, and their headwater tributaries. Poor agricultural practices have resulted in soil loss and nutrient enrichment that impact scattered stream reaches throughout the species' range. Construction of bridges, roads, and buildings without adequate siltation control appears to have reduced habitat in sections of the Calfkiller and Collins Rivers. Recent gravel removal operations have destroyed habitat and increased siltation in the upper Caney Fork River and some tributaries. The population in lower Hickory Creek appears to have been lost due to nutrient enrichment and siltation resulting from domestic animal waste (from cows and hogs), as well as from physical habitat alteration caused by allowing animals to have free access to the stream.

Mussel populations in adjacent watersheds with similar geology (upper Duck and Elk Rivers) have also been largely lost as a result of poor land management practices and impoundments (Anderson 1990; Stephen Ahlstedt, Tennessee Valley Authority, personal communication, 1990).

Because the Cumberland pigtoe is presently restricted to short river reaches, it is also very vulnerable to extirpation from accidental toxic chemical spills. Also, because the populated reaches are physically isolated from each other by impoundments and unsuitable habitat, recolonization of any extirpated population would be unlikely without human intervention. Additionally, because natural gene flow among populations is no longer possible, the long-term genetic viability of these remaining isolated populations is questionable.

PART II

RECOVERY

A. Recovery Objectives

The ultimate goal of this recovery plan is to restore viable populations of the Cumberland pigtoe mussel (Pleurobema gibberum) to a significant portion of its historic range in the upper Caney Fork River system and to remove the species from the Federal List of Endangered and Threatened Wildlife and Plants. **NOTE:** A viable population is defined as a naturally reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural environmental changes. The number of individuals needed to achieve a viable population will be determined as one of the recovery tasks.

The Cumberland pigtoe mussel 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 four distinct viable populations exist. The populations shall be distributed within the upper Caney Fork River system and can include the present populations or newly discovered or created populations.

2. One distinct naturally reproduced year class exists within each of the four populations. The year class must have been produced within 5 years prior to the time the species is reclassified from endangered to threatened. Within 1 year of the downlisting date, gravid females and the mussel's host fish must be present in each populated river reach.

3. Biological and ecological studies have been completed and any required 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 four populations.

The Cumberland pigtoe mussel 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 six 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.

2. Two distinct naturally reproduced year classes exist within each of the six 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 and the mussel's 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 six populations.

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

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

B. Narrative Outline

1. Preserve the existing populations of the species in the Collins River, Calfkiller River, Barren Fork, and Cane Creek.

1.1 Identify and eliminate specific threats that jeopardize the existing Cumberland pigtoe populations. The five known populations of the Cumberland pigtoe exist in geologically complex areas with correspondingly complex land uses. The Collins River and Cane Creek populations are threatened by coal mining, agricultural activities, and domestic waste. Additionally, the Collins River has extensive plant nurseries and some urban development potentially affecting water quality. The Calfkiller River and Barren Fork populations appear to be primarily affected by urban development and small-scale agricultural uses. Streambed gravel mining impacts all the populations. The nature of and the mechanisms by which these factors 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 1.2 and 1.3 must be utilized to target specific problem areas and determine the specific causative agent(s).

1.2 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 Cumberland pigtoe mussel's life history exists. Unless the species' life history (especially its host fish) and environmental requirements are defined, recovery efforts may be inconsequential or misdirected.

1.3 Characterize the species' habitat requirements (relevant physical, biological, and chemical components) for all life history stages. The Cumberland pigtoe mussel appears to be sensitive to habitat degradation. The species coexists with other mussel species, but it generally 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.

1.4 Investigate the relationship with nonnative bivalves. Many malacologists believe the Asiatic clam (Corbicula fluminea) poses a threat to the native mussel fauna. Another exotic clam, the zebra mussel (Dreissena polymorpha), has recently invaded the Great Lakes, and

some adverse impacts to endemic mussels have been noted. A few zebra mussels have been seen in the Ohio River basin. Because the species has spread quickly in the Great Lakes, it may prove to be a problem in the Ohio River system. 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.

1.5 Determine number of individuals required to maintain a viable population. Theoretical considerations by Franklin (1980) and Soulé (1980) indicate that 500 breeding individuals represents 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, possibly by as much as 10 times. The factors that will influence effective population size include sex ratio, length of the species' reproductive life, fecundity, and extent of exchange of genetic material within the population, plus other life history aspects.

