

RECOVERY PLAN

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for

Boulder Darter (Etheostoma sp.)

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7/27/89

C. LITERATURE CITED

- O'Bara, C. J., and D. A. Etnier. 1987. Status survey of the boulder darter. Final report submitted to U.S. Fish and Wildlife Service, Asheville Field Office, 100 Otis Street, Room 224, Asheville, NC. May 1987.
- Stiles, R. A. 1972. The comparative ecology of three species of Nothonotus (Percidae-Etheostoma) in Tennessee's Little River. Ph.D. Diss., University of Tennessee, Knoxville, TN. 97 pp.
- Franklin, R. I. 1980. Evolutionary change in small populations. IN: Conservation biology, an evolutionary-ecological perspective. Michael E. Soulé and Bruce A. Wilcox (eds.). Published by Sinauer Assoc., Inc., Sunderland, MA. Pp. 135-149.
- Soulé, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. IN: Conservation biology, an evolutionary perspective. Michael E. Soulé and Bruce A. Wilcox (eds.). Published by Sinauer Assoc., Inc., Sunderland, MA. Ch. 8, pp. 151-169.

III. IMPLEMENTATION SCHEDULE

KEY TO IMPLEMENTATION SCHEDULE - COLUMNS 1 AND 4

General Category (Column 1):

Information Gathering - I or R (Research)

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

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Priorities within this section (Column 4) have been assigned according to the following:

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

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.

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

IMPLEMENTATION SCHEDULE

Boulder darter (*Etheostoma* sp.)

#1 GENERAL CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	TASK DURATION	RESPONSIBLE AGENCIES #2		ESTIMATED FISCAL YEAR COSTS #4			COMMENTS/NOTES
					FWS REGION	DIVISION	OTHERS #3	FY 1	FY 2	
I1-2	Search for additional populations and suitable habitat.	2	2	1 year	4	FWE	TWRA, TDC, ADCNR, ANHP	10	---	---
R7, R13, M1-2	Develop techniques, select sites, reintroduce the species back into historic habitat, and evaluate and protect any populations established.	3	1	3 years	4	FWE	TWRA, TDC, ADCNR, ANHP	25	20	20
I1-2	Develop and implement a monitoring program.	4	2	Biennial	4	FWE	TWRA, TDC, ADCNR, ANHP	3	---	3
O4	Annually assess recovery program and modify program and plan where required.	5	3	Continuous	4	FWE	TWRA, TDC, ADCNR, ANHP	.5	.5	.5
#1	See previous page entitled, "Key to Implementation Schedule - Columns 1 and 4."									
#2	<ul style="list-style-type: none"> - U.S. Fish and Wildlife Service - Fish and Wildlife Enhancement - U.S. Army Corps of Engineers - Tennessee Valley Authority - Tennessee Wildlife Resources Agency - Tennessee Department of Conservation - Alabama Department of Conservation and Natural Resources - Alabama Natural Heritage Program 									
#3	Other agencies' responsibility would be of a cooperative nature of projects funded under a contract or grant program. In some cases contracts could be let to universities or private enterprises.									
#4	All estimates are for FWS funds only (in thousands).									

IV. APPENDIX
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IMPLEMENTATION SCHEDULE

for darter (*Etheostoma* sp.)

#1 GENERAL CATEGORY	PLAN TASK	TASK NUMBER	PRIORITY	TASK DURATION	RESPONSIBLE AGENCIES #2		ESTIMATED FISCAL YEAR COSTS #4			COMMENTS/NOTES
					REGION	DIVISION	FY 1	FY 2	FY 3	
O2-4	Continue to utilize existing legislation and regulations to protect species and its habitat.	1.1.	1	Continuous	4	FWE	COE, TVA, TWRA, TDC, ADCNR, ANHP	1	1	1
O1	Meet with local governmental officials and business interests and elicit their support for recovery.	1.2.1, 1.2.2	2	3 years	4	FWE	TWRA, TDC, ADCNR, ANHP	1	1	1
O1	Develop information and education program and present.	1.2.3	1	1 year (then con- tinuous)	4	FWE	COE, TVA, TWRA, TDC, ADCNR, ANHP	4	1	1
R1-4, R6-8, R9-10, R12, R14	Conduct research necessary for species management and recovery; i.e., habitat requirements, biology, and threat analysis.	1.3.1, 1.3.2, 1.3.3	1	3 years	4	FWE	TVA, TWRA, TDC, ADCNR, ANHP	25	25	25
I4, R4, M3-5, M7	Based on biological and threat analysis, investigate need for management and implement where needed.	1.3.4	#	1 year	4	FWE	TWRA, TDC, ADCNR, ANHP	---	---	10
R14	Determine number of individuals required to maintain viable population.	1.3.5	3	1 year	4	FWE	TWRA, TDC, ADCNR, ANHP	---	---	?

