77-09-09-005

ALABAMA CAVEFISH

RECOVERY PLAN

ALABAMA CAVEFISH

Speoplatyrhinus poulsoni

COOPER AND KUEHNE 1974

(Second Revision)

Recovery Plan

(Original Approved: 1982)
(First Revision Approved: September 23, 1985)

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EXECUTIVE SUMMARY

Current Status: The Alabama cavefish is known from only one cave in Lauderdale County, Alabama. Population levels and trends are not known. The limited access to the aquifer and limited number of individuals makes any systematic population study very difficult and potentially dangerous to the species.

Habitat Requirements and Limiting Factors: Specific habitat requirements are not known. This species is a cave obligate. Cave habitats are relatively stable, with the most dramatic changes associated with water inflows.

Recovery Objective: To downlist the Alabama cavefish from endangered to threatened status.

Recovery Criteria: The objective of this plan is to reclassify the Alabama cavefish from endangered to threatened status. The criteria for downlisting the Alabama cavefish are: (1) when three other viable populations are found in discontinuous aquatic systems outside the Key Cave area, (2) when the recharge areas for all four populations are protected, and (3) when all four populations are demonstrated to be stable or increasing over at least a 20-year period, this species will be reclassified as a threatened species. These reclassification criteria are preliminary and may be revised as new data becomes available.

Actions Needed:

1. Study local and regional hydrological patterns.
2. Conduct field surveys for Alabama cavefish.
3. Assess and monitor the Key Cave aquifer.
4. Assess and protect the energy source.
5. Conduct biological studies of the entire Key Cave ecosystem.

Total Estimated Cost of Recovery: With practically no information on the life history, population levels, and habitat requirements for this species, an estimate of the cost of recovery to the point of downlisting is not possible. The estimated cost for the three years in this plan is $469,000.

Date of Recovery: Recovery may not be possible for this species as the time required for meeting the objective is a function of locating additional populations.

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the listed 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 citation should read as follows:

U.S. Fish and Wildlife Service, 1990. Alabama Cavefish, (*Speoplatyrhinus poulsoni*) Cooper and Keuhne 1974 Recovery Plan. U.S. Fish and Wildlife Service. Jackson, Mississippi. 17 pp.

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Fish and Wildlife Reference Service
5430 Grosvenor Lane, Suite 110
Bethesda, Maryland 20814
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The fee for the plan varies depending on the number of pages.

PART I: INTRODUCTION

Background

The Alabama cavefish was first collected on March 18, 1967, by J.E. and M.R. Cooper. Merlin Tuttle collected the holotype on May 24, 1970, which was identified in 1974 as Speoplatyrhinus poulsoni by J. Cooper and R. Kuehne (Cooper and Kuehne 1974). The Alabama cavefish is known only from the type-locality, Key Cave in Lauderdale County, Alabama. Only nine specimens are known to exist in scientific collections. Based on the apparent distribution, specimens collected, and individuals observed, this small fish appears to be the rarest of American cavefish and one of the rarest of all freshwater fish (Cooper 1977, 1980). Speoplatyrhinus poulsoni closely resembles the only other cavefish known from within its range, the southern cavefish, Typhlichthys subterraneus.

This species is known from only Key Cave and may be an endemic relict in this aquatic system. If this is correct, the Alabama cavefish is a monotypic genus in tenuous circumstances and therefore is considered a high priority species on a global basis for ensuring its continued survival. On the basis of the known distribution, the Alabama cavefish was officially recognized in the Federal Register (42 FR 45526-45530) as a threatened species and Key Cave as critical habitat by the U.S. Department of the Interior, effective October 11, 1977. Based upon further clarification of the species range, the Service determined the Alabama cavefish to be an endangered species effective October 28, 1988 (53 Federal Register 37968-37970). Critical habitat designation remains unchanged.

