

GEOLOGICAL SURVEY OF ALABAMA

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**STATUS SURVEY OF THE SOUTHEASTERN BLUE SUCKER
(*Cycleptus meridionalis*) IN THE ALABAMA RIVER, 1995-2004**

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by

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ABSTRACT

A spawning population of *Cycleptus meridionalis* was sampled 79 times in the generator outflow area below Millers Ferry Lock and Dam from 1995-2004. Sixty-six percent of 1,144 fish captured were males, 31 percent were females, and 3 percent were gender undetermined. Regression slopes for total length versus standard length and standard length versus total weight were significantly different ($P < 0.01$) between males and females. Greatest spawning activity occurred in late March when water temperatures ranged from 15 to 17° C. Most fish left the spawning area when water temperatures reached 20 to 21° C. Sixteen percent of 911 *Cycleptus meridionalis* anchor tagged from 1995-2003 were recaptured from 1996-2004. Multiple recaptures confirmed that many *Cycleptus meridionalis* inhabiting the Alabama River spawned annually below Millers Ferry Lock and Dam for 10 years. Jolly and Jolly-Seber population estimates ranged from 773 to 1,275. Of the 149 fish fitted with sonic tags, 111 were detected from 1 to 19 times and from 1 to 1,228 days following release. Some lower Alabama River and Mobile-Tensaw River Delta *Cycleptus* completed one of the longest known spawning runs of any freshwater fish species in North America.

INTRODUCTION

The genus *Cycleptus* contains two described and one undescribed species. *Cycleptus elongatus* (Lesueur, 1817) occupies major tributaries to the Mississippi River (Gilbert, 1978; Page and Burr, 1991). *Cycleptus meridionalis* (Burr and Mayden, 1999) occurs in Gulf Coast drainages from the Pearl River east to the Mobile River basin. Burr and Mayden (1999) recognized a third undescribed form from the Rio Grande River.

Cycleptus elongatus was widespread and seasonally abundant in the Mississippi (Coker, 1929) and Ohio (Jordan, 1882) Rivers until the early 1900s. Recent reports suggest populations have been adversely affected by reservoir construction (Robison and Buchanan, 1988; Boschung, 1992; Etnier and Starnes, 1993), habitat alteration (Pflieger, 1975; Williams and

others, 1989; Etnier, 1997), and increased sedimentation and pollution (Moss and others, 1983; Elstad and Werdon, 1993).

Peterson and others (1999, 2000) reported *Cycleptus meridionalis* populations were stable and self sustaining in the Pearl and Pascagoula Rivers in Mississippi. Ross (2001) predicted Mississippi populations could be harmed by future reservoir construction and sedimentation. Semmens (1985) reported spawning activity in the Alabama River at water temperatures $>12^{\circ}$ C. Mettee and others (1996) mapped *Cycleptus meridionalis* distribution in Alabama including new records from the lower Tombigbee River and Mobile-Tensaw River Delta. This paper presents information gathered during a 10-year investigation of a spawning population of *Cycleptus meridionalis* sampled in the generator outflow area below Millers Ferry Lock and Dam in the Alabama River, Alabama.

ACKNOWLEDGMENTS

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THE STUDY AREA

The Alabama River is formed by the junction of the Coosa and Tallapoosa Rivers and it drains approximately 22,617 square miles in eastern Alabama, northwestern Georgia, and a small section of southern Tennessee. The Alabama and Tombigbee Rivers join to form the Mobile River, which flows about 30 miles before entering Mobile Bay.

The USCOE has constructed three navigation locks and dams on the Alabama River, two of which have hydroelectric generating facilities. Robert F. Henry Lock and Dam at Alabama River mile (ARM) 236 and Millers Ferry Lock and Dam at ARM 133 each have a gated

spillway, a lock chamber, and hydroelectric generating facilities. The powerhouse at Henry Lock and Dam is adjacent to the gated spillway on the west bank of the river. The powerhouse at Millers Ferry was constructed on the east bank of the river about 0.5 mile downstream of the gated spillway and lock chamber. Claiborne Lock and Dam, located at ARM 73, has a combined crested and gated spillway and a lock chamber, but it does not have hydroelectric generating capability.

