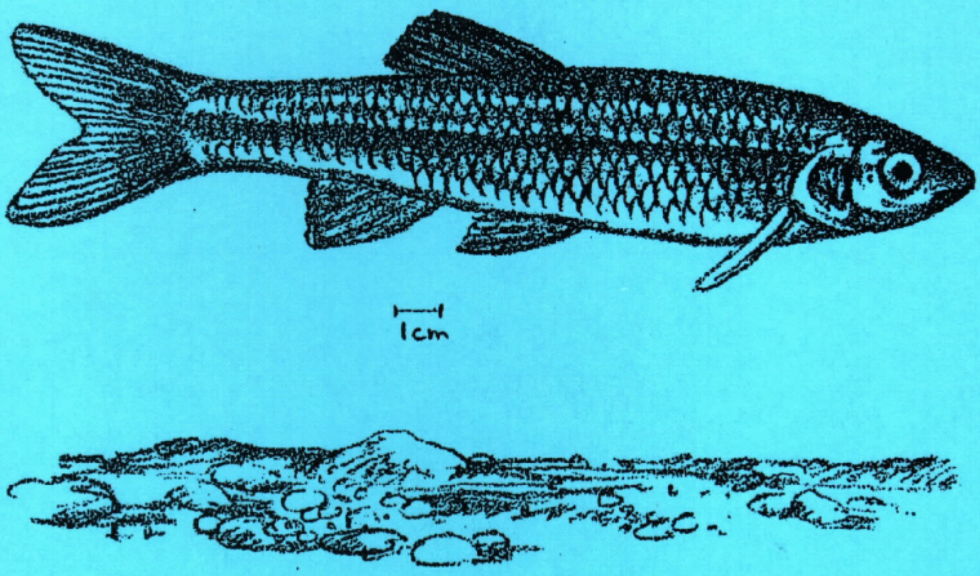
RECOVERY PLAN

Blue shiner

(Cyprinella caerulea)



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

BLUE SHINER
(*Cyprinella caerulea*)
RECOVERY PLAN

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EXECUTIVE SUMMARY

Current Status: The blue shiner was listed as threatened on April 22, 1992. It is represented by approximately six populations occurring in headwater streams of the Coosa River system in Northwest Georgia and Southeast Tennessee, and in smaller tributaries of the Coosa River in Northeast Alabama. Populations are isolated by impoundments, inappropriate habitat, inadequate water quality, and distance. The species has apparently been extirpated from the Cahaba River system and Big Wills Creek, in the upper Coosa River of Alabama, and perhaps other streams within the Coosa system.

Habitat Requirements and Limiting Factors: The blue shiner requires water of relatively high quality and appears sensitive to turbidity and siltation. Major threats are habitat alteration and water quality degradation.

Recovery Objective: The objective is to delist the species.

Recovery Criteria: The blue shiner may be delisted when significant threats in specified stream stretches are reduced and populations in those stretches are documented to be viable.

Actions Needed:

1. Determine ecological needs.

2. Develop and implement a plan to identify and reduce threats to essential habitats.

3. Monitor populations and essential habitats.

4. Reintroduce the shiner into former habitats.

Total Estimated Cost of Recovery: The estimated cost of recovery may be at least $750,000 and will increase if the time required to attain recovery is prolonged.

Date of Recovery: The date of recovery can not be determined at this time.

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I. INTRODUCTION

Background and Description

The blue shiner (*Cyprinella caerulea*) was originally described by D.S. Jordan in 1877 as *Photogenis caeruleus* from tributaries of the Oostanaula River, Floyd County, Georgia. The following year it was placed in the genus *Erogala*, and in 1891, it was moved to the genus *Notropis*. Finally in 1981, it was transferred to the genus *Cyprinella*, following a revision by Mayden (1989). It was designated as a threatened species on April 22, 1992 (U.S. Fish and Wildlife Service 1992).