Description

The Alabama cavefish has no obvious pigment and appears pinkish-white. It has a size range of just less than 60 millimeters (mm) (2.4 inches) in standard length (Cooper 1980). The integument, fins, fin rays, and elements of the cranial skeleton are quite transparent. The fish has no externally visible eyes, and probably no internal optical structures.

Like other members of the family Amblyopsidae, S. poulsoni has (1) a large branchial cavity, ostensibly for oral incubation, (2) nearly overlapping branchiostegal membranes, (3) a vent that is jugular in position, (4) tubular anterior nostrils (that direct water to an olfactory rosette), and (5) imbedded cycloid scales. The fish lacks pelvic fins, as do all amblyopsids except the northern cavefish, Amblyopsis spelaea. Like the other troglobites of the family, the Alabama cavefish shows great hypertrophy of the lateral line system, with an extensive system of free neuromasts arranged in obvious ridges. Also, like the other troglobitic amblyopsids, it has long, delicate pectoral fins, and the most highly developed caudal sensory papillae in the family. Other similarities can be found in Cooper and Kuehne (1974).

Speoplatyrhinus is readily distinguished from other amblyopsid cavefishes by: (1) its very large, extremely elongate head, which comprises over a third of the standard length in adults, (2) its dorsoventrally depressed and laterally constricted snout, which has a bill-like appearance, (3) the absence of bifurcate fin rays in all fins, (4) its notably incised fin membranes, which impart a spiked appearance to all fins (especially the caudal), (5) the absence of supraopercular papillae, structures that extend the opening of each supraorbital canal in other amblyopsids, (6) its nearly terminal as opposed to distinctly superior mouth, and (7) larger and fewer caudal sensory papillae than any other amblyopsid. The Alabama cavefish additionally differs from the southern cavefish, Typhlichthys subterraneus (the only other amblyopsid known from within its range), in having five caudal rays between the inner rows of caudal sensory papillae instead of three. Cooper and Kuehne (1974) provided other distinctive features.

Distribution

The only known locality at which the Alabama cavefish occurs is Key Cave in Lauderdale County, Alabama (Figure 1). The fish's distribution is characteristic of relics, i.e. a limited area at the periphery of a broader family range.

When this species was initially listed, it was speculated that the distribution may be more widespread than just one cave. A review of records for 120 caves in Colbert and Lauderdale Counties determined that suitable habitat may exist in 27 caves (Cobb 1985, 1986). Those 27 caves were surveyed without finding Speoplatyrhinus poulsoni. The occurrence of southern cavefish to the east and south of Key Cave and probably to the north (Cobb 1985, 1986) is further evidence the Alabama cavefish is restricted to one site. A potentially more widespread distribution of the Alabama cavefish may well have been changed by competition for food and space by the more adaptable southern cavefish.

Habitat

The cave environment is considered to be relatively stable with low temperature and lack of visible incident radiation. However, because of flooding, the aquatic portion of the cave habitat is not as stable as the terrestrial one, though it is more stable than surface aquatic habitat (Poulson 1963). Variations in the aquatic cave habitat are primarily related to the annual rainfall cycle and flood events. Flooding in caves brings changes in water level, temperature, food availability, turbidity, and water chemistry. They may also be the trigger for hormonal and other changes in aquatic organisms (Poulson 1961).

In most caves, the lack of primary producers results in dependency of primary consumers on the import of organic matter. Flooding is responsible for organic import in most caves (Poulson 1961). This increase in food availability as a result of flooding may be a factor in cavefish reproduction. In Key Cave, the gray bat colony is likely the primary source of organic matter through the deposition of guano.