2. Work with Federal, State, and local government entities and with local businesses and individuals to preserve present populations and occupied habitat. Because so few Cumberland pigtoe mussel populations exist, it is essential to the survival and eventual recovery of the species that all existing populations and their habitat are protected.

2.1 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 Cumberland pigtoe mussel populations can be protected only by the full enforcement of existing laws and regulations. Regulatory agencies with jurisdiction over portions of the species' range should be made aware of the sensitive nature of the species' habitat. Some agencies may be unaware of how and to what extent their agency's actions could adversely impact the species.

2.2 Monitor the levels of siltation and pesticide run-off in the basin and work with the Environmental Protection Agency to encourage strict compliance with pesticide use standards. Nonpoint sources of pollution are difficult to assess and control. However, their control is critical to the recovery of this species. Monitoring should be conducted to determine fluctuations during the

year as well as during divergent flow conditions. Sources of contaminants should be identified and brought into compliance with State and Federal clean water legislation.

2.3 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 the protection of the species, but these programs alone cannot recover the Cumberland pigtoe mussel. 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.

2.3.1 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. The Cumberland pigtoe is poorly known. Making government agencies aware of this species' existence in the upper Caney Fork River watershed, its value as a water quality indicator, and its contribution to the overall environmental quality of the region may assist in the protection of this riverine habitat.

2.3.2 Meet with local business, mining, logging, farming, and/or industry interests to identify deleterious land and water uses and elicit their support in implementing protective actions. The most immediate threat to the survival of the Cumberland pigtoe is continued deterioration of the water and habitat quality in the Caney Fork system. Soil erosion and associated nutrient, pesticide, and herbicide inputs may be significant factors in the demise of this mussel. Localized habitat loss may also be attributed to gravel removal, all-terrain-vehicle use in streams, watering animals in streams, and household waste disposal.

2.3.3 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 the use of mussels as indicators of good environmental quality.

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

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 (Anderson 1990). However, it is possible that some relic populations were missed. Further study may yield additional populations; and, more importantly, suitable habitat for transplants could likely be identified during these surveys.

4. Determine, through research, the feasibility of augmenting extant populations and reestablishing the Cumberland pigtoe mussel into historic habitat and reintroduce where feasible. The historic distribution of the Cumberland pigtoe mussel is unknown, but available records indicate that the species was likely once widespread in the upper Caney Fork 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. The extant populations may have insufficient individuals to maintain long-term genetic 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 reintroductions 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. Cryogenic preservation of the species could maintain genetic material (much like seed banks for endangered plants) from all the extant populations. 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 actions are implemented, 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 other studies, etc.). The recovery plan must be evaluated annually 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

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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

COE - U.S. Army Corps of Engineers
FWE - Fish and Wildlife Enhancement
FWS - U.S. Fish and Wildlife Service
TDOC - Tennessee Department of Conservation
TNC - The Nature Conservancy
TVA - Tennessee Valley Authority
TWRA - Tennessee Wildlife Resources Agency

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS			FY	FY	FY	
				Region	Division	Other				
1	1.1	Identify and eliminate threats.	3 years to identify; unknown time to eliminate	4	FWE	See *, pg. 15.	12.5	25.0	25.0	
1	1.2, 1.3	Conduct research necessary for species' protection, management, and recovery; i.e., habitat requirements, and biology.	4 years	4	FWE	See *.	25.0	25.0	25.0	
2	1.4	Investigate interactions with non-native bivalves.	2 years	4	FWE	See *.	15.0	15.0	15.0	
3	1.5	Determine number of individuals required to maintain viable population.	1 year	4	FWE	See *.	---	---	?	
1	2.1	Continue to utilize existing legislation and regulations to	Ongoing	4	FWE	See *.	7.0	7.0	7.0	

