

GEOLOGICAL SURVEY OF ALABAMA

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**SURVEY OF THE ELK RIVER SYSTEM IN ALABAMA
FOR FISH SPECIES OF MODERATE TO
HIGHEST CONSERVATION CONCERN:
REPORT OF RESULTS FOR 2004-06**

OPEN-FILE REPORT 0621

by

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ABSTRACT

In 2004-06, 134 fish samples were collected at 75 stations in the Elk River system to determine the present distribution and abundance of 13 species of moderate to highest conservation concern in Alabama. Sampling produced 96 species including 12 of 13 species of conservation concern historically known to occur in the system. New tributary records were found for five of these species including a population of the boulder darter, which was found in Shoal Creek upstream of the embayment of Wheeler Reservoir. New tributary records were found for the streamline chub, the highlands stonecat, the skygazing minnow, and the highland shiner. This report also documents the invasion of the Elk River system by the Mississippi silverside. Based on the results of this study, three species which are currently listed as high conservation (P2) concern in Alabama should be considered for elevation to highest conservation (P1) concern. These are the shoal chub (*Macrhybopsis hyostoma*), the mountain madtom (*Noturus eleutherus*), and the bluebreast darter (*Etheostoma camurum*). All three are known only from the Elk River system within Alabama. The shoal chub was not collected in three years of sampling the system in Alabama, and the other two species were found at only a single shoal in the state.

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Fish and Wildlife Service (USFWS) office in Atlanta, Georgia, issued an endangered species permit to conduct this project. Field assistance was provided by Bob Baker, Marlon Cook, Blakeney Gillett, Neil Moss, John Koster, Justin Bagley, and Cal Johnson of the Geological Survey of Alabama (GSA), Keith Floyd and Glen Selby of WFFD, and John Justice of TVA. Keith Floyd also made arrangements for sampling on a local landowner's property and assisted in logistics and sampling on a canoe float trip to sample a section of Sugar Creek. Dr. Bernard R. Kuhajda provided information on recent fish collections in the Elk River system in Alabama by University of Alabama (UA) personnel and on material housed at the University of Alabama Ichthyological Collection.

INTRODUCTION

A conference of biologists was convened in 2002 to determine the conservation status of Alabama's vertebrates and freshwater mollusks (Mirarchi and others, 2004). The fish committee at the conference determined that of 296 native freshwater and estuarine/marine fishes known to inhabit the state, 22 were of highest conservation concern, 25 were of high conservation concern, 33 were of moderate conservation concern, and the other 216 species were of low or lowest concern (Mettee, 2004a). An unusually large number of fish species of moderate to highest conservation concern are known to occur in the Alabama segment of the Elk River system (Smith-Vaniz, 1968; Jandebour, 1972; Mettee and others, 1996; Mettee and others, 2002; Boschung and Mayden, 2004a). In the Elk River system in Alabama, there are four species of moderate concern (skipjack herring, *Alosa chrysochloris*; blotched chub, *Erimystax insignis*; highland shiner, *Notropis micropteryx*; and silver shiner, *N. photogenis*), eight species of high concern (streamline chub, *Erimystax dissimilis*; shoal chub, *Macrhybopsis hyostoma*; ghost shiner, *N. buchanani*; stargazing minnow, *Phenacobius uranops*; mountain madtom, *Noturus eleutherus*; highlands stonecat, *N. sp. cf. flavus*; bluebreast darter, *Etheostoma camurum*; and gilt darter, *Percina evides*), and one species of highest conservation concern (boulder darter, *Etheostoma wapiti*) that is also federally listed as an endangered species. The striped bass (*Morone saxatilis*) is also a species of moderate conservation concern in Alabama and occurs in the Elk River

system as an introduced species. There are two species that are known from the Elk River system in Tennessee but are thought to be extirpated in Alabama. These are the popeye shiner, *Notropis ariommus*, and the ashy darter, *Etheostoma cinereum*.

Jandebeur (1972) conducted a fish survey of the entire Elk River system between 1967 and 1971 and documented the occurrence of 104 species. Subsequent collections in the system in Alabama have produced new distributional records for a number of species. Some examples are the bluebreast darter, *Etheostoma camurum*, and mountain madtom, *Noturus eleutherus*, which were first found in Alabama state waters in the Elk River by GSA biologists in 1993 (Mettee and others, 1996; Mettee and others, 2002). The ghost shiner, *Notropis buchmanii*, and river darter, *Percina shumardi*, were also only recently discovered in the Elk River in Alabama by biologists with UA (B.R. Kuhajda, pers. comm.; Boschung and Mayden, 2004a). For the most part, recent collection efforts have been restricted to a few easily accessible localities, and a thorough survey has not been conducted in the Elk River system since Jandebeur's (1972) work.

While the Elk River system provides habitat for a large number of sensitive and uncommon fish species, it is not a pristine river and has been significantly impacted by nonpoint-source pollution and regulated flows from hydroelectric generation at Tims Ford Dam about 100 river miles upstream of the Alabama state line in Tennessee. Extensive agriculture in the lower portions of the watershed has produced heavy sediment loads in the main channel. Peaking flows from Tims Ford Dam can lead to daily water level fluctuations of over 5 feet in the main channel at the Alabama state line.

The GSA was funded by ADCNR in 2004 to investigate the status of fish species of conservation concern in the Elk River system in Alabama. The objective of this study is to accurately determine the current distribution and relative abundance of these species and to attempt to identify impacts to the system that may be adversely affecting their populations. This report presents the final results of three years of sampling by GSA in the Elk River system.

STUDY AREA

The Elk River is a large tributary of the Tennessee River draining an area of about 2,250 square miles in north-central Alabama and south-central Tennessee (fig 1). The river extends for about 200 miles from its headwaters in Grundy County, Tennessee, to the mouth at the borders of Limestone, Lauderdale, and Lawrence Counties in Alabama (Jandebeur, 1972). Elevations range from over 1,900 feet in the headwaters to about 550 feet at the embayment of Wheeler Reservoir near the mouth. Major tributaries in Alabama are Anderson Creek, Big Creek, Sugar Creek, Sulphur Creek, and Shoal Creek. The majority of the Elk River watershed and all of the drainage in Alabama flows through the Tennessee Valley district of the Highland Rim physiographic section (Sapp and Emplaincourt, 1975). The region is composed of Mississippian chert and limestone and Ordovician limestone and shale (Osborne and others, 1989). Streams in the Highland Rim are characterized by moderate gradients with low to moderately productive clear waters and substrates of chert gravel, sand, and bedrock (Etnier and Starnes, 1993). Etnier and Starnes (1993) noted that the Highland Rim harbors one of the most diverse fish faunas of any area of comparable size in North America due to its geologic complexity and many drainage systems.

The lower portion of the Elk River is impounded by the embayment of Wheeler Reservoir for about 28 miles upstream to near Gallus Island. The downstream portions of Anderson, Big, Sugar, Sulphur, and Shoal Creeks are also within the embayment of the reservoir. Wheeler Dam, which was completed in 1936 and impounds an area of over 67,000 surface acres, is a Tennessee Valley Authority (TVA) facility located on the Tennessee River near Rogersville, Alabama. Other major impoundments in the Elk River system are Tims Ford Lake near Tullahoma, Tennessee, about 100 river miles upstream of the Alabama state line, and Woods Reservoir, also on the main stem of Elk River several river miles upstream of the Tims Ford embayment. Woods Reservoir was completed in 1952 by the U.S. Army Corps of Engineers as a water supply reservoir with a surface area of about 3,900 acres. Tims Ford Reservoir was completed by TVA in 1970 as a hydroelectric/multipurpose facility. The reservoir area encompasses about 10,700 surface acres and extends for 34 river miles upstream of the dam. Cold water