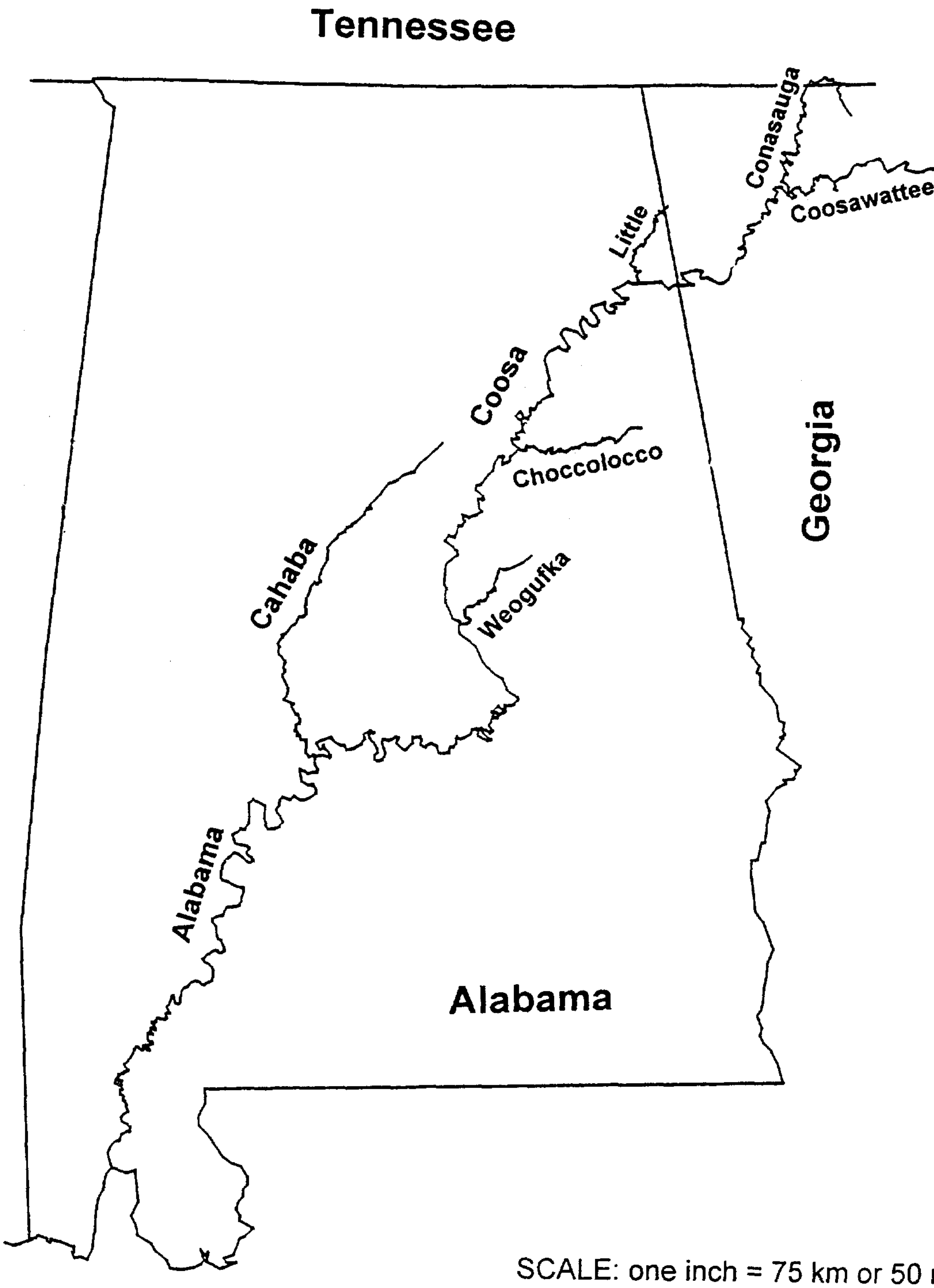
The blue shiner is a medium-sized minnow that grows to about 100 millimeters (4 inches) in total length (Krotzer 1984, Ramsey and Pierson 1986, Mayden 1989, Krotzer 1990). Males are larger than females. Nonbreeding males and females are dusky blue with pale yellow fins. The scales are diamond-shaped and outlined with melanophores. The lateral line is distinct. Breeding males develop nuptial tubercles, a yellowish tint in the fins, and a metallic blue sheen on the body. Females lack tubercles or breeding colors.