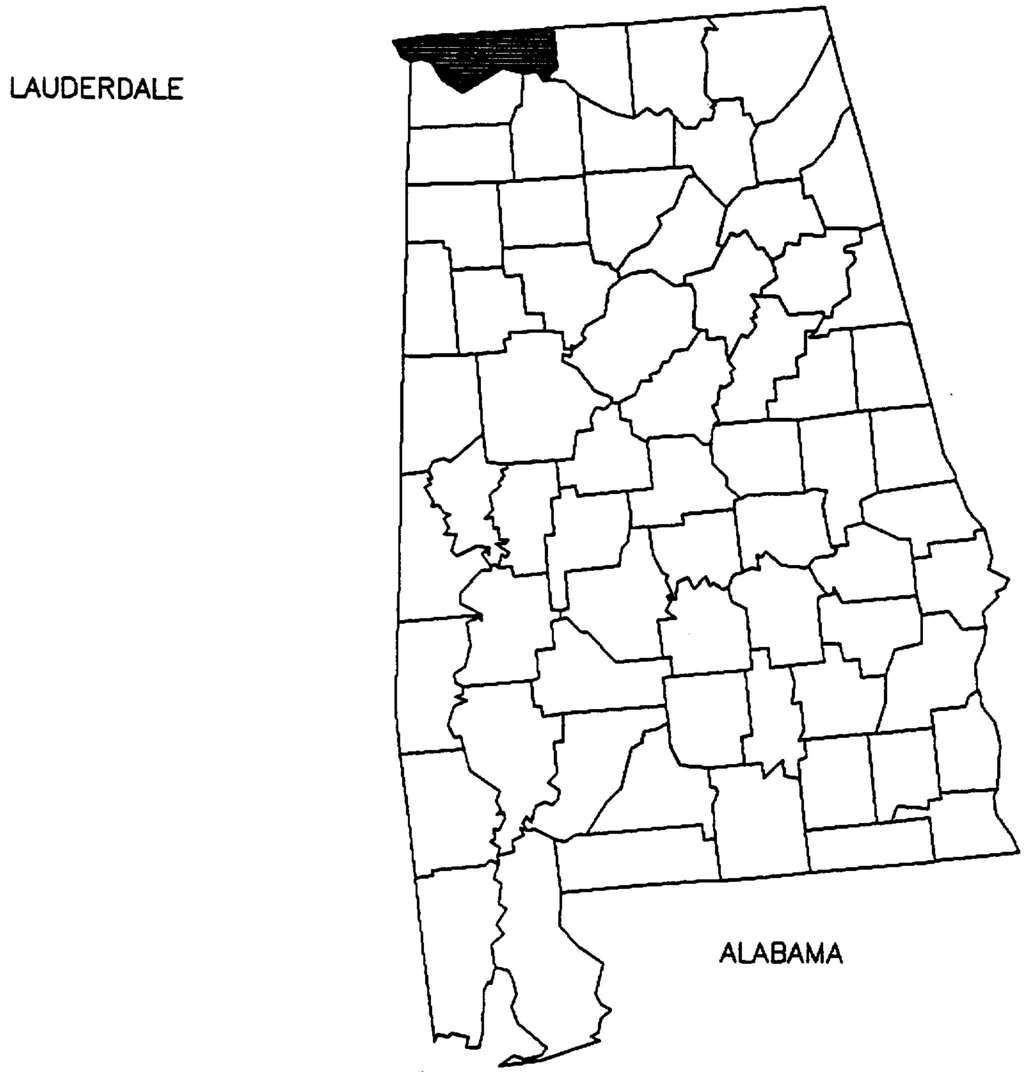

Fig. 1: Range of Alabama Cavefish

Life History/Ecology

The environmental triggers which result in growth and reproductive cycles for obligate cave species must be different than for surface species. Surface species are affected by photoperiod and temperature changes. Seasonal flooding of caves may trigger hormonal and other changes in cavefish, thereby, stimulating growth and reproduction (Poulson 1961). It is not known if temperature changes, increased food availability or some other factor or combination of factors relative to flooding is the trigger for reproductive activity.

The primary consumers in the Key Cave aquatic community are the Alabama cavefish and two species of cave crayfish. The food of the cavefish has not been determined, but undoubtedly includes copepods, isopods, amphipods, and small crayfish.