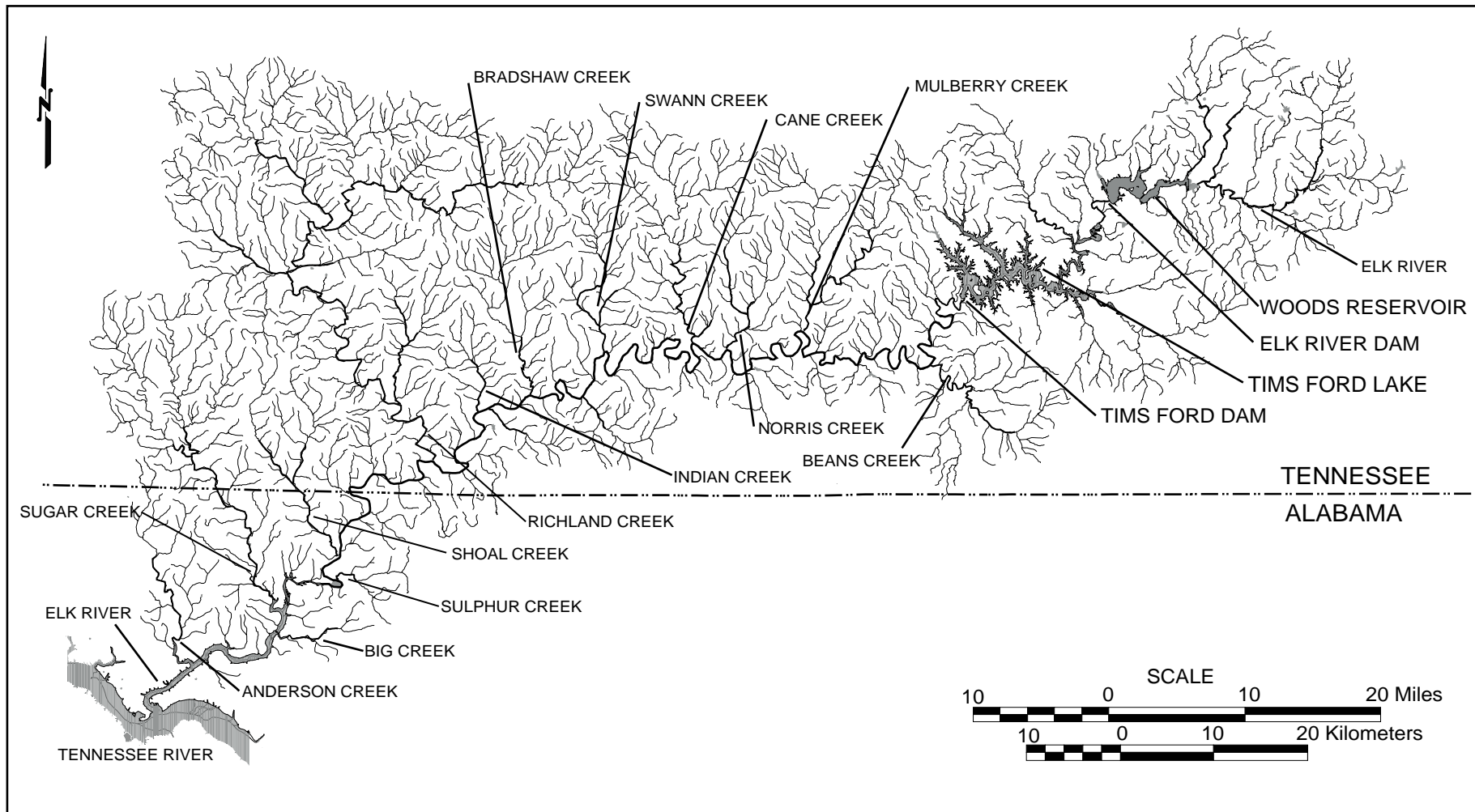


Figure 1. The Elk River system in Alabama and Tennessee.

discharge from the dam supports a recreational fishery for stocked trout downstream of the dam. TVA has installed compressors to aerate waters downstream of the dam and a small turbine to produce minimum flows when there is no power generation. Pulsed flows from Tims Ford Dam have a major influence on water levels and flow rates in the flowing section of the Elk River in Alabama. Water levels can rise over 5 feet between minimum flows and maximum turbine operation at the dam. Bank structure is also degraded due to the scouring effects of peaking flows.

Land use in the watershed in Alabama is dominated by row crops and pastureland. The cities of Fayetteville, Pulaski, Tullahoma, and Winchester are located in the watershed in Tennessee. In Alabama, Limestone County uses the Elk River as a water supply and has a water intake located just upstream of Mason Island. The city of Athens also has a water intake on the river located across from the abandoned Elk River fish hatchery.

METHODS

One hundred thirty-four samples were collected from 75 stations in the Elk River system in Alabama in 2004-06 to determine the presence and relative abundance of species of conservation concern (table 1, fig. 2, apps. A, B). Twenty-six stations were on the main stem of the Elk River and 49 were in tributaries. Collections in wadeable shoals were conducted using nylon minnow seines from 6 to 20 feet in length, depending on the stream size. A portable backpack electrofishing unit was used in conjunction with the seine at many stations to facilitate effective sampling. Techniques consisted of seining pools, setting the net below shallow stream riffles and electrofishing through the rubble while kicking and overturning the substrate, following the person operating the shocking unit with a seine, and operation of the electrofisher in deeper waters and around larger obstacles in the stream and netting stunned fish with a dip net. A 14-foot electrofishing boat was used to sample in the impounded section of the river and in pools in the flowing section that were too deep to sample effectively with the seine and backpack electrofisher. Gill nets were used in the impounded sections of the Elk River in an attempt to capture larger riverine fishes of conservation concern such as blue suckers, *Cycleptus elongatus*, which could potentially occur in the Elk

Table 1. Summary information on sampling stations in the Elk River system, 2004-06.

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
ER-1	Elk River about .25 mi. upstream of mouth	Limestone/ Lauderdale, AL	sec. 21, T. 3 S., R. 7 W.	34°46'55.9"N 87°16'44.6"W	11 Aug. 2004	1130-1400	5-200 ft. gill nets
ER-2	Elk River @ slough S. of Poplar Springs Branch	Limestone, AL	sec. 15, T. 3 S., R. 7 W.	34°47' 12.5"N 87°15'02.9"W	11 Aug. 2004	1345-1525	electrofishing boat
ER-3	Elk River N. of Dells Vista Shores (slough)	Lauderdale, AL	sec. 16, T. 3 S., R. 7 W.	34°46'59.2"N 87°16'57.2"W	11 Aug. 2004	1135-1300	electrofishing boat
ER-4	Elk River just upstream and downstream of U.S. Hwy. 72	Limestone/ Lauderdale, AL	sec. 12, T. 3 S., R. 7 W.	34°48'25.7"N 87°13'51.8"W	11 Aug. 2004	1430-1700	5-200 ft. gill nets
ER-5	Elk River @ cliffs upstream of Anderson Creek mouth	Lauderdale, AL	sec. 31, T. 2 S., R. 6 W.	34°49' 50.4"N 87°12' 24.0"W	11 Aug. 2004	1615-1650	electrofishing boat
ER-6	Elk River @ mouth of Maple Swamp Branch	Limestone, AL	sec. 32, T. 2 S., R. 6 W.	34°49'46.3"N 87°11'1.4"W	12 Aug. 2004	0915-1130	5-200 ft. gill nets
ER-7	Elk River @ slough downstream of Elk River Mills landing	Limestone, AL	sec. 25, T. 2 S., R. 6 W.	34°50'00.6"N 87 °07'27.1"W	12 Aug. 2004	0845-0930	electrofishing boat
ER-8	Elk River @ slough across from mouth of Sugar Creek	Limestone, AL	sec. 24, T. 2 S., R. 6 W.	34°51'59.8"N 87°06'17.0"W	12 Aug. 2004	1035-1135	electrofishing boat
ER-9	Elk River just upstream of Twin Springs	Limestone, AL	sec. 13, T. 2 S., R. 6 W.	34°52'42"N 87°6'18.4"W	12 Aug. 2004	1615-1800	3-200 ft. gill nets
ER-10	Elk River @ slough 2 mi. S. of Salem	Limestone, AL	sec. 1, T. 2 S., R. 6 W.	34°54'20.7"N 87°06' 28.5"W	12 Aug. 2004	1215-1240	electrofishing boat
ER-11a	Elk River @ river mile 19	Limestone, AL	sec. 1, T. 2 S., R. 6 W.	34°54'17.8"N 87°06'23.6"W	12 Aug. 2004	1300-1510	5-200 ft. gill nets
ER-11b					31 Aug. 2005	1530-1600	electrofishing boat
ER-12	Elk River upstream of Buck Island	Limestone, AL	sec. 4, T. 2 S., R. 5 W.	34°53'55.9"N 87°3'39.8"W	12-13 Aug. 2004	1600-0830	2-200 ft. gill nets (overnight set)
ER-13	Elk River @ water intake	Limestone, AL	sec. 3, T. 2 S., R. 5 W.	87°06'28.5"N 87°03'03.4"W	12 Aug. 2004	1525-1600	electrofishing boat
ER-14a	Elk River between hatchery and Easter Ferry Bridge	Limestone, AL	sec. 33, T. 1 S., R. 5 W.	34°54'20.5"N 87°03'28.2"W	12 Aug. 2004	1435-1455	electrofishing boat
ER-14b					31 Aug. 2005	1145-1300	electrofishing boat
ER-15a	Elk River @ Easter Ferry Bridge	Limestone, AL	sec. 27/34, T. 1 S., R. 5 W.	34°55'19.9"N 87°03'05.4"W	12 Aug. 2004	1350-1430	electrofishing boat
ER-15b					31 Aug. 2005	0945-1125	electrofishing boat
ER-15c					10 Aug. 2006	1045-1110	electrofishing boat
ER-15d					23 Aug. 2006	1610-1635	electrofishing boat