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not necessarily represent the views nor the official positions 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. 1989. Boulder Darter Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 15pp.

ADDITIONAL COPIES MAY BE PURCHASED FROM:

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

301/492-6403
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The fee for the plan varies depending on the number of pages.

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I. INTRODUCTION

The boulder darter (Etheostoma sp.) was listed as an endangered species on September 1, 1988 (53 FR 33996). This fish likely once inhabited fast-water boulder habitat in the Tennessee River and its large tributaries in Tennessee and Alabama from the Paint Rock River, Madison County, Alabama, downstream to at least Shoal Creek, Lauderdale County, Alabama. However, primarily due to the construction of dams, which impounded much of the Tennessee River and the lower portions of its tributaries, most of the fish's boulder habitat was lost. Presently it is restricted to a few fast-water runs over about 62 river miles in the Elk River system (a Tennessee River tributary) in Giles and Lincoln Counties, Tennessee, and Limestone County, Alabama.

Description, Ecology, and Life History

The boulder darter (Etheostoma sp.), sometimes referred to as the Elk River darter, is an undescribed species in the subgenus Nothonotus (a manuscript describing it is in press [David Etnier, University of Tennessee, personal communication, 1988]). It attains a maximum length of about 3 inches (7.5 millimeters [Etnier, personal communication, 1988]). The body of the male is olive to gray in color, and it lacks the red spots that are characteristic of closely related species. The female is similar but lighter in color. Both sexes have a gray to black bar located below the eyes and a similarly colored spot behind the eyes. Type specimens are located at the Illinois Natural History Survey, Tulane University, the University of Alabama, the Florida State Museum, the U.S. National Museum, the University of Michigan, and the University of Tennessee. Photographs will be available in the species description which is being prepared (Etnier, personal communication, 1988).

The boulder darter is very rare (only 50 specimens were collected prior to listing), and no life history studies have ever been conducted on the fish. However, biologists have been collecting the fish for taxonomic evaluation and status information. Their observations provide some insight into the species' biology. The boulder darter inhabits warm-water riverine environments and has been found only in moderate to fast current over boulder/slab rock substrate in water over 2 feet deep (O'Bara and Etnier 1987). The fish has not been taken in pool habitat or gravel runs lacking in boulder substrate. Juveniles likely occur in areas with smaller substrate size (Charles Saylor, Tennessee Valley Authority, personal communication, 1988).

Little is known about its food habits. However, other members of the subgenus Nothonotus feed primarily on immature aquatic insects (Stiles 1972). The species is likely a sight feeder and is therefore probably diurnally active. Spawning likely occurs in large boulder/slab rock habitat in areas with moderate to fast current (O'Bara and Etnier 1987; Etnier, personal communication, 1988). In related species, spawning occurs in late May to early August; the eggs are attached to the undersides of rocks, and the males guard the eggs (Stiles 1972).

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

The boulder darter is presently known to occur in nine river reaches (see table below) over about 60 miles (96 kilometers) of the Elk River in Giles and Lincoln Counties, Tennessee, and Limestone County, Alabama, and about 2 miles (3 kilometers) total in two Elk River tributaries (Richland Creek and Indian Creek) in Giles County, Tennessee (O'Bara and Etnier 1987; James Williams and Noel Burkhead, U.S. Fish and Wildlife Service, personal communication, 1988). This represents a reduction over its historically known range, and the present distribution represents only a fraction of what the fish's range might have been prior to the construction of impoundments on the Elk and Tennessee Rivers.

Table. Collection sites for boulder darter (Etheostoma sp.) since 1986.
*Records from O'Bara and Etnier (1987).
**Records reported by James Williams and Noel Burkhead (U.S. Fish and Wildlife Service, personal communication, 1988).