The Alabama cavefish likely incubates the eggs and protects fry in branchial chambers similar to the northern cavefish, Amblyopsis spelaea (Poulson 1961). Cavefish show an increase in longevity and a decrease in population growth rate with increasing restriction to caves (Poulson 1961). At one spawning, a northern cavefish female will produce an average of 45 fry which survive to leave the gill chamber, two-thirds of which will be female. Only about 55 percent of the population is mature and only 20 percent of the females spawn in a given year (Poulson 1961). The rate of population growth for the northern cavefish is likely more than twice that of the Alabama cavefish.

This probability is based upon the Alabama cavefish being the most cave adapted of the amblyopsids (U.S. Fish and Wildlife Service 1982). Using Poulson's findings on the northern cavefish, the maximum longevity of the Alabama cavefish is 5-10 years. This estimate may be off by a factor of three or four (Poulson 1963).

Status

Factors which are most likely to limit or cause the decline of the Alabama cavefish include unsuccessful reproduction, groundwater degradation, alteration in drainage and hydrologic patterns, lower ground water levels, collecting, and diminished organic matter inputs.

Groundwater degradation caused by toxins, nutrient fertilizers, sewage and the inflow of lower quality water could have far-reaching effects on the Alabama cavefish. Such a primary consumer will bioconcentrate toxins found in the food chain and will likely find food organisms less abundant with lower water quality. This aquatic, environment related stress will likely reduce longevity and reproductive capability. The recharge area for Key Cave includes considerable agricultural land and until recently included an active sewage sludge land application site.

Alterations in drainage and hydrologic patterns may affect aquifer recharge capabilities. In addition to reducing flow rates in cave streams, the input of organic matter may be reduced when surface drainage is altered. This directly affects the cavefish's food supply and reproductive capabilities.

The lowering of groundwater levels may also occur from increased pumping of groundwater. Permanent lowering of the water table could reduce aquatic troglobitic habitat and isolate it from extrinsic energy sources. Planned industrial development of the Key Cave area could alter drainage and hydrological patterns within the recharge area for Key Cave.

Collecting for novelty value or for scientific or educational purposes could be devastating to the population. The larger individuals of other more common cavefish are the most frequently taken. Such taking of the Alabama cavefish would represent a reduction of an already tenuous breeding population.

Diminished organic matter inputs adversely impact the aquatic food base in many caves. In Key Cave, the gray bat maternity colony is perhaps the primary source of organic input by deposition of guano. The status of the gray bat in Key Cave is important to the status of the Alabama cavefish (Tuttle 1979).

Limiting factors to dispersal of the Alabama cavefish include the geologic area in which Key Cave occurs and possibly competition from the southern cavefish. The Tuscumbia formation, which contains Warsaw limestone, in which Key Cave exists is a large aquifer and an excellent conveyor of groundwater. This formation rests on Fort Payne chert which is cut by many joints that furnish passage for groundwater. In such a system, the potential for dispersal of aquatic troglobites is very good unless thin bedding exists in some areas or if physical features block dispersal routes. A biological consideration to the dispersal of Alabama cavefish is competition from other species of cavefish. The Alabama cavefish may once have occupied a larger range that was reduced by competition by the southern cavefish. The southern cavefish is an aggressive species with a greater reproductive potential than any of the other troglobitic cavefish. There is no data available on the population trends of the Alabama cavefish. During a partial survey of Key Cave in 1984, U.S. Fish and Wildlife Service biologists saw 10 Alabama cavefish. This observation represents more than has ever been seen during a single excursion and also more than the entire known collection of the species. The survey was likely more intensive than any previous biological survey of Key Cave. The small numbers of cavefish observed on a given trip, the unknown extensiveness of the aquatic habitat, and the difficulty in traversing Key Cave make any estimate of the total cavefish population very tenuous.