Distribution

The historic range of the blue shiner included two major rivers within the Mobile Basin, the Cahaba and Coosa (Smith-Vaniz 1968, Ramsey 1976, Krotzer 1984, Ramsey and Pierson 1986, Pierson and Krotzer 1987, Mayden 1989, Pierson et al. 1989, Boschung 1992, Etnier and Starnes 1993, Dobson 1994). At present, this minnow is thought to be represented by six populations in the Coosa River system in Northeast Alabama, Northwest Georgia, and Southeast Tennessee (Figure 1, page 2).

The Alabama range for this species is Weogufka Creek (Coosa County); Choccolocco Creek, and the lower reach of Shoal Creek, a tributary (Calhoun County); and Little River (Cherokee County) (Ramsey and Pierson 1986, Pierson and Krotzer 1987, Mayden 1989, Pierson et al. 1989, Suttkus and Etnier 1991, Boschung 1992, Dobson 1994). The blue shiner was historically known from a 100-kilometer (km) (60-mile [mi]) reach of the Cahaba River, extending from Jefferson County to Bibb County (Ramsey and Pierson 1986, Pierson et al. 1989). It was last collected in the Cahaba in 1971, and may be extirpated from that system (Krotzer 1984, Ramsey and Pierson 1986, Pierson and Krotzer 1987). It has not been seen in Big Wills Creek, a tributary of the upper Coosa River in DeKalb County, Alabama, since 1958 (Ramsey and Pierson and Krotzer 1987). In Georgia, the blue shiner was historically known from the Conasauga River (Murray and Whitfield counties) and three tributaries: Holly, Perry, and Rock creeks (Murray County); and the Coosawattee

Figure 1. Map of the Mobile Basin showing river systems where the blue shiner has been reported.



SCALE: one inch = 75 km or 50 mi

River (Murray County) and one tributary, Turniptown Creek (Gilmer County); and from unspecified tributaries of the Oostanaula River (perhaps in Floyd County), the type locality (Freeman 1983, Boschung 1992).

Possible sightings of blue shiners in the Conasauga River have been recently made as far downstream as U.S. Highway 76 (Freeman 1995). If this is confirmed, it would be a 25 km (16 mi) range extension. In the past 10 years, collections of blue shiners in Georgia have been limited to the upper Conasauga River and in Rock Creek (Freeman, personal communication 1995). Its status in the other streams in Georgia is unknown.

In Tennessee, the blue shiner's range is limited to the Conasauga River (Bradley and Polk counties) and the lower-most portion of a small, second order tributary, Minnewauga Creek (Polk County).

Estimates of blue shiner population sizes are unavailable. However, Pierson and Krotzer (1987) reported that the blue shiner represented 6 to 15 percent of the total fish population in Choccolocco and Weogufka creeks, and Conasauga and Little rivers. Dobson (1994) found that blue shiners represented 7 percent, on average, of the total fish population in Little River, but individual sample values exceeded 25 percent. Numbers of blue shiners were seasonally stable at one site that was sampled monthly for 1 year in the Little River (Dobson 1994).

Based on the amount of stream reach occupied by blue shiners the largest extant population probably occurs in the Conasauga River (at least 35 km or 22 mi). The Cahaba River population, previous to its extirpation in the 1970s, was found in a 100-km (60-mi) reach (Ramsey and Pierson 1986, Pierson et al. 1989).

Habitat Requirements

The blue shiner primarily occupies second to fourth order, moderate gradient streams within the Ridge and Valley and Piedmont physiographic provinces of Alabama, Georgia, and Tennessee (Smith-Vaniz 1968, Ramsey 1976, Krotzer 1984, Ramsey and Pierson 1986, Pierson and Krotzer 1987, Mayden 1989, Pierson et al. 1989, Boschung 1992, Etnier and Starnes 1993, Dobson 1994). Most watersheds where it is found are predominately forested, and agriculture and urban development are minimal. For example in Alabama, land cover in the Choccolocco watershed is 66 percent forest, 20 percent pasture, and 13 percent agriculture. The headwaters of Choccolocco and Shoal creeks are in Talladega National Forest. The Weogufka watershed is also primarily forested; the lowermost portion is managed by the Kimberly Clark Corporation. The Little River flows through Little River Canyon

National Preserve (formerly DeSoto State Park), which is managed by the National Park Service. In Georgia and Tennessee, the blue shiner is found in the upper reaches of streams flowing through two National Forests. The Conasauga River originates within the Chattahoochee National Forest in Georgia and flows into Tennessee where it enters the Cherokee National Forest. Minnewauga Creek is within the Cherokee National Forest. Rock Creek, in Georgia, is mostly within the Chattahoochee National Forest. Perry and Holly Creek have headwaters in the Chattahoochee National Forest.