Forest production and agriculture are the dominant land use throughout most of the Alabama River watershed. As such, riparian areas along much of the river are relatively undisturbed. Montgomery and Selma are the largest metropolitan areas that discharge treated wastewater directly into the river. The Cahaba River enters the Alabama near ARM 189, and it contributes nonpoint runoff and permitted discharges from wastewater treatment plants in the Birmingham Metropolitan area and the town of Centreville. Other major dischargers in the watershed include paper mills near Montgomery, Selma, Camden, and Monroeville. The Alabama River is subject to daily water level fluctuations from hydroelectric discharges at Henry and Millers Ferry Lock and Dams. Commercial barge traffic has declined significantly over the past 10 to 20 years, but the USCOE still maintains a 9-foot (ft) minimum depth throughout the 299-mile navigational channel of the Alabama River. Most dredging activities are confined to the lower 73 miles of the river downstream of Claiborne Lock and Dam. Fishing and boating are popular recreational activities throughout the Alabama River system.

OBJECTIVE

The objective of this study is to document the biology, population size, and movements of a *Cycleptus meridionalis* population that spawns below Millers Ferry Lock and Dam in the Alabama River.

METHODS

Samples were collected in March and April from 1995-2004. Hydroelectric generation was discontinued at 0900-1200 on each sample day. Five multi-filament nylon gill nets, each of which was 200-ft-long, 8-ft high tied down to 6-ft, had 2.0- to 2.5-inch (in.) bar netting, a foamcore float line, and a leadcore bottom line, were deployed in the generator outflow area (fig. 1), fished for approximately 60 minutes, and retrieved. All *Cycleptus meridionalis* collected