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
ER-16	Elk River @ lower end of Gallus Island	Limestone, AL	sec. 22, T. 1 S., R. 5 W.	34°56'20.1"N 87°02'27.6"W	13 Aug. 2004	0930-1245	3-200 ft. gill nets
ER-17a	Elk River @ Gallus Island	Limestone, AL	sec. 22, T. 1 S., R. 5 W.	34°56'36.4"N 87°02'33.8"W	13 Aug. 2004	0900-1120	electrofishing boat
ER-17b					22 Sep. 2005	1515-1530	electrofishing boat
ER-18a	Elk River @ upper end of Gallus Island	Limestone, AL	sec. 22, T. 1 S., R. 5 W.	34°56'44.5"N 87°02'30.6"W	3 Aug. 2004	1425-1500	10 ft. seine
ER-18b					17 Aug. 2004	1340-1400	8 ft. seine
ER-18c					9 Aug. 2005	1335-1415	15 ft. seine
ER-18d					23 Aug. 2005	1320-1415	15 ft. seine
ER-18e					22 Sep. 2005	1110-1210	15 ft. seine
ER-18f					27 July 2006	1315-1415	15 ft. seine
ER-18g					10 Aug. 2006	0900-0940	15 ft. seine
ER-18h					10 Aug. 2006	0945-1025	electrofishing boat
ER-18i					25 Aug. 2006	0850-1045	15 ft. seine, electrofishing boat
ER-19a					Elk River upstream of Gallus Island, river mile 28.5	Limestone, AL	sec. 22, T. 1 S., R. 5 W.
ER-19b	17 Aug. 2004	1530-1615	electrofishing boat				
ER-19c	22 Sep. 2005	1430-1500	electrofishing boat				
ER-20	Elk River @ river mile 29	Limestone, AL	sec. 15, T. 1 S. R. 5 W.	34°57'31.8"N 87°02'10.7"W	17 Aug. 2004	1450-1525	electrofishing boat

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
ER-21a	Elk River @ Mason Island	Limestone, AL	sec. 12, T. 1 S., R. 5 W.	34°58'27.5"N 87°00'23.7"W	29 July 2004	1515-1540	10 ft. seine
ER-21b					2 Aug. 2004	1240-1310	10 ft. seine
ER-21c					17 Aug. 2004	1115-1230	20 ft. seine, backpack shocker
ER-21d					9 Aug. 2005	1135-1230	15 ft. seine
ER-21e					23 Aug. 2005	1140-1245	15 ft. seine
ER-21f					22 Sep. 2005	0930-1015	15 ft. seine
ER-21g					27 July 2006	1115-1215	15 ft. seine
ER-21h					31 July 2006	1510-1555	15 ft. seine
ER-21i					9 Aug. 2006	1510-1610	15 ft. seine
ER-21j					30 Aug. 2006	1435-1510	15 ft. seine
ER-22a					Elk River @ Fishtrap Ford, river mile 32.5	Limestone, AL	sec. 1, T. 1 S., R. 5 W.
ER-22b	2 Aug. 2004	1345-1445	10 ft. seine, backpack shocker				
ER-22c	17 Aug. 2004	0900-1040	10 ft. seine, backpack shocker				
ER-22d	9 Aug. 2005	0900-1108	10 ft. seine, backpack shocker				
ER-22e	23 Aug. 2005	0900-1100	10 ft. seine, backpack shocker				
ER-22f	19 Sep. 2005	1530-1615	10 ft. seine, backpack shocker				
ER-22g	20 Sep. 2005	1530-1555	electrofishing boat				
ER-22h	27 July 2006	0910-1045	10 ft. seine, backpack shocker				
ER-22i	31 July 2006	1300-1430	10 ft. seine, backpack shocker				
ER-22j	8 Aug. 2006	1145-1300	10 ft. seine, backpack shocker				
ER-22k	24 Aug. 2006	1450-1530	electrofishing boat				
ER-22l	30 Aug. 2006	1325-1420	15 ft. seine, backpack shocker				

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
ER-23a	Elk River @ river mile 33	Limestone, AL	sec. 2, T. 1 S., R. 5 W.	34°59'26.8"N 87°01'26.0"W	20 Sep. 2005	1240-1340	backpack shocker, dip net
ER-23b					20 Sep. 2005	1410-1500	electrofishing boat
ER-23c					8 Aug. 2006	1330-1430	electrofishing boat
ER-23d					24 Aug. 2006	1400-1425	backpack shocker, dip net
ER-24	Elk River @ Buck Island	Limestone, AL	sec. 4, T. 2 S., R. 5 W.	34°53'55.9"N 87°04'16.3"W	31 Aug. 2005	1345-1430	electrofishing boat
ER-25	Elk River 200 ft. downstream of Fishtrap Ford	Limestone, AL	sec. 1, T. 1 S., R. 5 W.	34°59' 18"N, 87°00' 36"W	23 Aug. 2005	1530-1540	electrofishing boat
ER-26a	Elk River just upstream of Alabama Hwy. 127	Limestone, AL	sec. 12, T. 1 S., R. 5 W.	34° 58' 10"N 87° 00' 51"W	8 Aug. 2006	1520-1600	electrofishing boat
ER-26b					24 Aug. 2006	1600-1725	electrofishing boat
PS-1	Poplar Springs Branch @ County Hwy. 70	Lauderdale, AL	sec. 10, T. 3 S., R. 7 W.	34°47' 51.2"N, 87°15'33.0"W	15 Feb. 2005	1030-1130	6 ft. seine, backpack shocker
AC-1	Planter Branch @ Snake Road	Lauderdale, AL	sec. 24, T. 2 S., R. 7 W.	34°50'57.2"N 87°16'07.0"W	27 Feb. 2004	1215-1230	6 ft. seine
AC-2a	Anderson Creek @ first flowing shoal upstream of Wheeler Lake	Lauderdale, AL	sec. 26, T. 2 S., R. 7 W.	34°50'35.5"N 87°14'19.7"W	22 July 2004	1140-1230	10 ft. seine, electrofishing boat
AC-2b					5 Aug. 2004	0855-1015	10 ft. seine, backpack shocker
AC-2c					1 Sep. 2004	0830-1000	10 ft. seine, backpack shocker
AC-3	Unnamed tributary to Dement Creek @ County Hwy. 117	Lauderdale, AL	sec. 24, T. 2 S., R. 7 W.	34°51'42.8"N 87°13'28.8"W	27 Feb. 2004	1115-1130	8 ft. seine
AC-4	Deerlick Branch @ County Hwy. 156	Lauderdale, AL	sec. 36, T. 1 S., R. 7 W.	34°55'20.5"N 87°13'26.2"W	27 Feb. 2004	0945-1000	6 ft. seine
AC-5	East Fork Anderson Creek @ County Hwy. 526	Lauderdale, AL	sec. 14, T. 1 S., R. 7 W.	34°56'31.9"N 87°14'17.0"W	26 Feb. 2004	0945-1010	6 ft. seine
AC-6	East Fork Anderson Creek @ Alabama Hwy. 64	Lauderdale, AL	sec. 12, T. 1 S., R. 7 W.	34°58'37.3"N 87°13'26.9"W	26 Feb. 2004	1100-1122	6 ft. seine
AC-7	Middle Fork Anderson Creek @ County Hwy. 181	Lauderdale, AL	sec. 3, T. 1 S., R. 7 W.	34°59'12.1"N 87°15'52.7"W	26 Feb. 2004	1150-1205	6 ft. seine