The blue shiner can be abundant in the proper habitat and is rare or absent elsewhere, suggesting that it is habitat dependent (Pierson, personal communication 1994). It is a fluvial specialist, being found only in flowing water. It prefers a sand or sand and gravel substrate sometimes with cobble, low to moderate velocity current, and a depth of about 0.15 to 1 meters (0.5 to 3 feet) (Gilbert et al. 1979; Krotzer 1984, Pierson and Krotzer 1987, Dobson 1994). Blue shiners are sometimes associated with submerged tree roots and fallen branches. They also occur near water willow (*Justicia americana)* beds, especially in eddy currents downstream from the beds. In the Little River and Choccolocco Creek, lateral pools away from the main current, and backwaters with sandy substrates were preferred (Pierson and Krotzer 1987, Dobson 1994). In Weogufka Creek, Pierson (personal communication 1994) observed a concentration of blue shiners below a leaky beaver dam where flows were moderated. In the Conasauga River and Weogufka Creek, this shiner is also prevalent in long, low-velocity pools.

Krotzer (1984) found the blue shiner in the Conasauga River in association with the closely-related, tricolor shiner (*Cyprinella trichroistia*) and the Coosa shiner (*Notropis xaenocephalus*). Pierson (personal communication 1994) observed in Alabama streams that the occurrence of the tricolor shiner and the greenbreast darter (*Etheostoma jordani*) were good indicators of suitable blue shiner habitat. In Little River, Dobson (1994) found that the tricolor shiner and the blue shiner would school together as juveniles.

There is little available information on the water quality necessary to maintain blue shiner habitat. This is because the shiner primarily lives in streams in rural areas where water quality sampling is not regularly conducted. Blue shiner habitat seasonally ranges from cool to warm. In the upper Conasauga River, for example, temperatures range widely from about 5 to 30° Celsius (C)(40 to 85° Fahrenheit [F]), but the average is near 16° C (60° F) (Freeman, personal communication 1994). Dissolved oxygen concentrations in the upper Conasauga are probably near saturation throughout the year because of low biological or chemical oxygen demand. Water clarity in blue shiner habitat is relatively high due to the extent of land-cover in these watersheds. Freeman believes that a turbidity value of approximately 10 nephelometric turbidity units (NTU) was about average for the upper Conasauga River (personal communication 1994); however, more recent observations by Freeman suggest that turbidity may be increasing (personal communication 1995). A value of 10 NTU is indicative of relatively high water clarity for the Southeast.

Life History and Ecology

Some aspects of the blue shiner's life history in the Conasauga River, Georgia, have been studied (Krotzer 1984, 1990). Based upon the presence of fish in breeding condition (e.g., tuberculate males with enlarged testes and nuptial colors, and changes in the size of developing eggs [oocytes] and ovaries in females), Krotzer (1984, 1990) determined that spawning extended from early May through late August. It is likely that multiple clutches of eggs are produced as evidenced by the extended spawning season and the occurrence of distinct size classes of oocytes. Spawning sites are unreported, however; other *Cyprinella* species are known to be cavity spawners that lay adhesive eggs in cavities in submerged rock and wood, and under the bark of downed trees (Mayden, 1989).

Length-frequency analysis revealed that the blue shiner lives for 3 years, and that most spawning fish were 2 years old (Krotzer 1984, 1990). Mortality of adults during August and September is high, possibly as a result of exhaustion following spawning.

The diet of the blue shiners is dominated throughout the year by terrestrial insects (Krotzer 1984, Etnier and Starnes 1993), indicating that the blue shiner is a visual, drift feeder. Other *Cyprinella* species are also known to feed on a variety of benthic, planktonic, and drifting invertebrates and are thought to be visual predators (see Mayden 1989).