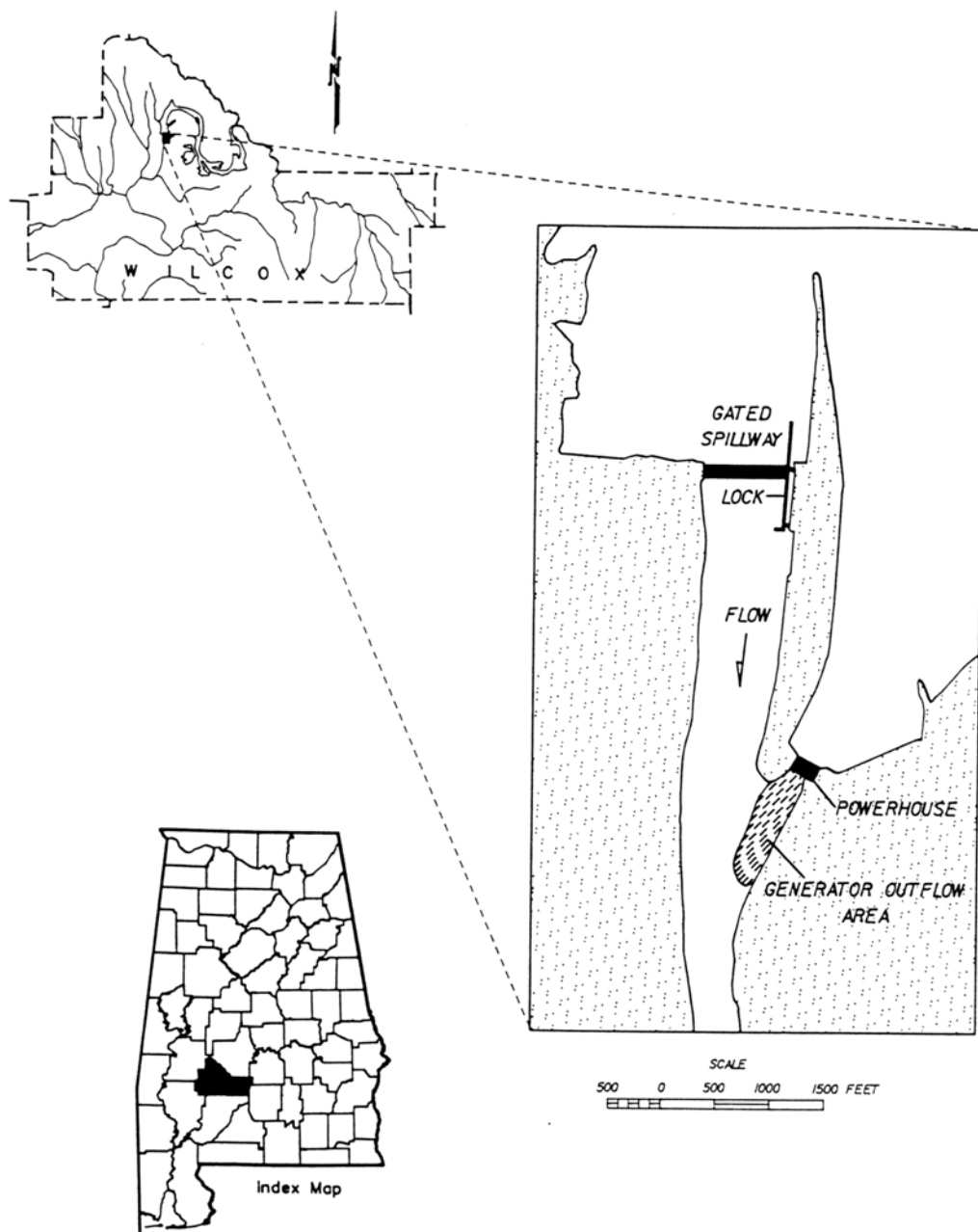


Figure 1.- Sampling area for *Cycleptus meridionalis* below Millers Ferry Lock and Dam.

were placed in a large aerated tank for later processing. Other species were identified, tallied, and released.

Processing and tagging operations were completed downstream of the netting area. Total length (TL) and standard length (SL) were measured in millimeters (mm), and total weight (TW) was measured in grams (g). Gender was determined by extruding gametes with light abdominal pressure. When no gametes were extruded, the fish was recorded as gender undetermined. A numbered anchor tag was inserted into the abdominal cavity through a small vertical incision made posterior to the distal end of the flattened left pectoral fin. Tags were pre-soaked in Betadine and the incision area was treated with Betadine after tagging.

Post-spawning movements of *Cycleptus meridionalis* were monitored by implanting a 14-month or 48-month ultrasonic tag produced by Sonotronics, Inc., into selected fish captured each year. Each individual was anesthetized with MS-222 diluted in a tub of river water, and a Betadine-soaked sonic tag was inserted into the abdominal cavity through a 2.5- to 3.0-in.-long incision made near the ventral midline. The incision was sutured with black non-absorbable nylon thread, the surgical area was treated with Betadine, and the fish was placed in a livewell and observed for several minutes before release.

Listening trips were completed from summer through the fall of each year. During each trip, the boat was stopped at about 0.3 mile intervals and a Sonotronics DH-2 directional hydrophone was lowered into the water and slowly turned to complete two 360° sweeps of the immediate area. A Sonotronics USR-5W receiver was used to detect the 69-83 kilohertz (kHz) range of tags used throughout the project. Once detected, each fish was located by triangulation and its position was georeferenced with a Lowrance LCX-15MT global positioning system (GPS) when the sonic signal was equally audible in all directions. Detection dates, locations, and depths were recorded on field sheets that are deposited in the GSA Ichthyological Collection in Tuscaloosa. Maps showing individual fish locations through time were generated with ArcView software.

Gender-based relationships of TL versus SL and SL versus TW were examined using least squares regression. Male and female slopes for each relationship were compared using analysis of covariance (ANCOVA). Spawning population size was estimated using Jolly (Jolly, 1965) and Jolly-Seber (Seber, 1982) population estimate models. Jolly estimates were calculated

by hand for 1997-2000 recapture data. The Jolly-Seber estimate and 95% confidence intervals were calculated on 1996-2003 capture-recapture data using Mark computer software.

RESULTS AND DISCUSSION

POPULATION DATA

Thirty-two species, including 1,144 *Cycleptus meridionalis*, and the palmetto bass (Table 1) were collected below Millers Ferry from 1995 through 2004. Sixty-six percent of all *Cycleptus* were males, 31 percent were females, and 3 percent were gender undetermined (Table 2). Males outnumbered females in every year except in 1995 and 2004 when females outnumbered males; numbers were equal in 1998. Differences in the 2:1 male to female ratio obtained during this study and the 1:1 ratio documented by Peterson and others (1999, 2000) in the Pearl and Pascagoula Rivers probably resulted from variations in sampling design. This study sampled a spawning population annually for 10 years using nets. Peterson and others (1999, 2000) collected random 15-minute electrofishing samples monthly in Mississippi.