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
AC-8	Belue Branch @ County Hwy. 86	Lauderdale, AL	sec. 15, T. 2 S., R. 7 W.	35°52'30.2"N 87°15'40.9"W	14 Feb. 2005	1230-1310	6 ft. seine
AC-9	Dement Creek @ County Hwy. 52	Limestone, AL	sec. 6, T. 2 S., R. 6 W.	34°54'35.2"N 87°12'18.9"W	15 Feb. 2005	1315-1340	6 ft. seine
AC-10	Spring Run tributary to Dement Creek on Thacker Road	Limestone, AL	sec. 31, T. 1 S., R. 6 W.	34°54'48.6"N 87°12'1.1"W	15 Feb. 2005	1240-1300	6 ft. seine, backpack shocker
AC-11	Tributary to Dement Creek	Limestone, AL	sec. 2, T. 2 S., R. 7 W.	34°54'38.3"N 87°12'5.4"W	14 Feb. 2005	1430-1510	6 ft. seine, backpack shocker
AC-12	West Fork Anderson Creek @ County Hwy. 510	Lauderdale, AL	sec. 4, T. 1 S., R. 7 W.	34°59'20.7"N 87°16'34.5"W	15 Feb. 2005	1640-1705	6 ft. seine, backpack shocker
AC-13	West Fork Anderson Creek @ County Hwy. 49	Lauderdale, AL	sec. 17, T. 1 S., R. 7 W.	34°57'57.7"N 87°17'18.2"W	11 Apr. 2006	0830-0914	6 ft. seine, backpack shocker
AC-14	Middle Fork Anderson Creek @ County Hwy. 49	Lauderdale, AL	sec. 16, T. 1 S., R. 7 W.	43°57' 35.3"N 87°16'18.8"W	10 Apr. 2006	1500-1610	6 ft. seine
MB-1	Maple Swamp Branch .5 mi E Temperance Oak Church	Limestone, AL	sec. 29, T. 2 S., R. 6 W.	34°50'44.2"N 87°10'52.4"W	11 Apr. 2006	1130-1200	6 ft. seine
BC-1a	Big Creek @ first flowing shoal upstream of Wheeler Lake	Limestone, AL	sec. 30, T. 2 S., R. 5 W.	34°50'29.4"N 87°6'4.3"W	27 July 2004	1540-1750	10 ft. seine, backpack shocker, electrofishing boat
BC-1b					10 Aug. 2005	0840-1030	10 ft. seine, backpack shocker
BC-1c					13 Apr. 2006	0920-1045	10 ft. seine, backpack shocker
BC-2	Big Creek @ Tillman Mill Road	Limestone, AL	sec. 22, T. 2 S., R. 5 W.	34°51'6"N 87°2'32"W	13 Apr. 2006	1515-1600	8 ft. seine, backpack shocker
BC-3	Four Mile Branch near O'Neal	Limestone, AL	sec. 26, T. 2 S., R. 5 W.	34°50'56.3"N 87°01'37.6"W	13 April 2006	1100-1130	6 ft. seine, backpack shocker
SC-1	Sugar Creek @ power line	Limestone, AL	sec. 11, T. 2 S., R. 6 W.	34°52'54.8"N 87°7'26.5"W	28 July 2004	1645-1705	electrofishing boat

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
SC-2a	Sugar Creek @ river mile 3	Limestone, AL	sec. 11, T. 2 S., R. 6 W.	34°53'30.1"N 87°08'4.3"W	28 July 2004	1450-1620	10 ft. seine, backpack shocker, electrofishing boat
SC-2b					24 Aug. 2005	0850-0915	10 ft. seine, backpack shocker
SC-2c					24 Aug. 2005	0900-1200	electrofishing boat
SC-2d					28 July 2006	0945-1045	10 ft. seine, backpack shocker
SC-2e					9 Aug. 2006	1200-1315	electrofishing boat
SC-3a	Sugar Creek @ shoal .5 mi. SSW Band Mill Springs, river mile 4	Limestone, AL	sec. 3, T. 2 S., R. 6 W.	34°53' 49.5"N 87°08'41.0"W	28 Jul 2004	1015-1415	10 ft. seine, backpack shocker, electrofishing boat
SC-3b					23 Sep. 2005	0930-1130	10 ft. seine, backpack shocker
SC-3c					9 Aug. 2006	0920-1145	10 ft. seine, backpack shocker
SC-4	Dobbins Branch @ County Hwy. 98	Limestone, AL	sec. 13, T. 1 S., R. 7 W.	34°57'45.4"N 87°13'02.7"W	27 Feb. 2004	0915-0930	6 ft. seine
SC-5	Mechanic Branch @ Alabama Hwy. 99	Limestone, AL	sec. 26, T. 1 S., R. 6 W.	34°56'25.6"N 87°07'39.7"W	26 Feb. 2004	1600-1615	6 ft. seine
SC-6a	Sugar Creek @ shoal upstream of Alabama Hwy 99	Limestone, AL	sec. 22, T. 1 S., R. 6 W.	34°56'39.9"N 87°09'21.2"W	4 Aug. 2004	1024-1130	10 ft. seine, backpack shocker
SC-6b					23 June 2005	0900-1000	10 ft. seine, backpack shocker
SC-6c					1 Aug. 2006	1505-1605	10 ft. seine, backpack shocker
SC-7a	Sugar Creek @ Sugar Creek Road	Limestone, AL	sec. 8, T. 1 S., R. 6 W.	34°58'43.9"N 87°10'30.3"W	21 Sep. 2005	1430-1535	10 ft. seine, backpack shocker
SC-7b					10 July 2006	1300-1525	15 ft. seine, backpack shocker