The importance of riparian vegetation and a tree canopy along the stream margin of blue shiner habitat is suggested by the importance of terrestrial insects in the diet. Successful visual foraging may be dependent on water clarity, as suggested by Ramsey and Pierson (1986).

Reasons For Listing

The exact causes of blue shiner declines are unknown. However, there is strong circumstantial evidence to suggest that water quality degradation was a major factor. Reductions in water quality, e.g. nutrification and probable low dissolved oxygen levels, coincided with extirpation of the blue shiner and other aquatic species from the Cahaba River (Howell et al. 1982, Ramsey 1982; O'Neil 1984, Pierson and Krotzer 1987, U.S. Environmental Protection Agency 1979, and Shepard et al. 1994 a and b). Relatively high levels of nitrogen and phosphorus still occur at sites throughout the basin. Increased algal biomass, high diurnal dissolved oxygen fluctuations, and decreased dissolved oxygen values were associated with low flows. The EPA found that flow in the Cahaba River was insufficient to handle the sewage load.

In Georgia, blue shiner habitat is threatened by point- and nonpoint-source pollution originating from rapid increase in homesite development in rural areas of Northwest Georgia. Stream flow could be reduced by increased demand for water caused by this growth.

In watersheds where nutrification is not a problem, excessive turbidity may be the major problem. Blue shiner survival may require high water clarity because of its possible effects on feeding and reproduction. Successful feeding may depend on seeing drifting prey from a distance. Turbid water would reduce the distance that prey would be seen, with the result being a lowered food intake. Turbidity may affect food competition with other shiners.

Turbidity could also adversely affect reproduction. Reproduction in *Cyprinella* species often involves courtship and territorial displays by males (see Mayden 1989). Mating could be inhibited by turbid water if females are unable to see these displays. Also, turbidity may affect survival of blue shiner eggs if they are laid where they might be smothered by silt.

The blue shiner's range has been reduced and fragmented by construction of dams, loss of habitat, and/or water pollution. This has created isolated and relatively small populations. Of all known blue shiner populations, only the one in the Conasauga is relatively large, extending over about 35 km (22 mi) of stream. However, the amount of occupied habitat is actually much smaller than the total stream miles occupied because of habitat heterogeneity.

Isolated populations are especially vulnerable to habitat degradation and decreased genetic diversity. Any event that adversely affects an isolated population has the potential to eliminate it. This is especially true for stream-dwelling species since recolonization may be prevented by a variety of barriers, e.g., dams, inappropriate habitat, poor water quality, and distance. Thus, a single, even ephemeral incident or event such as a chemical spill or an extreme drought can permanently reduce the range of an aquatic species with fragmented populations and make it very susceptible to extinction. Isolated populations may also suffer from low genetic diversity limiting their ability to adapt to environmental changes. Also, such populations may be adversely affected by low reproduction simply because of the scarcity of potential mates. All of the existing blue shiner populations need protection to preserve genetic diversity and to reduce the likelihood of a catastrophic extinction event.

Conservation Measures

The Fish and Wildlife Service has taken actions to aid in the recovery of the blue shiner. The Nature Conservancy of Tennessee has received Fish and Wildlife Service funding to plan a watershed enhancement program aimed at the Conasauga River. In addition, the Fish and Wildlife Service will be preparing educational brochures that describe how land management affects water quality and aquatic biota (including endangered species). These brochures will be distributed to local landowners.

The Natural Resources Conservation Service (NRCS) is also involved in recovery actions. Its Rome, Georgia office is developing a plan to reduce adverse agricultural effects on water quality in the Conasauga watershed (R. Oliver, NRCS, Rome, GA, personal communication 1994). Governments at all levels are also working to enhance water quality in the Cahaba River.

Recovery Strategy

Recovery may be best achieved through reduction of threats and increasing our knowledge about the blue shiner's habitat requirements. Watershed protection is an essential component of threat reduction and recovery cannot be achieved without it. Studies on the blue shiner's ecology can help reduce threats by identifying potential stressors. Monitoring is essential to recovery because it documents further declines or increases in populations and range.