Table 1. Fish species collected below Millers Ferry Lock and Dam from 1995-2004.

Family Polyodontidae- paddlefish <i>Polyodon spathula</i> - paddlefish Family Lepisosteidae- gars <i>Lepisosteus oculatus</i> - spotted gar <i>L. osseus</i> - longnose gar Family Anguillidae- freshwater eels <i>Anguilla rostrata</i> - American eel Family Clupeidae- herrings <i>Alosa alabamae</i> - Alabama shad <i>A. chrysochloris</i> - skipjack herring <i>Dorosoma cepedianum</i> - gizzard shad <i>D. petenense</i> - threadfin shad Family Hiodontidae- mooneyes <i>Hiodon tergisus</i> - mooneye Family Cyprinidae- carps and minnows <i>Notropis candidus</i> - silverside shiner Family Catostomidae- suckers <i>Carpionodes cyprinus</i> - quillback <i>C. velifer</i> - highfin carpsucker <i>Cycleptus meridionalis</i> - southeastern blue sucker <i>Ictiobus bubalus</i> - smallmouth buffalo <i>Minytrema melanops</i> - spotted sucker <i>Moxostoma carinatum</i> - river redhorse <i>M. poecilurum</i> - blacktail redhorse	Family Ictaluridae- bullhead catfishes <i>Ictalurus furcatus</i> - blue catfish <i>I. punctatus</i> - channel catfish <i>Pylodictis olivaris</i> - flathead catfish Family Belonidae- needlefishes <i>Strongylura marina</i> - Atlantic needlefish Family Moronidae- striped basses <i>Morone chrysops</i> - white bass <i>M. saxatilis</i> - striped bass <i>M. chrysops</i> x <i>saxatilis</i> - palmetto bass Family Centrarchidae- sunfishes <i>Lepomis macrochirus</i> - bluegill <i>L. microlophus</i> - redear sunfish <i>Micropterus punctulatus</i> - spotted bass <i>M. salmoides</i> - largemouth bass <i>Pomoxis annularis</i> - white crappie <i>P. nigromaculatus</i> - black crappie Family Percidae- perches <i>Stizostedion vitreum</i> - walleye Family Sciaenidae- drums <i>Aplodinotus grunniens</i> - freshwater drum Family Mugilidae- mullets <i>Mugil cephalus</i> - striped mullet
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Table 2. Net hours and catch statistics for *Cycleptus meridionalis* collected below Millers Ferry Lock and Dam, 1995-2004.
CPH = average catch per hour.

Year	Net hours	Males	Females	Unknown	CPH
1995	40	56	61	16	3.3
1996	50	88	27	3	2.4
1997	40	93	56	0	3.7
1998	65	23	23	3	0.8
1999	45	156	39	2	4.4
2000	35	30	7	2	1.1
2001	25	22	4	6	1.3
2002	30	101	29	1	4.4
2003	25	163	84	0	9.9
2004	40	22	23	4	1.2

Sampling success at Millers Ferry was influenced by the number of days that Claiborne Lock and Dam was inundated by winter floods. Eight to 20 days of inundation provided ideal conditions for sampling, which produced larger catches in 1995, 1996, 1997, 1999, 2002, and 2003 (Table 2). Least numbers of *Cycleptus* were collected in 2000 when Claiborne was not inundated and in 2001 when it was submerged for only two days (Table 3). The spillway at Claiborne was submerged for 45 days in 1998, allowing *Cycleptus* ample opportunity to move upstream past the dam. However, continuous flooding postponed netting operations until the end of the spawning season and as a result, only limited numbers of fish were collected.

Female *Cycleptus meridionalis* were generally longer (446 to 742 mm TL) and heavier (813 to 6,810 g TW) than males (438 to 702 mm TL and 888 to 3,915 g TW, respectively) (Table 4). Year-to-year variations in female TW were influenced in part by the fact that fish were weighed in gravid and post-spawning condition. The TL of females collected in the Alabama River and in Mississippi (452 to 702 mm TL) were similar, but Alabama River males were slightly longer than those collected in Mississippi (327 to 593 mm TL) (Peterson and others, 1999). Total weights of fish collected in Alabama and Mississippi could not be compared because weight ranges were not included in Peterson and others (1999).