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS			FY	FY	FY	
				Region	Division	Other				
		protect species and its habitat.								
1	2.2	Monitor levels of silt and pesticides.	Ongoing	4	FWE	See *.	10.0	10.0	10.0	
2	2.3.1, 2.3.2	Meet with local governmental officials and business interests and elicit their support for recovery.	3 years	4	FWE	See *.	---	---	2.0	
1	2.3.3	Develop information and education program and present.	Ongoing	4	FWE	See *.	25.0	20.0	---	Task duration: 1 year to develop, then continuous.
2	2.4	Consider use of land acquisition to protect the species.	Ongoing	4	FWE	See *.	---	---	---	
1	3	Search for additional populations and suitable habitat.	1 year	4	FWE	See *.	30.0	30.0	8.0	

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (Years)	RESPONSIBLE PARTY			COST ESTIMATES ($000'S)			COMMENTS
				FWS			FY	FY	FY	
				Region	Division	Other				
1	4	Develop techniques, select sites, reintroduce the species back into historic habitat, augment populations, and protect any populations established.	Ongoing	4	FWE	See *.	40.0	40.0	40.0	Task duration: 3 years (protection continues).
1	5	Develop and implement cryopreservation.	3 years	4	FWE	See *.	5.0	5.0	5.0	
2	6	Develop and implement a monitoring program.	Ongoing	4	FWE	See *.	---	---	8.0	Biennial.
3	7	Annually assess recovery program and modify program and plan where required.	Ongoing	4	FWE	See *.	0.5	0.5	0.5	

* - COE, TDOC, TNC, TVA, and TWRA

PART IV

LIST OF REVIEWERS

Mr. Robert A. Hunt, Director
Division of Water Resources
Tennessee Department of Conservation
701 Broadway
Nashville, Tennessee 37203

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

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

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

Mr. Dan Eagar
Program Administrator
Ecological Services Division
Tennessee Department of
Environment and Conservation
701 Broadway
Nashville, Tennessee 37243-0447

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

Dr. Arthur E. Bogan
36 Venus Way
Sewell, New Jersey 08080

Dr. Paul W. Parmalee
Department of Anthropology
The University of Tennessee
Knoxville, Tennessee 37916

Dr. David H. Stansbery
Museum of Zoology
Ohio State University
1813 North High Street
Columbus, Ohio 43210

Natural Resources Defense Council, Inc.
40 West 20th Street
New York, New York 10011

Dr. Arthur Clarke
Ecosearch Inc.
325 E. Bayview
Portland, Texas 78374

Mr. Julius T. Johnson
Director of Public Affairs
Tennessee Farm Bureau Federation
P.O. Box 313
Columbia, Tennessee 38401

Mr. Elbert T. Gill, Jr.
Commissioner
Tennessee Department of Conservation
701 Broadway
Nashville, Tennessee 37219-5237

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

U.S. Soil Conservation Service
U.S. Court House, Room 675
801 Broadway
Nashville, Tennessee 37203

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

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

Tennessee State Clearinghouse
1800 James K. Polk Building
501 Deadrick Street
Nashville, Tennessee 37219

U.S. Geological Survey, WRD/SR
Spalding Woods Office Park - Suite 160
3850 Holcomb Bridge Road
Norcross, Georgia 30092-2202

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. Riley Anderson, Jr.
County Executive
Grundy County Courthouse
Altamont, Tennessee 37301

Mr. Charles Curtiss
County Executive
White County Courthouse
Sparta, Tennessee 38583

Mr. Jackie Clayton
County Executive
Van Buren County Courthouse
Spencer, Tennessee 38585

Mr. L. Ray Moore
County Executive
Warren County Courthouse
McMinnville, Tennessee 37110

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
P.O. Box 5114
Cookeville, Tennessee 38505

Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814

Environmental Protection Agency
Hazard Evaluation Division - EEB (TS769C)
401 M Street, SW.
Washington, DC 20460

Mr. Rich Owings
North Carolina Arboretum
P.O. Box 6617
Asheville, North Carolina 28816

Mr. Alan Smith
P.O. Box 887
Mars Hill, North Carolina 28754

Mr. Ben Hafer
2117 Andy Holt Avenue, #1527
Knoxville, Tennessee 37916

Mr. John Geddie
8040 Bellamah Court, NE.
Albuquerque, New Mexico 87110

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

U.S. Forest Service
Wildlife, Fisheries, and Range
1720 Peachtree Road, NW.
Atlanta, Georgia 30367

fish and wildlife reference service

5430 GROSVENOR LANE, SUITE 110
BETHESDA, MD 20814
800-582-3421 (301) 492-6403/6404