II. RECOVERY

A. **Recovery Objectives**

The blue shiner will be considered for delisting when extant populations within its current range (i.e., Conasauga River, Choccolocco Creek, Little River, Holly Creek system, Weogufka Creek, and Coosawattee River system) plus one additional population in the species' former range (Cahaba River) demonstrate long-term viability and are all adequately protected.

A population will be considered to have achieved long-term viability when it is persistent, i.e., rebounds following significant natural perturbations, such as a severe drought. Criteria for determining what constitutes persistence will be developed as one of the recovery tasks. Since severe droughts or floods would be the most likely natural catastrophic events to threaten the species, the effect of 50- or 100-year hydrologic events should be considered.

A population will be considered aqequately ptotected when protective measures (e.g., conservation agreements and or easements, Memorandums Of Understanding (MOU's), adoption of silvicultural and agicultural best management practices, regulations and ordinances, etc.) have been implemented to protect essential habitat and ensure population viability. Protection should extend within the watershed, including both public and private lands, to the point where future adverse impacts to the stream systems would be unlikely.

The habitats essential for these populations are herein termed "essential habitats"; they are listed below.

Essential Habitats:

1. **Calhoun County, Alabama**

   Choccolocco Creek from its crossing by Federal Highway 78 upstream to its origin, and including tributaries.

2. **Cherokee County, Alabama**

   Little River from its confluence with Weiss Lake upstream to its origin, and including tributaries.

3. **Coosa County, Alabama**

Weogufka Creek from its confluence with Lake Mitchell upstream to its origin, and including tributaries.

4. **Gilmer County, Georgia**

a. Coosawattee River from its confluence with Mountaintown Creek upstream to its formation by the confluence of the Ellijay and Cartecay Rivers.

b. Ellijay River from its confluence with the Cartecay River upstream to its confluence with Turniptown Creek; and Turniptown Creek from its confluence with the Ellijay River upstream to its origin.

5. **Murray County, Georgia**

Holly Creek from its confluence with Rock Creek upstream to its origin, including tributaries;

Rock Creek from its confluence with Holly Creek upstream to its origin, including tributaries.

6. **Murray County, Georgia and Bradley and Polk County, Tennessee**

a. Conasauga River from its crossing by U.S. Highway 76 (State Highway 52) upstream to its origin;

b. Perry Creek from its confluence with the Conasauga River upstream to its origin; and

c. Minnewauga Creek from its confluence with the Conasauga River upstream to its origin.

7. **Bibb, Jefferson, and Shelby counties Alabama**

Cabaha River from the Fall Line to its headwaters.

Essential habitat may need to be revised as new survey data is obtained. Reclassification criteria are preliminary and may be revised on the basis of new information.

B. Narrative Outline

1. Determine ecological needs.
Before threats to the blue shiner can be removed the ecology of the species must be better understood.

    1.1. Determine necessary macrohabitat parameters. Aquatic species are tolerant of a range of chemical and physical factors such as water temperature, pH, nutrient content, dissolved oxygen levels (DO), amount of suspended sediments, and etc. These parameters usually change over the course of kilometers rather than meters and thus are referred to as macrohabitat parameters.

    Macrohabitat parameters are usually lumped under the term "water quality." It is believed that one major water quality parameter adversely affecting the blue shiner is suspended silt. Unfortunately little baseline data exist on the water quality in blue shiner streams because few synoptic water quality stations are located in these primarily headwater streams.

    Long-term water quality measurements need to be made in various sized streams that support blue shiners. It is important that parameter extremes (e.g., DO, temperature, turbidity, and nutrients) be determined, rather than just measure average conditions. Once it is known what water quality factors are normal in blue shiner streams, these streams can be monitored for abnormal conditions and measures to reduce or eliminate problems can be implemented.

    1.2. Determine necessary microhabitat parameters. Aquatic species are also adapted to a range of physical "microhabitat" parameters such as substrate size, depth, and flow that can change over relatively short distances. Available data suggest that the blue shiner occupies a range of microhabitats but that this range is relatively narrow. To insure long-term protection of the species the microhabitat needs of the blue shiner need to be determined. Such studies should examine habitat needs of all life history stages from eggs to adults.