Table 3. Number of days Claiborne Lock and Dam spillway was inundated by winter floods, January and February, 1995-2004.		
Year	January	February
1995	0	12
1996	4	16
1997	7	10
1998	23	22
1999	1	8
2000	0	0
2001	0	2
2002	6	2
2003	4	6
2004	0	12

Table 4. Total lengths (TL), standard lengths (SL), and total weights (TW) of male and female <i>Cycleptus</i> collected in the Alabama River, 1995-2004.						
Year	Males			Females		
	TL (mm)	SL (mm)	TW (g)	TL (mm)	SL (mm)	TW (g)
1995	438-600	362-510	888-2879	446-718	379-600	813-5276
1996	458-676	390-563	965-3625	515-722	438-605	1795-4254
1997	468-702	394-575	987-3450	551-710	460-590	1555-5670
1998	480-634	385-525	1025-3132	540-635	450-530	1902-3500
1999	462-693	415-626	1444-3915	560-690	512-630	1905-4815
2000	469-610	372-488	910-2905	502-706	400-572	1595-4385
2001	472-615	388-510	975-2045	510-618	430-574	1390-4765
2002	453-635	383-521	987-2617	535-690	427-583	1737-4218
2003	471-672	379-546	980-3705	523-742	437-608	1500-6810
2004	478-655	379-532	1065-3824	558-695	456-585	2310-6125

Linear regressions were used to compare TL versus SL for 722 males and 329 females collected from 1995-2003 (fig. 2). Equations were: $SL = 7.75 + 0.81 (TL)$ ($r = 0.944$) for males and $SL = -7.97 + 0.85 (TL)$ ($r = 0.954$) for females. Slopes for males and females were

significantly different ($P < 0.01$). The relationships for SL versus TW for 670 males and 308 females collected from 1995-2003 (fig. 3) were plotted as exponential functions because long-lived fishes generally grow faster in their first few years of life. Equations describing these functions were: $\log_{10} TW = -5.44 + 3.26 (\log_{10} SL)$ ($r = 0.923$) for males and $\log_{10} TW = -6.61 + 3.72 (\log_{10} SL)$ ($r = 0.954$) for females. Slopes for males and females were significantly different ($P < 0.01$).

SPAWNING SEASON

Cycleptus meridionalis congregate below Millers Ferry when water temperatures range from 15 to 21° C. The head and dorsum on males in pre-spawning condition are a pale bluish gray; the ventrum varies from gray to cream color; and the head, body, and fins are densely covered with prominent white tubercles. The head and dorsum of females are a lighter shade of bluish gray and the ventrum is gray to cream color. Tubercles are less prominent and more widely spaced on the head, body, and fins. Over 100 males and females were collected in a state of high spawning condition on March 29, 1999, and March 26-27, 2003. Water temperatures on these dates varied from 15 to 17° C. All individuals observed were much more intensely colored and they freely extruded large quantities of gametes during processing. Frayed fins and open wounds on some males and females collected each year could have resulted from aggressive spawning behavior or from moving upstream through turbulent currents at Claiborne Lock and Dam.

Spawning dates and temperatures observed during our study were consistent with the $>12^{\circ}$ C reported by Semmens (1985) in the Alabama River and the $13-14^{\circ}$ C reported in Mississippi by Peterson and others (1999). Spawning ceased and most fish left the Millers Ferry spawning area when temperatures reached $20-21^{\circ}$ C. Moss and others (1983) reported *Cycleptus elongatus* spawned in May in Kansas, and Rupprecht and Jahn (1980) and McNerny and Held (1988) noted late April to early May spawning in the upper Mississippi River.

CAPTURE/RECAPTURE DATA AND POPULATION ESTIMATES

Sixteen percent of 911 *Cycleptus meridionalis* anchor tagged below Millers Ferry from 1995-2003 were recaptured in the same sampling area from 1996-2004 (Table 5). The largest number of recaptures from a previous year occurred in 1996 and 1997, and the largest number