Collection Site Creek and River Miles	County/State	Number of Individuals Collected
**Elk River 89.9	Lincoln/TN	23
**Elk River 60.9	Lincoln/TN	2
*Elk River 52.5	Giles/TN	8
*Elk River 36.7	Giles/TN	6
*Elk River 30.7	Limestone/AL	4
*Elk River 29.7	Limestone/AL	1
*Indian Creek 0.5	Giles/TN	1
*Richland Creek 2.1	Giles/TN	5
*Richland Creek 1.0	Giles/TN	2

Historically the fish has been collected in the Elk River upstream as far as river mile 90 in Lincoln County, Tennessee. A 1986 survey of the Elk River in Lincoln County by O'Bara and Etnier (1987) failed to re-collect the fish in the county even though suitable habitat was apparently still present. However, efforts in 1988 by Williams and Burkhead (personal communication, 1988) located the species at two sites in Lincoln County (see table, page 3). It is believed this population segment, especially upstream near Fayetteville, Tennessee, and above, is probably suppressed by the cold-water releases from Tims Ford Reservoir. Historical records of this species also exist for Shoal Creek, Lauderdale County, Alabama. Sampling in this creek during the summer of 1983 and the fall of 1986 failed to find any specimens of this fish. It is believed the Shoal Creek population was lost due to flooding of lower Shoal Creek by Wilson Dam and due to pollution from an upstream industrial complex. The water quality in Shoal Creek has been substantially improved, but the boulder darter apparently has not recolonized the creek.

Although no collection records are available outside the Elk River and Shoal Creek, it is believed, based on the historical availability of suitable habitat, that the boulder darter likely once inhabited the Tennessee River and the lower portion of some Tennessee River tributaries in the southern bend area of the Tennessee River from the Paint Rock River downstream to at least Shoal Creek (O'Bara and Etnier 1987). These main Tennessee River and tributary populations would have been eliminated when the Tennessee River impoundments (Wheeler and Wilson Dams) inundated the boulder habitat the fish appears to require.

No impoundment projects are planned for the Elk River in the area presently occupied by the species. However, other factors, such as the present high silt levels of streams in the watershed, potential increased siltation from major land use changes, improper pesticide use, toxic chemical spills, the cold-water releases from Tims Ford Reservoir, and/or uncontrolled mining of phosphate in the watershed, could further threaten the species in the limited number of short river reaches it now occupies.

Based on limited samples, adult boulder darters appear to require deep (greater than 2 feet or 0.6 meters), fast-moving water over boulder substrate. Because the Elk River's riffle substrate is primarily gravel and cobble and most river reaches consist of long, slow pools, the adult boulder darter habitat is extremely limited. The scarcity of this habitat appears to further restrict the species within the Elk River and increases its vulnerability to habitat alteration.

II. RECOVERY

A. Recovery Objectives

The ultimate goal of this recovery plan is to restore viable populations* of the boulder darter (Etheostoma sp.) to a significant portion of its historic range and remove the species from the Federal List of Endangered and Threatened Wildlife and Plants.

Reclassification to threatened:

The species 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 the existing population in the Elk River and its tributaries and successful establishment of a reintroduced population in Shoal Creek or other historic habitat, or by discovery of an additional population, two distinct viable populations* exist.
2. Studies of the fish's biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies have been or are likely to be successful.

Removal from Endangered Species Act protection:

The species will be considered for removal from Endangered Species Act protection when the likelihood of the species' becoming endangered in the foreseeable future has been eliminated by the achievement of the following criteria:

1. Through protection of the existing population and successful establishment of reintroduced populations or discovery of additional populations, three distinct viable populations* exist. The existing Elk River population, including the two tributary segments, must be secure from river mile 90 downstream to river mile 30.

*Viable populations: A reproducing population that is large enough to maintain sufficient genetic variation to enable it to evolve and respond to natural habitat changes. The number of individuals needed and the amount and quality of habitat required to meet this criterion will be determined for the species as one of the recovery tasks.

2. Studies of the fish's biological and ecological requirements have been completed, and the implementation of management strategies developed from these studies has been successful.
3. No foreseeable threats exist that would likely threaten survival of any of the populations.

B. Narrative Outline

1. Preserve present population and presently used habitat. Because only one population exists, it is essential that this population be protected.
 - 1.1 Continue to utilize existing legislation and regulations (Federal Endangered Species Act, Federal and State surface mining laws, water quality regulations, stream alteration regulations, Federal Energy Regulatory Commission licensing, etc.) to protect the fish and its habitats. Prior to and during implementation of this recovery plan, the species and its habitat can be protected by the full enforcement of existing laws and regulations.
 - 1.2 Solicit help in protecting the species and its essential habitats. Section 7 consultation under the Endangered Species Act and Fish and Wildlife Coordination Act activities can assist in protection of the species, but these programs alone cannot recover the boulder darter. The assistance of Federal and State agencies and conservation groups as well as local governments will be essential. Also, support of the local industrial and business community as well as local individuals will be needed to meet the goal of recovering the species. Without a commitment from the people in the lower Elk River and Shoal Creek watersheds who have an influence on habitat quality, recovery efforts will be doomed.
 - 1.2.1 Meet with local government officials and regional and local planners to inform them of our plans to attempt recovery and request their support.
 - 1.2.2 Meet with local business and/or industry interests and try to elicit their support in implementing protective actions.
 - 1.2.3 Develop an educational program using such items as slide/tape shows, brochures, etc. Present this material to schools, business groups, civic groups, youth groups, church organizations, etc. Educational material outlining the recovery goals, with emphasis on the other benefits of maintaining and upgrading habitat quality, will be extremely useful in informing the public of our actions.