Conservation Measures

Maps of Key Cave and nearby Collier Slough Bone Cave have been completed and the entrance to Key Cave has been fenced. In 1983, a survey team of Fish and Wildlife Service biologists traversed 800 feet of passage to estimate the population. A total of 10 Alabama cavefish were counted at five sites. The sites were selected on the basis of access and do not represent a statistical sample. This cave is very difficult to traverse and the aquifer is not very accessible. Much of the 800 feet surveyed had water at a lower level that was not observable. Any effort to assess the total population will have to rely upon some type of mark and recapture study. The status of this species is too tenuous for such a study now. A dye tracing study has identified discrete recharge points and identified areas where hazardous substances may enter the aquifer (Aley 1990). This study indicates that Collier Bone Slough Cave shares the aquifer with Key Cave. This indicates that the Alabama cavefish may also occur in Collier Bone Slough Cave, even though there are no known sightings. This lack of sightings may be due to very difficult access to the limited habitat, rather than the absence of cavefish. Should an Alabama cavefish be sighted in Collier Bone Slough Cave, it would not be evidence of an additional population since this is continuous habitat with Key Cave.

PART II: RECOVERY

A. Objective

The objective of this plan is to reclassify the Alabama cavefish from endangered to threatened status. The criteria for downlisting the Alabama cavefish are: (1) when three other viable populations are found in discontinuous aquatic systems outside the Key Cave area, (2) when the recharge areas for all four populations are protected, and (3) when all four populations are demonstrated to be stable or increasing, this species will be reclassified as a threatened species. These reclassification criteria are preliminary and may be revised as new data becomes available.

A viable population is defined as a population with the reproductive capability to sustain itself without immigration of individuals from other populations.

Protected is defined as having enough control over the geographic area in question that adverse impacts are unlikely to occur.

Stable or increasing is defined as a population level that remains at the same or higher level as evidenced by monitoring over a 20 year period.

The time required for meeting this objective is a function of the success in locating additional populations of the Alabama cavefish, determining and protecting the recharge areas, and of the species' ability to maintain a viable population. Recovery will take at least 20 years after these events occur.

B. Narrative Outline for Recovery Actions Addressing Threats

1. Study local and regional hydrological patterns. The specific recharge and resurgence areas of the ground water system that contains the Alabama cavefish is unknown. This knowledge is necessary before the Fish and Wildlife Service can protect Key Cave and would help in assessing the extent of habitat and distribution.

    1.1 Determine recharge and drainage area for Key Cave. A dye trace study has identified discrete recharge points for Key Cave (Aley 1990). To protect this system, and thereby the species, we must fully identify the discrete and diffuse recharge to the cave. Using water-level data from wells in the area will allow development of a potentiometric map from which the boundary of the recharge area can be further delineated.

1.2 Determine the extent of potential continuous habitat. If the Key Cave recharge area is not localized, determine the extent of the system and identify potential cave habitat in the area.

1.3 Develop and implement protection of the recharge area. With the determination of the recharge area, important components of that area must be identified. Once identified, these areas will be protected by the most practical method. The method will be determined for each component.

2. Conduct field surveys for Alabama cavefish. Other populations of the Alabama cavefish must be discovered to meet the recovery objective. An experienced caver with the ability to identify cavefish will survey caves for potential habitat, and for species associated with the Alabama cavefish, i.e. cave crayfish. Earlier surveys by Cobb and others will be used to select caves with potential habitat.

2.1 Survey caves near Key Cave. Caves in the Tuscumbia formation in Lauderdale and Colbert Counties, Alabama, will be surveyed for suitable habitat and species associates. Those caves that contain suitable habitat or species associates will be surveyed at periodic intervals until cavefish have been observed or until all reasonable effort to locate another population of *Speoplatyrhinus poulsoni* has been expended. The presence of southern cavefish will be evidence that Alabama cavefish are not present. Bell, Elbow, and Watkins Sink Caves are the best candidates for an additional population of *Speoplatyrhinus poulsoni* (Cobb 1985). From previous efforts, it is apparent that SCUBA will be required if cavefish are to be captured in any of these three caves (Cobb *in litt*.).