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
SC-8	McGowen Branch @ Elk River Mills Road	Limestone, AL	sec. 4, T. 2 S., R. 6 W.	34°53'50.9"N 87°09'58.5"W	13 Apr. 2006	1215-1300	8 ft. seine, backpack shocker
SC-9	Sugar Creek @ river mile 5.75	Limestone, AL	sec. 34, T. 1 S., R. 6 W.	34°55'6.2"N 87°08'37.2"W	31 Aug. 2006	1220-1405	10 ft. seine, backpack shocker
SC-10	Sugar Creek @ river mile 6.5	Limestone, AL	sec. 27, T. 1 S., R. 6 W.	34°55'34.6"N 87°09'11.1"W	31 Aug. 2006	0920-1115	10 ft. seine, backpack shocker
SC-11	Sugar Creek @ river mile 2	Limestone, AL	sec. 11, T. 2 S., R. 6 W.	34°53'8.7"N 87°07'34.0"W	9 Aug. 2006	1335-1355	electrofishing boat
BB-1	Baptizing Branch, .75 mi. NNE Salem Spring	Limestone, AL	sec. 31, T. 2 S., R. 5 W.	34°55'14.7"N 87°06'11.8"W	11 April 2006	1000-1030	6 ft. seine
SU-1a	Sulphur Creek @ first shoal upstream of Wheeler Lake	Limestone, AL	sec. 3, T. 2 S., R. 5 W.	34°54'25.8"N 87°02'41.1"W	30 July 2004	0930-1145	10 ft. seine, backpack shocker, electrofishing boat
SU-1b					1 Sep. 2005	1200-1340	10 ft. seine, backpack shocker
SU-2	Sulphur Creek @ Alabama Hwy. 127	Limestone, AL	sec. 31, T. 1 S., R. 4 W.	34°54'34.8"N 86°59'18.8"W	12 Apr. 2006	1400-1425	6 ft. seine, backpack shocker
SH-1a	Shoal Creek upstream of mouth	Limestone, AL	sec. 27, T. 2 S., R. 5 W.	34°55'48.8"N 87°02'33.9"W	13 Aug. 2004	1130-1200	electrofishing boat
SH-1b					23 Aug. 2006	1435-1505	electrofishing boat
SH-2a	Shoal Creek about 1 mi. downstream of first flowing shoal	Limestone, AL	sec. 27, T. 2 S., R. 5 W.	34°55'48.3"N 87°02'47.3"W	3 Aug. 2004	1325-1350	electrofishing boat
SH-2b					23 Aug. 2006	1520-1550	electrofishing boat
SH-3a	Shoal Creek @ first flowing shoal upstream of Wheeler Lake	Limestone, AL	sec. 27, T. 2 S., R. 5 W.	34°56'10.1"N 87°02'52.7"W	3 Aug. 2004	1040-1210	10 ft. seine, backpack shocker
SH-3b					21 Sep. 2005	0900-1100	10 ft. seine, backpack shocker
SH-3c					1 Aug. 2006	0912-0954	10 ft. seine, backpack shocker
SH-4a	Shoal Creek @ Leggtown Road	Limestone, AL	sec. 16, T. 1 S., R. 5 W.	34°57'9.0"N 87°4'1.8"W	18 Aug. 2004	0900-1125	10 ft. seine, backpack shocker
SH-4b					23 June 2005	1105-1215	10 ft. seine, backpack shocker
SH-5	Shoal Creek, .25 mi. E Gourdsville	Limestone, AL	sec. 5, T. 1 S., R. 5 W.	34°59'23.7"N 87°5'8.7"W	21 Sep. 2005	1230-1345	10 ft. seine, backpack shocker

Table 1. Summary information on sampling stations in the Elk River system, 2004-06—continued

Station	Location	County, State	TRS	Coordinates	Date	Time	Techniques
SH-6	Shoal Creek, .6 mi. E Legg Cemetery	Limestone, AL	sec. 22, T. 1 S., R. 5 W	34°56'16"N 87°02'59"W	1 Aug. 2006	1015-1030	10 ft. seine, backpack shocker
SH-7	Shoal Creek, .5 mi. E Legg Cemetery	Limestone, AL	sec. 22, T. 1 S., R. 5 W	34° 56' 16"N 87° 03' 06"W	1 Aug. 2006	1035-1050	10 ft. seine, backpack shocker
SH-8	Shoal Creek, .4 mi. E Legg Cemetery	Limestone, AL	sec. 21, T. 1 S., R. 5 W	34° 56' 19"N 87° 03' 08"W	1 Aug. 2006	1100-1115	10 ft. seine, backpack shocker
SH-9	Shoal Creek, 1 mi. SE Leggtown	Limestone, AL	sec. 21, T. 1 S., R. 5 W	34° 56' 34"N 87° 03' 12"W	1 Aug. 2006	1140-1205	10 ft. seine, backpack shocker
SH-10	Shoal Creek, .8 mi. ESE Leggtown	Limestone, AL	sec. 21, T. 1 S., R. 5 W	34° 56' 58"N 87° 03' 15"W	1 Aug. 2006	1230-1245	10 ft. seine, backpack shocker
SH-11	Shoal Creek, .7 mi. ESE Leggtown	Limestone, AL	sec. 21, T. 1 S., R. 5 W.	34° 57' 02"N 87° 03' 23"W	1 Aug. 2006	1300-1310	10 ft. seine, backpack shocker
TC-1	Turkey Creek @ Turkey Creek Road	Limestone, AL	sec. 23, T. 1 S., R. 5 W.	34°56'27.0"N 87°01'42.9"W	12 Apr. 2006	0840-0945	6 ft. seine, backpack shocker
CRB-1	Crooked Branch @ Maple Store	Limestone, AL	sec. 10, T. 1 S., R. 5 W.	34°58'10.6"N 87°02'19.5"W	12 Apr. 2006	1115-1145	6 ft. seine
MC-1	Mill Creek @ Mill Creek RV Park	Limestone, AL	sec. 7, T. 1 S., R. 4 W.	34°58'15.4"N 86°59'52.1"W	16 Feb. 2005	1610-1640	10 ft. seine, backpack shocker
CB-1	Cave Branch near Pettusville	Limestone, AL	sec. 5, T. 1 S., R. 4 W.	34°59'8.0"N 86°58'4.7"W	16 Feb. 2005	0945-1015	6 ft. seine, backpack shocker
RC-1	Ragsdale Creek @ Shipley Hollow Road	Limestone, AL	sec. 11, T. 1 S., R. 4 W.	34°57'53.8"N 86°55'1.4"W	16 Feb. 2005	1120-1155	6 ft. seine, backpack shocker

River. The gill nets were multifilament, 200 feet long and 6 feet deep with a 2-inch bar mesh.

RESULTS AND DISCUSSION

Collection efforts in the Elk River system in 2004 through 2006 produced 96 fish species and a few hybrid sunfish and one hybrid striped bass (table 2). On at least one occasion, sampling produced 12 of 13 species of moderate to highest conservation concern known to occur in the Elk River system in Alabama. New localities were found for seven of these species, including new tributary records for the boulder darter, the streamline chub, the stargazing minnow, the highlands stonecat, and the highland shiner. A single large (approximately 2.5-foot total length [TL]) striped bass was captured at station ER-13 in the Wheeler Lake embayment. Striped bass are not native to the Tennessee River drainage, and there is apparently no natural reproduction in the population. The following are brief accounts of collection results for each of the species of conservation concern that were encountered.

BOULDER DARTER, *Etheostoma wapiti*, highest conservation concern and federally listed as endangered. Boulder darters were found at seven stations in this study (fig. 3, apps. A, B). Six of the stations were in the main channel of the Elk River from Gallus Island (ER-17) upstream to a bluff near the state line at river mile 33 (ER-23), and the other was in Shoal Creek in a slab-boulder run at the first shoal upstream of the embayment of Wheeler Reservoir. The boulder darter is known from 60 river miles of the main channel of the Elk River from just upstream of the embayment of Wheeler Reservoir upstream to near Fayetteville, Tennessee. It historically occurred in Shoal Creek in Lauderdale County, Alabama, but that population is thought to be extirpated (Etnier and Starnes, 1993; Shute, 2004). Boulder darters were experimentally reintroduced into Shoal Creek in 2005 by the USFWS with stock produced from specimens collected in Elk River. In 1993, boulder darters were found at Fishtrap Ford (ER-22), Mason Island (ER-21), and at a deep boulder shoal just upstream of Alabama Highway 127 (Mettee and others, 2002). One individual was collected at Mason Island in this study in both 2005 and 2006. No individuals were found in two collections upstream of Highway 127. One small (approximately 30 mm

t2

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standard length [SL]) juvenile was found on a gravel shoal at the head of Gallus Island (ER-18) in 2004. In 2005, boat electrofishing along rock bluffs with piles of slab-boulders at their bases near Gallus Island (ER-17, ER-19) produced individual adult specimens. The presence of boulder darters at these bluffs was somewhat surprising since they are deepwater habitats and were at the transition between the flowing segment of Elk River and the embayment of Wheeler Reservoir. Two adults were collected from Shoal Creek in a boulder shoal upstream of the embayment of Wheeler Reservoir (SH-3a) in 2004. This collection represents a new tributary record for the species. An additional specimen was collected in the same shoal in 2005 and 2006. Although boulder darters are associated with large stream habitats such as the main stem of Elk River, they are also known from the downstream reaches of two other Elk River tributaries, Richland and Indian Creeks in Tennessee (Etnier and Starnes, 1993). Shoal Creek at station SH-3 is a small stream only about 40 feet wide. Since Shoal Creek is separated from the flowing section of Elk River by Wheeler Reservoir, it is likely that the Shoal Creek specimens represent a reproducing population. Two collections at station SH-4, several miles upstream of this site, and six other stations between SH-3 and SH-4 failed to produce boulder darters although there appeared to be suitable slab-boulder habitat available at the stations.