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

- 1.3.1 Conduct life history research on the species to include such factors as reproduction, food habits, age and growth, mortality factors. The status survey (O'Bara and Etnier 1987) provides a brief glimpse into some aspects of the species' life history, but much more information is needed to understand the species' requirements. Unless the species' life cycle and environmental requirements are defined, recovery efforts may be inconsequential or misdirected.
- 1.3.2 Characterize the species' habitat (relevant physical, biological, and chemical components) for all life history stages. The boulder darter has been able to withstand some degree of habitat degradation. However, some habitat has been so severely altered (changes in temperature and flow levels and impoundments) that the species has been extirpated. Knowledge of the species' habitat requirements and ecological associations is needed to focus management and recovery efforts on the specific problems within the species' habitat.
- 1.3.3 Determine present and foreseeable threats to the species. Hydroelectric and navigation development has had a major role in altering the species' habitat and reducing its range. Siltation from poor land use and road construction practices has contributed and continues to contribute to substrate and water quality degradation. However, other factors, such as wastewater treatment plant discharges, may also be impacting the species. The mechanism by which the species and its habitat are impacted by these factors is not entirely understood, and the extent to which the species can withstand these impacts is unknown.
- 1.3.4 Based on the biological data and threat analysis, investigate the need for management, including habitat improvement. Implement management, if needed, to secure viable populations. Specific components of the species' habitat, such as fast-water boulder habitat, may be lacking, and these may be limiting the species' potential expansion. Habitat improvement programs, such as changes in the placement of large rocks in riffle areas, may be needed to alleviate these limiting factors. To minimize and eliminate these threats, where necessary to meet recovery, the information gathered under tasks 1.3.1 and 1.3.2 must be utilized to target the specific problem areas.

1.3.5 Determine the number of individuals required to maintain a viable population. Theoretical considerations by Franklin (1980) and Soulé (1980) indicate that 500 individuals represent a minimum population level (effective population size) which 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 can be expected to be larger, possibly by as much as ten times. The factors which will influence actual population size include sex ratio, length of species' reproductive life, fecundity, and extent of exchange of genetic material within the population (there is a need to determine if populated stream reaches are distinct populations or population segments), plus other life history aspects of this species. Some of these factors can be addressed under task 1.3.1, while others will need to be addressed as part of this task on a need-to-know basis.

2. Search for additional populations and/or habitat suitable for reintroduction efforts. Distributional studies of this species, conducted primarily in the summer and fall months, have been completed (O'Bara and Etnier 1987). Nearly all available habitat has been surveyed; however, it is possible that some small populations were missed. Further study during all seasons of the year may reveal additional populations; suitable habitat for transplants may also be identified during these surveys.
 3. Determine the feasibility of reestablishing the boulder darter into historic habitat and reintroduce where feasible. The extent of the boulder darter's historic distribution is unknown, but available records of historical habitat indicate that the species likely once inhabited much of the rocky riverine habitat in the Tennessee River and its larger tributaries from the Paint Rock River downstream to Shoal Creek. Presently, it is known from only one population. As the population is isolated by dams from other potential habitat, it is unlikely the species can naturally recolonize any historic habitat. If suitable stream reaches are available, such as in Shoal Creek, or can be made suitable, populations should be reintroduced.
- 3.1 Develop successful techniques for reestablishing populations. Sufficient stock of the boulder darter may not be available to allow for the removal of enough adults to establish populations. Techniques for rearing the species and introduction techniques should be developed to help ensure success.

- 3.2 Reintroduce the species into its historic range and evaluate success. Using techniques developed in task 3.1, reintroduce the boulder darter into a likely historic habitat and monitor success.
- 3.3 Implement the same protective measures for any introduced populations as outlined for established populations.
4. Develop and implement a program to monitor population levels and habitat conditions of the presently established population 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.
5. Annually assess overall success of the recovery program and recommend action (changes in recovery objectives, delist, continue to protect, implement new measures, other studies, etc.). The recovery plan must be evaluated periodically to determine if it is on track and to recommend future actions. As more is learned about the species, the recovery objectives may need to be modified.