2.2 Survey caves in adjacent counties, water-filled sinks and wells. Survey any caves in the Warsaw limestone formation not included in 2.1. Survey caves in the Fort Payne chert formation. Survey water-filled sinks and monitor wells for cavefish where possible.

2.3 Survey Collier Slough Bone Cave. Collier Slough Bone Cave shares the Key Cave aquifer (Aley 1990), and as a result *Speoplatyrhinus poulsoni* likely occurs in the limited habitat. The only accessible water in Collier Slough Bone Cave will be surveyed to document the presence of this species. Cobb (*in litt*.) believes the reported pool of water in this cave to be a drip pool with no likely connection to the water table. Any survey of this cave will attempt to determine if permanent water is present. Should Speoplatyrhinus poulsoni be found in Collier Slough Bone Cave, it will not indicate a second population since the aquifer would be continuous between these caves. A single impact to the aquifer would affect both caves.

2.4 Monitor all populations of Alabama cavefish. This task will conduct systematic monitoring of all known populations at three year intervals to determine trends. The method of conducting this task will be determined for each population.

3. Assess and monitor the Key Cave aquifer. Survival of the Alabama cavefish is totally dependent upon the Key Cave aquifer, based upon known distribution of the species. Impacts to the aquifer must be determined and adverse impacts eliminated if the Alabama cavefish is to survive.

3.1 Identify past trends in water table and flows. Correlate historical well log and spring flow data with precipitation data for the same periods. Assess probable cause of change and potential impact of future environmental modifications to the water table and flows.

3.2 Assess changes in water table and flows. Monitor changes in water levels in Key Cave by placing graduated rods at various stations in the cave. Monitor waterflows from drainage sites identified in hydrologic studies. Correlate changes in water level and flows with precipitation and with water levels in Pickwick Reservoir to assess impacts to the Alabama cavefish. Preliminary work by Cobb (in litt.) indicates the water level in Key Cave fluctuates with the level of Pickwick Reservoir. A crevice near the entrance may allow the monitoring of water levels year round without disturbing the maternity colony of gray bats (Cobb in litt.).

3.3 Collect baseline data on water quality. Using standard methods for field sampling, collect water, sediment, bat guano, and crayfish tissues for analysis. Survey data will include water and air temperature, turbidity, pH, dissolved oxygen, free carbon dioxide, specific conductivity, total dissolved and suspended solids, total and fecal coliform bacteria, metals, and pesticides.

3.4 Monitor groundwater quality parameters. Monitor water and air temperatures, turbidity, dissolved oxygen and pH at monthly intervals for one year and quarterly for the next four years. Any significant deviation from baseline data would require a resumption of monthly monitoring. Monitor metal and pesticide levels annually. Monitor all other baseline parameters semi-annually for five years.

4. <u>Assess and protect the energy source.</u> Since primary producers are not permanent members of subterranean aquatic systems, the integrity of such systems depends on extrinsic energy inputs. A major contributor of organic matter to Key Cave is the gray bat. Survival of the Alabama cavefish may depend upon the gray bat.

   4.1 <u>Implement the Gray Bat Recovery Plan for Key Cave.</u> The gray bat population must be protected and the relationship of its trophic input on the Alabama cavefish evaluated. Maintain the existing fence and limit entry to Key Cave by law enforcement. Monitor the bat population and assess changes relative to trophic input to Key Cave. Protection of this bat colony enroute to and from Key Cave is also necessary. There is some evidence this colony uses Collier's Cave on their departure from Key Cave (Cobb <u>in litt</u>.). They may also use it in enroute to Key Cave. Either of these possibilities increase the need to protect Collier's Cave from disturbance during these critical periods.