STREAMLINE CHUB, *Erimystax dissimilis*, high conservation concern.

Streamline chubs were collected in 26 samples at eleven stations (fig. 4, apps. A, B). Within the Elk River system in Alabama, the species was previously known from only one locality in Sugar Creek (Mettee and others, 2002; Mettee, 2004b). In this study, streamline chubs were found in Big, Sulphur, and Sugar Creeks and at two stations in the main stem at the upper end of Gallus Island (ER-18) and at Mason Island (ER-21). Although uncommon at most stations, collections at stations SC-2, SC-3, SC-6, and SC-7 in Sugar Creek produced from one to nine individuals (apps. A, B). A boat electrofishing collection at station SC-7 in 2006 produced 12 individuals. Collections in Big and Sulphur Creeks are new tributary records, and the collections at Gallus Island are new downstream range extensions in the main stem of the Elk River. Discovery of these new localities in the system is probably more related to lack of previous collection

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effort at the stations than to a range expansion by the species in recent years. Most of the new localities are accessible mainly by boat and had not been frequently sampled, if at all, in the past. Etnier and Starnes (1993) reported numerous localities for streamline chubs in the Elk River upstream of the Alabama state line. Streamline chubs are also found in the Shoal Creek (Lauderdale Co.) and Paint Rock River systems in Alabama (Mettee and others, 1996; Mettee and others, 2002; Boschung and Mayden, 2004a). The overall distribution of the species is in the Tennessee, Cumberland, and upper Ohio River drainages (Harris, 1980).

SHOAL CHUB, *Macrhybopsis hyostoma*, high conservation concern. Our collection efforts in this study did not produce any shoal chubs in Alabama in 2004-06. In 2004, GSA collected a single individual over a gravel shoal at river mile 34.5 just across the state line in Tennessee. In Alabama, the species is known from only a few localities from the main channel of the Elk River from Mason Island upstream to near the Alabama-Tennessee state line (Mettee and others, 1996; Etnier and Starnes, 1993; Mettee and others, 2002; B.R. Kuhajda, pers. comm., 2004 ; Boschung and Mayden, 2004a, b). Boschung and Mayden (2004b) concluded that the population in the Elk River is in danger of extirpation in Alabama. Results of this study support that opinion. Shoal chubs may be more easily collected in the spring when they congregate to spawn in shoals than in the summer when they disperse to deeper water (Charles F. Saylor, personal comm., 2006). Since all of our collections in the main stem of the Elk River were in late summer, this might partially explain our lack of success collecting the fish. The species has been extirpated in many parts of its former range in the Cumberland and Tennessee River systems (Etnier and Starnes, 1993). Boschung and Mayden (2004a) recommend that the shoal chub be considered for endangered species status. Based on this study, consideration should also be given to raising the shoal chub from high (P2) to highest (P1) conservation concern in Alabama.

STARGAZING MINNOW, *Phenacobius uranops*, high conservation concern. Sampling produced stargazing minnows in 16 collections at nine stations in Alabama (fig. 5, apps. A, B). In the main channel of the Elk River, the species was collected at the head of Gallus Island (ER-18), Fishtrap Ford (ER-22), and at river mile 33 (ER-23).

f5

Five stations in Sugar Creek (SC-2, SC-3, SC-6, SC-7, and SC-9) and the first upstream shoal in Big Creek (BC-1) also produced stargazing minnows. Our largest catch was 10 individuals in a collection from Sugar Creek (SC-9). Jandebour (1972) reported the species from only a single station in Sugar Creek for the Elk River system within Alabama, although he found it at several other stations in Tennessee. The species has recently been collected at several additional localities in the Elk River near Mason Island in Alabama (B.R. Kuhajda, pers. comm., 2004; Boschung and Mayden, 2004a). The collection in Big Creek is a new tributary record. Etnier and Starnes (1993) show numerous localities in the Elk River and tributaries in Tennessee. Stargazing minnows are also found in the flowing sections of the Shoal Creek (Lauderdale Co.) system in Alabama (Mettee and others, 1996). The species is apparently extirpated in the Cypress Creek system (Mettee and others, 2002; Mettee, 2004c). The overall range of the species includes the Cumberland, Tennessee, and Green River drainages (Jenkins, 1980).

MOUNTAIN MADTOM, *Noturus eleutherus*, high conservation concern.

Mountain madtoms were collected at only one station in Alabama at Fishtrap Ford (ER-22) (fig. 6, apps. A, B). Mountain madtoms were taken in six of 12 collections at Fishtrap Ford, with from one to five specimens per collection. This species was first collected in Alabama by GSA biologists in 1993 at Fishtrap Ford (Mettee and others 1996), which is the only known locality in the state. Etnier and Starnes (1993) also reported records in the Elk River in Tennessee near the state line. GSA collected 28 individuals in one collection in Tennessee near the state line at river mile 34.5 in 2004. Fishtrap Ford may offer the only suitable habitat in the Elk River in Alabama for this peripheral species. Within the main channel, there is not another shoal upstream of Fishtrap Ford until river mile 34 in Tennessee. Downstream, Mason and Gallus Islands do not contain the shallow cobble/gravel shoals inhabited by mountain madtoms. The species does not occur in any other river system in Alabama. Since mountain madtoms only occur in a single shoal in the state, consideration should be given to elevating the species to highest conservation concern (P1). Outside of Alabama, the species is

f6

widespread in the Tennessee, Cumberland, Ohio, White, Red, and Ouachita River systems (Mettee, 2004d).

HIGHLANDS STONECAT, *Noturus* sp. cf. *flavus*, high conservation concern. The highlands stonecat was collected in nine samples at two stations in Alabama (fig. 7, apps. A, B). One of the stations was in the main channel of the Elk River at Fishtrap Ford (ER-22), and the other was in Sulphur Creek at the first shoal upstream of the embayment of Wheeler Reservoir (SU-1), which is a new locality and tributary record for the Elk River system. Only a single individual was collected in Sulphur Creek in 2004. Another sample at the station in 2005 did not produce any highlands stonecats. Eight of 12 collections at Fishtrap Ford produced the species with up to 33 individuals in a collection. Stonecats are typically found under large slab-boulders during daytime sampling, and this is the habitat that produced them at Fishtrap Ford. Highlands stonecats were first collected in the Elk River in Alabama in 1993 by GSA biologists at Fishtrap Ford (Mettee and others, 1996). The species has also been collected upstream of Mason Island by biologists with UA (B.R. Kuhajda, pers. comm., 2004) and is known from the Elk River in Tennessee (Jandebour, 1972; Etnier and Starnes, 1993). In Alabama, it also occurs in the flowing segment of Shoal Creek in Lauderdale County (Mettee, 2004e). The stonecat, *Noturus flavus*, is the most widespread madtom species, occurring in the upper Mississippi, Ohio, and Great Lakes basins and in the Red River of the Hudson Bay drainage (Etnier and Starnes, 1993).

BLUEBREAST DARTER, *Etheostoma camurum*, high conservation concern. Bluebreast darters were collected only at Fishtrap Ford (ER-22) in five of 12 samples, (fig. 8, apps. A, B). The species was uncommon at Fishtrap Ford; however, we collected 15 individuals in 2004 at river mile 34.5 in Tennessee near the state line. Bluebreast darters were first found in Alabama at three shoals upstream of the Highway 127 bridge in 1993 by GSA biologists (Mettee and others, 1996). Mason Island produced bluebreast darters in 1993, but six collections there in the past two years have yielded none. The habitat at Mason Island has been altered since 1993. In 1993, the shoal was shallower and partly composed of cobble and boulders. The shoal is now mostly a deep gravel run. Bluebreast darters do not occur in other river systems in

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Alabama (O'Neil, 2004a) but are found in the main stem of the Elk River in Tennessee (Jandebeur, 1972; Etnier and Starnes, 1993). Since the species has such a limited distribution in Alabama, it should be considered for highest conservation concern status (P1). Overall, the species has a widespread distribution in much of the Ohio, Cumberland, and Tennessee River drainages (Etnier and Starnes, 1993).