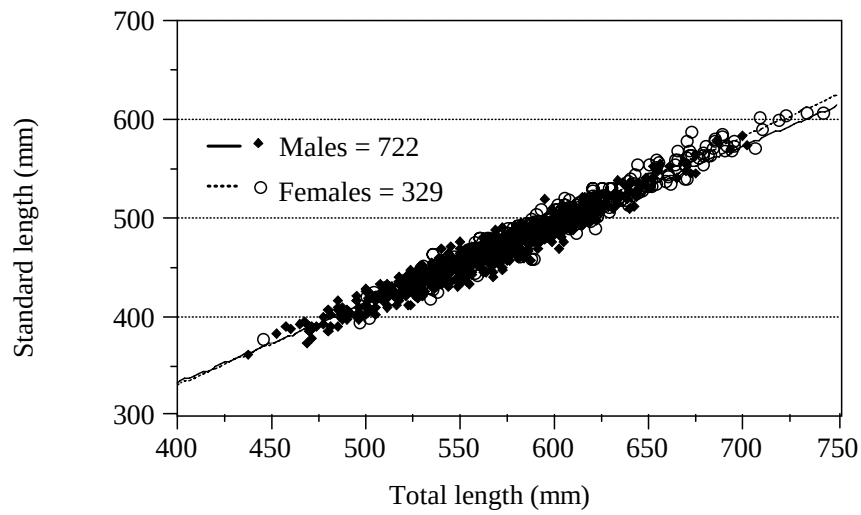


Figure 2.- Total length versus standard length for male and female *Cycleptus meridionalis* collected below Millers Ferry Lock and Dam, 1995-2003.

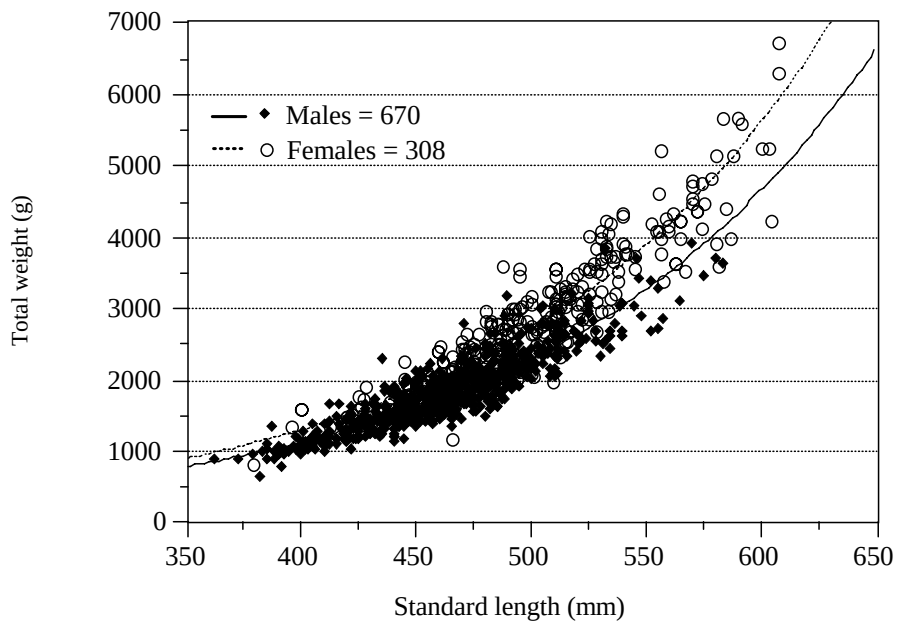


Figure 3.- Standard length versus total weight for male and female *Cycleptus meridionalis* collected below Millers Ferry Lock and Dam, 1995-2003.

Table 5. *Cycleptus meridionalis* anchor tagged below Millers Ferry Lock and Dam from 1995-2003 and recaptured in the same area from 1996-2004. Total recaptures (%) per tag year indicates the total number of fish recaptured per tag year. Totals in the bottom row include records of all fish recaptured from a previous year or during the original tag year.

Tag	Fish	Recaptures										Fish (%)
Year	Tagged	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	Recaptured
1995	133	3	25	7	0	6	0	0	3	1	1	43 (32)
1996	100		4	16	2	6	0	0	0	2	0	26 (26)
1997	124			1	2	13	0	0	1	2	0	18 (15)
1998	45				3	7	5	0	1	0	1	13 (29)
1999	148					6	8	0	4	9	0	21 (14)
2000	23						0	0	2	0	1	3 (13)
2001	31							0	4	0	3	4 (13)
2002	98								11	13	2	15 (15)
2003	209									8	1	1 (0)
Totals	911	3	29	24	7	38	13	0	26	35	9	144 (16)

of recaptures from the same tagging year occurred in 2002 and 2003. One hundred eight *Cycleptus* were recaptured only once. Thirty-six fish were recaptured two to six times and from two to eight years following release. Fish recaptured two or three times in a single year were recorded only once per year and in each tag class total in Table 5. Year-to-year differences in sampling success were influenced by a number of variables including river conditions, water temperatures, and the number of samples collected each year.