   4.2 <u>Identify and assess other inputs of energy.</u> Using hydrologic data, determine sites where trophic inputs may occur. Identify and quantify the inputs relative to amount and nutrient content. Relate the significance of these other trophic inputs to the gray bat's contribution to this cave. Aley (1990) indicates that water entering Key Cave aquifer passes through plugged sinkholes. This would filter out much of the organic matter, increasing the importance of the bat colony to the cavefish. The location and importance of these trophic input points must be determined.

5. <u>Conduct biological studies of the entire Key Cave ecosystem</u>. Failure to see cavefish in a cave system does not necessarily mean they are not there. The occurrence of species normally associated with cavefish is an indicator the habitat is suitable and deserves further survey. This requires that we know the constituency of the Key Cave aquatic community.

   5.1 <u>Identify undescribed aquatic species.</u> The major aquatic faunal components of Key Cave have been identified. The identity of microscopic organisms such as copepods, ostracods, and minute oligochaetes is currently unknown. Sampling with plankton nets and microscopic analysis of sediment samples to identify these components should be accomplished.

   5.2 <u>Acquire data on macroscopic crustacean population dynamics.</u> The major troglobitic crustacea of Key Cave, as currently known, are an isopod, an amphipod, and two crayfishes. All of these are vital in the trophic ecology of the cavefish. The size and structure of each species' population should be estimated using standard indexes. Careful analysis of the impact of removing large troglobites from the community must always precede sampling. If such action is determined to impact the cavefish, the action must not be taken.

5.3 Conduct study of Alabama cavefish. Recovery of the cavefish requires that we know the biology of the species. Pertinent studies should follow the methodologies used by Poulson on other amblyopsids. Such studies would include a determination of population size, structure, and dynamics; foods and feeding ecology; reproduction, natural mortality, and the rate of population increase; growth and longevity; and ecophysiology.

5.3.1 Estimate population size and assess population structure. Population size must be estimated to help determine if specimens can be collected and sacrificed. A non-harmful method of mark and recapture may be required. Assessing population structure will aid in determining if any individuals could be sacrificed with minimal impact on the population.

5.3.2 Determine reproductive requirements. If this species incubates eggs and protects fry in branchial chambers like other amblyopsids, this can be determined by observation. We also need to determine age at maturity, frequency of spawning, fecundity, length of reproductive life, and survival of fry to reproductive age.

5.3.3 Determine food organisms and preferences. Evaluating potential habitat requires that we know the required food organisms. This may require sacrificing individuals and will only be undertaken when the population can withstand the loss of individuals.

5.3.4 Determine growth rates, maturation age, and estimate longevity. Estimating growth and longevity from growth increments of individuals, assessing natural mortality, and getting data on some aspects of behavior is necessary to manage cavefish populations for recovery. Such knowledge gained from the study of Alabama cavefish in Key Cave will aid in the management of any other populations that are discovered.

Literature Cited

Aley, T. 1990. Delineation and Hydrogeologic Study of the Key Cave Aquifer, Lauderdale County, Alabama. A report prepared for the U.S. Fish and Wildlife Service. 114 pp. + appendix and maps.

Cobb, R.M. 1985. A reconnaissance of caves in Lauderdale and Colbert Counties, Alabama for the Alabama cavefish, Speoplatyrhinus poulsoni. A report prepared for the U.S. Fish and Wildlife Service. 26 pp.

Cobb, R.M. 1986. An attempt to collect specimens of cavefish at three cave sites in northwest Alabama. A report prepared for the U.S. Fish and Wildlife Service. 8 pp. + map

Cooper, J.E. 1977. American cave fishes and salamanders. Paper presented Interpretive Biology Session, Natl. Speleol. Conv., Alpena, MI. 8 manuscript pp.

Cooper, J.E. 1980. Speoplatyrhinus poulsoni Cooper and Kuehne, Alabama cavefish. p. 482 in: D.S. Lee, et al. Atlas of North American Freshwater.

Cooper, J.E., and R.A. Kuehne. 1974. Speoplatyrhinus poulsoni, a new genus and species of subterranean fish from Alabama. Copeia (2):486-493.