GILT DARTER, *Percina evides*, high conservation concern. Gilt darters were collected in 13 samples at three stations in Alabama (fig. 9, apps. A, B). All of the stations were on the main stem from the upper end of Gallus Island (ER-18) upstream to Fishtrap Ford (ER-21). Our largest collection in Alabama was of eight individuals at Gallus Island. Jandebeur (1972) reported gilt darters from the Elk River in Tennessee, but they were first collected in the system in Alabama in 1993 by GSA (Mettee and others, 1996). Gilt darters are also known from the Shoal and Bear Creek systems in Alabama (O'Neil, 2004b). The species is widely distributed in the Mississippi River Basin from New York to Minnesota and south to the White River system in Arkansas and the Tennessee River system (Etnier and Starnes, 1993).

SKIPJACK HERRING, *Alosa chrysochloris*, moderate conservation concern. Skipjacks were captured using the boat electrofisher and gill nets in nine collections at eight stations in Elk River and Sugar Creek (fig. 10, apps. A, B). In addition to the specimens captured, large numbers of skipjacks were seen leaping from the water as they pursued massive schools of threadfin shad, *Dorosoma petenense*, at several stations in the river. The species is found in almost every major river system in Alabama and most Gulf Coastal drainages including the Mississippi River basin (Mettee and others, 1996); it has, however, been extirpated in much of the upper Mississippi River system due to locks and dams which have blocked upstream migrations (Mettee and O'Neil, 2003). The skipjack herring is reported to be generally common in large rivers and main channel reservoirs in Tennessee (Etnier and Starnes, 1993). Populations in Mississippi and Alabama are also reported to be stable (Ross, 2001; Boschung and Mayden, 2004a). Our results in 2004-06 suggest that the population in the lower Elk River is stable as well.

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BLOTCHED CHUB, *Erimystax insignis*, moderate conservation concern. The blotched chub was collected regularly at Mason Island (ER- 21) and Fishtrap Ford (ER-22) (fig. 11, apps. A, B). The largest collection in Alabama consisted of 24 individuals from Fishtrap Ford. A collection in Tennessee at river mile 34.5 in 2004 showed the species to be even more common with 48 individuals taken on two occasions. Other collections in Alabama produced from one to 11 individuals. Blotched chubs were first collected in the Elk River in Alabama in 1993 by GSA biologists at Fishtrap Ford (Mettee and others, 2002). Jandebeur (1972) had previously reported them in the Elk River system in Tennessee. The species is endemic to the Cumberland and Tennessee River systems (Mettee and others, 1996). In Alabama, blotched chubs are also found in the Shoal Creek, Flint River, and Paint Rock River systems (Mettee and others, 2002).

GHOST SHINER, *Notropis buchmanii*, moderate conservation concern. We collected a single ghost shiner in the Elk River system in Alabama in 2004-06. The specimen was collected in the main channel at Fishtrap Ford (ER-22) (fig. 12, apps. A, B). The species was regularly captured at Mason Island and in substantial numbers several years ago by collectors from UA (B.R. Kuhajda, pers. comm., 2004). Two collections by GSA at river mile 34.5 across the state line in Tennessee in 2005 also produced 8 and 14 specimens. In Alabama, ghost shiners are only found in the Tennessee River system, where they are associated with large streams and rivers (Kuhajda, 2004; Mettee and others, 1996; Boschung and Mayden, 2004a). The species has been collected infrequently in the past several decades in Alabama with most collections from lower impounded reaches of large tributaries and the flowing section of Elk River (Mettee and others, 1996; Kuhajda, 2004). The ghost shiner has a wide distribution in Gulf Coast drainages from the Mississippi River Basin west to the Rio Grande (Etnier and Starnes, 1993).

HIGHLAND SHINER, *Notropis micropteryx*, moderate conservation concern. Sampling produced highland shiners, formerly called the rosyface shiner, *Notropis rubellus* (Nelson and others, 2004), in 30 collections at ten stations (fig. 13, apps. A, B). The species was taken at five stations in Sugar Creek (SC-2, SC-3, SC-6, SC-9, and SC-10), one station in Shoal Creek (SH-3) and Anderson Creek (AC-2), and three

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stations in the main channel of Elk River from the upper end of Gallus Island (ER-18) upstream to Fishtrap Ford (ER-22). Highland shiners were abundant at most of these stations with up to 33 individuals collected at Gallus Island. Previous records in the Elk River system in Alabama were of specimens collected in 1993 by GSA biologists at Fishtrap Ford (Mettee and others, 1996, 2002) and in the main channel at the boat ramp upstream of Alabama Highway 99 and at Mason Island by UA (B.R. Kuhajda, pers. comm., 2004). Jandebeur (1972) reported numerous records from the system in Tennessee. In addition to the Elk River system, the highland shiner is also found in the Bear Creek system in Alabama (Mettee and others, 1996). Their overall distribution encompasses the Cumberland and Tennessee River systems (Boschung and Mayden, 2004a).

SILVER SHINER, *Notropis photogenis*, moderate conservation concern. Silver shiners were collected in 30 samples at 11 stations (fig. 14, apps. A, B). Five of the stations were in Sugar Creek (SC-2, SC-3, SC-6, SC-7, and SC-9) and the other six were in the Elk River main channel from the upper end of Gallus Island (ER-17) to river mile 33 (ER-23). Although most of the collections consisted of only a few individuals, one collection in Sugar Creek (SC-2e) produced 39 silver shiners and another (SC-3c) produced 27. The silver shiner had been collected from Sugar Creek and the main channel of the Elk prior to this study (Mettee and others, 2002; B.R. Kuhajda, pers. comm., 2004; Boschung and Mayden, 2004a). In Alabama, the species also occurs in the flowing portion of Shoal Creek in Lauderdale County. The overall range of the silver shiner includes Lake Erie tributaries and Ohio, Cumberland, and Tennessee River drainages (Etnier and Starnes, 1993).

Our sampling in the Elk River system in 2004-06 documented the invasion of the system by the Mississippi silverside, *Menidia audens* (fig. 15, apps. A, B). Collection efforts by GSA of the Elk River produced no Mississippi silversides in 1993, and none were reported by Jandebeur (1972), Etnier and Starnes (1993), Mettee and others (1996), Mettee and others (2002), or Boschung and Mayden (2004a). In this study, however, the species was collected in 35 samples at 11 stations in the main channel from near the mouth to river mile 33 and at stations SC-2 and SC-3 in Sugar Creek.

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f15

The Mississippi silverside was somewhat common, with several samples producing over 50 individuals. Mettee and others (2002) reported collecting *Menidia* in Pickwick Reservoir, and that the specimens had been identified as *M. audens* by Dr. R.D. Suttkus. Chernoff and others (1981) considered *M. audens* to be a clinal variant of the inland silverside, *M. beryllina*. Boschung and Mayden (2004a) stated that *Menidia* specimens collected in Pickwick and Wilson pools of the Tennessee River by Dr. D. A. Etnier probably came up the Tennessee River from the Mississippi River rather than entering from the Mobile Basin through the Tennessee-Tombigbee Waterway, because Inland silversides, *M. beryllina*, in the Mobile Basin are only known to occur as far north as Little River in Baldwin County. Mississippi silversides have a high reproductive potential (Hubbs, 1976) and typically occur in large schools either in open water or in deeper water near shore and structures. Their primary prey items are microcrustaceans and other small invertebrates (Boschung and Mayden, 2004a). The impact of a new and prolific species like the Mississippi silverside on the native fish population of the Elk River is difficult to predict. Since they prefer open water, Mississippi silversides might not directly compete with species of conservation concern for habitat, food, or spawning areas and would not be predatory on at least the adults of these species. Inland silversides are a significant forage species for a number of predatory fish such as white bass, yellow bass, and largemouth bass (Etnier and Starnes, 1993) and could become a major prey item in Wheeler Lake as well.