1.3. Determine natural history of the blue shiner. Crucial to our ability to recover the species is information on breeding behavior, spawning sites, and early life history. Developing eggs and larvae are often more sensitive to water quality than other life-history stages, however; nothing is known about the extent of this sensitivity for the blue shiner.

1.4. Determine diet.
The blue shiner appears to be an opportunistic visual, drift feeder that feeds extensively on terrestrial insects. Additional data is needed to determine seasonal changes in diet and the source of the prey, e.g., are the insects living on riparian vegetation or are they primarily wind dispersed from more distant sites.

1.5. Determine population persistence.
Recovery of the blue shiner will be evident when long-term persistence is demonstrated. Persistence is perhaps best demonstrated if populations rebound following a significant natural perturbation such as a severe drought. Modeling the potential effects of such events as 100-year droughts on blue shiner habitat may lead to a better understanding of how to determine persistence.

2. Develop and implement a plan to identify and reduce threats to blue shiner essential habitats.
Reduction of threats to the blue shiner is essential for its recovery. A plan to identify potential threats and implement measures to reduce these threats needs to be developed in partnership with appropriate parties.

2.1. Define guidelines for activities that may adversely affect the blue shiner.
Activities such as pesticide and herbicide application, bridge and road construction, impoundment construction, land clearing, removal of riparian vegetation, discharge of point source domestic and industrial effluent, and urban and agricultural run-off may be detrimental to the blue shiner. This task would seek to identify these impacts and to define conditions under which specific activities would not adversely affect the species. Defining acceptable conditions will guide future conservation actions necessary to protect the blue shiner as provided for by the Endangered Species Act (Act).

Until stress levels of pollutants and water quality parameters are identified, the Fish and Wildlife Service recommends that stream reaches (including upstream waters) having blue shiner populations be protected by giving them the highest water quality classification such as "Outstanding State Resource Water."

2.2. Solicit help in protecting the species and its essential habitat.
The majority of the stream habitat of the blue shiner is within private ownership. Recovery of the blue shiner will require a coordinated effort by public and private sectors. Support from the industrial and business community, as well as from private landowners should be sought to recover the species.

Federal lands also are essential to the recovery of this species. The quality (and quantity) of water flowing from the Chattahoochee and Talladega National Forests could affect the blue shiner. Federal agencies have a responsibility under section 7(a)(1) of the Act to aid recovery of listed species. Actions by these agencies that would improve water quality and preserve riparian vegetation along blue shiner essential habitat could benefit recovery.

2.3. Develop a public outreach program.
The assistance of the public and private sectors can be favorably influenced by an outreach program that emphasizes the benefits of watershed protection to enhance water quality, improve water-related recreation, and protect aquatic biodiversity. This task involves developing such a program and promoting it in watersheds occupied by the blue shiner. Outreach should involve other agencies, schools, organizations, and individuals. Outreach would be most successful if it were oriented at communities in watersheds where there are blue shiners.

2.4. Utilize existing legislation to protect the species and its habitats.

Sections 7 and 9 of the Act afford protection to the blue shiner and its habitat. Careful adherence to this and other environmental legislation (e.g., Clean Water Act) will help prevent further blue shiner population declines. Section 7 consultations should ensure that Federal actions cause minimal loss of water quality and quantity to blue shiner essential habitats.

The blue shiner occurs in Chattahoochee, Cherokee, and Talladega National Forests and other populations occur in streams that have their headwaters within these National Forests. These Forests are required by section 7(a)(3) of the Act to consult with the Fish and Wildlife Service if their actions may affect listed species. Any actions that would likely affect water quality or quantity could affect the blue shiner. These include: timber cutting, road, bridge, or dam construction, instream gravel mining, and pesticide spraying. Regular transport of hazardous materials over bridges upstream of blue shiner populations could also be a potential threat.

3. Monitor the status of blue shiner populations and its essential habitat. Protection of this species requires that the status of each population and its habitat are monitored and that corrective actions are taken when a downward trend is indicated or if habitat becomes significantly degraded. Habitat monitoring should include obtaining data on the quality and quantity of instream habitat as well as monitoring land-cover in areas adjacent to essential habitat. Fish and habitat sampling methods should be consistent so that trend analyses are possible.