Poulson, T.L. 1961. Cave adaptation in amblyopsid fishes. Unpub. PhD dissert., Univ. Mich., Ann Arbor. vi + 185 pp.

Poulson, T.L. 1963. Cave adaptation in amblyopsid fishes. Am. Midl. Nat. 70(2):257-290.

Tuttle, M.D. 1979. Status, causes of decline, and management of endangered gray bats. J. Wildl. Manag. 43(1):1-17.

U.S. Fish and Wildlife Service. 1982. Alabama Cavefish Recovery Plan. U.S. Fish and Wildlife Service. 72 pp.

U.S. Fish and Wildlife Service. 1988. Endangered and threatened Wildlife and Plants: Reclassification of the Alabama Cavefish from threatened to endangered. Federal Register 53(188):37968-37969

PART III: IMPLEMENTATION SCHEDULE

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

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

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

<u>Key to acronyms used in Implementation Schedule</u>

FWE - Fish and Wildlife Enhancement, U.S. Fish and Wildlife Service
Res. - Division of Research, U.S. Fish and Wildlife Service
LE - Division of Law Enforcement, U.S. Fish and Wildlife Service
AGS - Alabama Geological Survey
ADEM - Alabama Department of Environmental Management
USGS - U.S. Geological Survey
EPA - Environmental Protection Agency
TVA - Tennessee Valley Authority
NSS - National Speological Society
ADCNR - Alabama Department of Conservation and Natural Resources

IMPLEMENTATION SCHEDULE										
				RESPONSIBLE PARTY			COST ESTIMATES ($K)			
				USFWS						
PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION	Region	Program	Other	FY 1991	FY 1992	FY 1993	COMMENTS/NOTES
1	1.1	Determine recharge and drainage area for Key Cave	2 years	4	FWE	AGS ADEM USGS	50	25		
1	1.3	Protect recharge area	continuous	4	FWE					
1	3.1	Identify trends in water table and flows	3 years	4	FWE	USGS AGS	10	10	10	
1	3.2	Assess changes in water table and flows	1 year	4	FWE Res.	USGS AGS	40			
1	3.3	Collect base line data on water quality	1 year	4	FWE Res.	ADEM EPA TVA	30			
1	3.4	Monitor groundwater quality	5 years	4	FWE Res. ECE	TVA ADEM EPA	10	10	10	
2	1.2	Determine continuous habitat	3 years	4	FWE	TVA AGS ADEM USGS NSS	50	50	50	
2	4.1	Implement Gray Bat Recovery Plan for Key Cave	continuous	4	FWE LE	TVA ADCNR	5	5	5	
2	5.3	Study Alabama cavefish	10 years	4	FWE RES	TVA ADCNR NSS	10	10	10	

IMPLEMENTATION SCHEDULE

PRIOR-ITY #	TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY: USFWS Region	RESPONSIBLE PARTY: USFWS Program	RESPONSIBLE PARTY: Other	COST ESTIMATES ($K) FY 1991	COST ESTIMATES ($K) FY 1992	COST ESTIMATES ($K) FY 1993	COMMENTS/NOTES
3	2.1	Survey caves near Key Cave	10 years	4	FWE		5	5	5	
3	2.2	Survey caves, sink wells in adjacent counties	10 years	4	FWE		7.5	7.5	7.5	
3	2.3	Survey Collier's Slough Bone Cave	2 years	4	FWE	ADCNR NSS	1	1	1	
3	2.4	Monitor populations	30 years	4	FWE		2	2	2	
3	4.2	Other inputs of energy	3 years	4	FWE	USGS AGS TVA				
3	5.1	Identify undescribed aquatic species	5 years	4	FWE Res.	TVA ADCNR	7.5	7.5	7.5	
3	5.2	Study crustacean population	5 years	4	FWE RES	TVA ADCNR NSS				

APPENDIX

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