Sampling in 2004-06 failed to produce any specimens of the ashy darter, *Etheostoma cinereum*. A single specimen of *E. cinereum* was collected in the Elk River by C. F. Saylor and TVA in 1981 near Fayetteville, Tennessee, in a rotenone sample (Shepard and Burr, 1984; Feeman, 1987). The species has not been found in subsequent sampling in the Elk in Tennessee and Alabama. Ashy darters are an uncommon species, most frequently collected in medium to large upland streams of moderate gradient from clear, silt-free pools and eddies with sluggish current in water from 2 to 6 feet deep. They are usually found over substrates of clean sand, gravel, or bedrock in close association with cover in the form of boulders, snags, and stands of water willow (*Justicia*). As a pool-dwelling species, the ashy darter is particularly

vulnerable to the effects of sedimentation. The heavy load of fine sediments in the lower Elk River in Alabama coupled with the effects of peaking flows and unstable littoral habitats from power generation at Tims Ford dam may have eliminated ashy darters from the system in Alabama if they ever did occur there.

CONCLUSIONS

Although the fish fauna of the Elk River system has been impacted by impoundments, altered flow regimes, and nonpoint-source pollution, survey results in 2004-06 revealed the continued existence of at least 12 of 13 species which have been designated for conservation concern. Range extensions and new localities were found for several of these species. Within Alabama, four of these species (boulder darter, shoal chub, mountain madtom, and bluebreast darter) are only found in the Elk River system. Three more (silver shiner, highlands stonecat, and streamline chub) are found only in the Elk River system and the Shoal Creek system. Still another (blotched chub) is found only in the Elk River system, the Shoal Creek system, the Flint River system, and the Paint Rock River system. The continued existence of these sensitive species in the Elk River system depends on wise management of the watershed through efforts such as the development of protected riparian buffer zones and implementation of best management practices in forestry and agriculture. Also, TVA should be encouraged to devise a generation schedule for Tims Ford Dam that minimizes downstream impacts to vulnerable species.

Three species which are currently listed as high conservation (P2) concern in Alabama should be considered for listing as highest conservation (P1) concern in the state. These are the shoal chub, the mountain madtom, and the bluebreast darter. Within Alabama, the shoal chub is only known from the Elk River; however, three years of sampling effort in this project in the system failed to produce any specimens in the state, and only a single individual was collected just across the state line at a large shoal in Tennessee. Additional monitoring of this species is needed and it should be designated as a species of highest conservation concern in Alabama. We consistently collected mountain madtoms and bluebreast darters in this project, but only at a single shoal. The shoal at Fishtrap Ford may be the only location in Alabama where these two

species exist and they should be considered for listing as highest conservation concern based on this very limited distribution.

REFERENCES CITED

- Boschung, H.T., and Mayden, R.L., 2004a, Fishes of Alabama: Washington, Smithsonian Books, 736 p.
- Boschung, H.T., and Mayden, R.L., 2004b, Shoal chub, *Macrhybopsis aestivalis hyostoma*, p. 210 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife. Volume 2 Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Chernoff, B., Conner, J.V., and Bryan, C.F., 1981, Systematics of the *Menidia beryllina* complex (Pisces: Atherinidae) from the Gulf of Mexico and its tributaries: Copeia, v. 1981, no. 2, p. 319-336.
- Etnier, D.A., and Starnes, W.C., 1993, The fishes of Tennessee: Knoxville, Tennessee, University of Tennessee Press, 681 p.
- Feeman, J.C., 1987, Results of fish surveys in the Tennessee River drainage, 1979-1981: Brimleyana, v. 13, p. 99-121.
- Harris, J.L., 1980, *Hybopsis dissimilis* (Kirtland), streamline chub, p. 184 in Lee, D.S., and others, eds., Atlas of North American freshwater fishes: Raleigh, North Carolina State Museum of Natural History, i-x+854 p.
- Hubbs, C., 1976, The diel reproductive pattern and fecundity of *Menidia audens*: Copeia, v. 1976, no. 2, p. 386-388.
- Jandebeur, T.S., 1972, A study of the fishes of the Elk River drainage in Tennessee and Alabama: Tuscaloosa, University of Alabama, Unpublished Masters thesis, 154 p.
- Jenkins, R.E., 1980, *Phenacobius uranops* Cope, Stargazing minnow, p. 334 in Lee, D.S., and others, eds., Atlas of North American freshwater fishes: Raleigh, North Carolina State Museum of Natural History, i-x+854 p.
- Kuhajda, B.R., 2004, Ghost shiner, *Notropis buchanani*, p. 211 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.

- Mettee, M.F., 2004a, Fishes, p. 158 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Mettee, M.F., 2004b, Streamline chub, *Erimystax dissimilis*, p. 215 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Mettee, M.F., 2004c, Stargazing minnow, *Phenacobius uranops*, p. 215 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Mettee, M.F., 2004d, Mountain madtom, *Noturus eleutherus*, p. 218 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Mettee, M.F., 2004e, Highlands stonecat, *Noturus* sp. cf. *flavus*, p. 222 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Mettee, M.F., and O'Neil, P.E., 2003, Status of Alabama shad and skipjack herring in Gulf of Mexico drainages: American Fisheries Society Symposium, no. 35, p. 157-170.
- Mettee, M.F., O'Neil, P.E., and Pierson, J.M., 1996, Fishes of Alabama and the Mobile basin: Birmingham, Alabama, Oxmoor House, 820 p.
- Mettee, M.F., O'Neil, P.E., Shepard, T.E., McGregor, S.W., and Henderson, W.P. Jr., 2002, A survey of protected fish species and species of uncommon occurrence in the Tennessee River drainage of north Alabama and northeast Mississippi: Alabama Geological Survey Bulletin 171, 173 p.
- Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife. Volume 2 Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Nelson, J.S., Crossman, E.J., Espinosa-Pérez, H., Findley, L.T., Gilbert, C.R., Lea, R.N., and Williams, J.D., 2004, Common and scientific names of fishes from the United States, Canada, and Mexico: American Fisheries Society, Special Publication 29, Bethesda, Maryland, 386 p.

- O'Neil, P.E., 2004a, Bluebreast darter, *Etheostoma camurum*, p. 227 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- O'Neil, P.E., 2004b, Gilt darter, *Percina evides*, p. 235 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife. Volume 2 Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Osborne, W.E., Szabo, M.W., Copeland, C.W., and Neathery, T.L., 1989, Geologic Map of Alabama: Alabama Geological Survey Special Map 221.
- Ross, S.T., 2001, The Inland fishes of Mississippi: The University Press of Mississippi, 624 p.
- Sapp, C.D., and Emplaincourt, Jacques, 1975, Physiographic regions of Alabama: Alabama Geological Survey Special Map 168.
- Shepard, T.E., and Burr, B.M., 1984, Systematics, status, and life history aspects of the ashy darter, *Etheostoma cinereum* (Pisces: Percidae): Proceedings of the Biological Society of Washington, v. 97, p. 693-715.
- Shute, P., 2004, Boulder darter, *Etheostoma wapiti*, p. 194 in Mirarchi, R.E., Garner, J.T., Mettee, M.F., and O'Neil, P.E., eds., 2004, Alabama Wildlife, Volume 2, Imperiled aquatic mollusks and fishes: Tuscaloosa, The University of Alabama Press, 225 p.
- Smith-Vaniz, W.F., 1968, Freshwater fishes of Alabama: Auburn University Agricultural Experiment Station, 221 p.

APPENDIX A

Collection results for fish samples in the Elk River system, 2004-06.

Station numbers reference table 1 and figure 2. "P" indicates that a species was present for those samples where individuals were not counted. "No Fish" indicates that sampling did not produce any fish specimens at the station.

APPENDIX B

Abundance and catch per unit effort (CPUE) for 13 fish species of conservation concern and two nonnative species in the Elk River system, 2004-06.

Number of individuals in each collection is followed in parentheses by number of individuals captured per sample hour at each station. Station numbers reference table 1 and figure 2.