Periodic sampling in formerly occupied habitat may indicate the species has increased to detectable levels. As the species' range expands, the area sampled each year should also increase. Monitoring should be continued as long as there are significant threats or if persistence is in doubt.

The range and status of the blue shiner is not fully known. Some of the historic sites for the species have not been sampled in the past 10 years. Surveys also need to be conducted in former habitat, e.g., Cahaba River and tributaries, to be certain the species is not now present. Sufficient habitat needs to be sampled to estimate population sizes. This information will serve as a baseline for future monitoring. Population viability should be confirmed through long-term monitoring (as determined by Task 1.5) before a final assessment is made of its eligibility for delisting.

4. Reintroduce into former habitats.
Reintroduction of blue shiners into former habitat is necessary for recovery. Degraded water quality in the late 1960s and early 1970s was believed responsible for extirpation of the blue shiner in the Cahaba River. However, water quality improvements have occurred there and if this trend continues it will perhaps be possible to reestablish a viable population of blue shiners in the Cahaba River.

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III. IMPLEMENTATION SCHEDULE

This Implementation Schedule outlines recovery actions and their estimated costs for the first 3 years of the recovery program. It is a guide for achieving objectives discussed in Part II of this plan. This Schedule indicates task priorities, task numbers, task descriptions, duration of tasks, responsible agencies, and estimated costs.

Priorities in column one of the following Implementation Schedule are assigned as follows:

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

2 - An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

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

Key to acronyms used in Implementation Schedule

ADCNR - Alabama Dept. of Conservation and Natural Resources
ADEM - Alabama Department of Environmental Management
COE - U.S. Army Corp of Engineers
EPA - Environmental Protection Agency
GDNR - Georgia Department of Natural Resources
GSA - Geological Survey of Alabama
HC - Habitat Conservation, U.S. Fish and Wildlife Service
LE - Law Enforcement, U.S. Fish and Wildlife Service
NBS - National Biological Service
NRCS - Natural Resources Conservation Service, U.S.D.A.
TE - Endangered Species Division, U.S. Fish and Wildlife Service
TWRA - Tennessee Wildlife Resources Agency
USGS - U.S. Geological Survey, U.S. Department of Interior
USFS - U.S. Forest Service, U.S. Department of Agriculture

IMPLEMENTATION SCHEDULE

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY			COST ESTIMATES ($K)			COMMENTS/NOTES
				USFWS		Other	FY 1	FY 2	FY 3	
				Region	Division					
1	1.1	Determine macrohabitat parameters of essential habitats.	3 years	4	TE	ADCNR, COE, GDNR, GSA, NBS, TWRA, USFS, USGS,	50	50	50	
1	1.2	Determine microhabitat paramaters of essential habitats.	3 years	4	TE	ADCNR, COE, GDNR, GSA, NBS, TWRA, USFS, USGS	20	20	20	
2	1.3	Determine life history.	2 years	4	TE	ADCNR, GDNR, NBS, TWRA, USFS	20	20	-	
2	1.4	Determine diet.	2 years	4	TE	ADCNR, GDNR, GSA, NBS, TWRA, USFS	20	20	-	
2	1.5	Determine time for persistance.	1 year	4	TE	ADCNR, GDNR, GSA, NBS, TWRA, USFS	20	-	-	
3	2.1	Define guidelines for activities.	continuous	4	HC, TE		-	-	-	No costs.
1	2.2	Solicit help on protection.	continuous	4	HC, TE	ADCNR, ADEM, COE, EPA, GDNR, NRCS, TWRA, USFS	-	-	-	No costs.
3	2.3	Develop outreach programs.	continuous	4	HC, TE	ADCNR, GDNR, TWRA, USFS	30	30	30	
1	2.4	Utilize existing legislation.	continuous	4	HC, TE	ADCNR, ADEM, COE, EPA, GDNR, TWRA	-	-	-	No costs.
2	3	Monitor populations and habitat.	continuous	4	TE	ADCNR, GDNR, NBS, TWRA, GSA, USFS, USGS				
2	4	Reintroduction.	continuous	4	TE	ADCNR, GDNR, GSA, NBS, TWRA, USFS				

Part IV. APPENDIX

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