Recapture data suggest that large numbers of *Cycleptus meridionalis* return to the Millers Ferry spawning area annually for up to 10 years. Seventy-five fish were recaptured in the same collecting area one year following release. Five fish were recaptured annually from 1995 to 1997. One fish was recaptured every year from 1997 through 1999, and four were recaptured from 2002 through 2004. The longest recapture record was of a male that was tagged four times (1995, 1997, 2000, and 2004) and recaptured eight times (1997, 2000, 2002 (3 times), 2003, and 2004 (twice)). A second fish tagged in 1998 was recaptured in 1999, 2002 (twice), 2003, and 2004 (twice).

Several anchor tagged *Cycleptus meridionalis* moved upstream and downstream past Claiborne Lock and Dam. Two males tagged below Millers Ferry in 1997 and 1999 were

recaptured in the Claiborne tailwater in 2000. The 1999 fish subsequently moved upstream and was recaptured below Millers Ferry in 2002. One male tagged in Claiborne tailwater in 2000 was recaptured below Millers Ferry in 2002. Although these fish could have moved through the lock chamber at Claiborne, this possibility seems unlikely since the number of lock operations completed at this facility has declined substantially over the past 10 years.

Population estimates of *Cycleptus meridionalis* that spawn below Millers Ferry ranged from 775 to 1,034 fish using the Jolly model and from 773 to 1,275 fish using the Jolly-Seber model. Both estimates are conservative since 911 fish were tagged through 2003 and only 123 to 364 fish, respectively, are needed to exceed the upper estimates of both models. Lower than expected population estimates were probably biased by several uncontrollable factors, including sample number and scheduling, flow conditions in the Alabama River, water levels in the Millers Ferry tailwater, and the inability of the USCOE to discontinue hydroelectric generation flood conditions which coincided with the prime spawning season in 1998.

SONIC TAGGING AND TRACKING

Cycleptus meridionalis were not sonic tagged in 2004, the final year of this project, but tracking operations detected three fish tagged in 2002 and eight tagged in 2003. All three fish tagged in 2002 were detected in 2002, 2003, and 2004. Five fish tagged in 2003 were detected in both 2003 and 2004. Three fish found in 2003 were not detected in 2004 and three fish not detected in 2003 were found in 2004. Two of the new fish found in 2004 were located in the Middle and Tensaw Rivers; the third fish occurred at ARM 124 above Claiborne. Failure to find every fish during every trip probably resulted from several factors, including variations in flow conditions, the possibility that the signal from a tagged fish was blocked by a submerged tree or rock ledge, fish may have moved up or down the river, diminished tag signal strength, and the locations of some fish may have exceeded the detection limits of the hydrophone.

One hundred eleven of 149 sonic tagged *Cycleptus* (Table 6) were detected from one to 19 times and from one to 1,288 days following release. Detection success was highest from August through December when discharge and turbidity levels were lowest. Conversely, detection success was lowest from January through July when water levels, turbulence, and turbidity were increased. The 38 undetected fish were assumed to have died from surgical complications, angler harvest, or natural causes or the tag may have malfunctioned.

Table 6. Numbers of <i>Cycleptus meridionalis</i> sonic tagged below Millers Ferry Lock and Dam from 1996-2003 and detected in the Alabama River and Mobile-Tensaw River Delta from 1996-2004.											
Tag	Fish	Detection Year									Fish (%)
Year	Tagged	1996	1997	1998	1999	2000	2001	2002	2003	2004	Detected
1996	4	3	3								4 (100)
1997	13		8	3							8 (62)
1998	12			12	7	1					12 (100)
1999	21				18	16	4	1			19 (91)
2000	28					22	9	5			23 (82)
2001	15						9	6			10 (67)
2002	36							24	8	3	24 (67)
2003	20								14	8	11 (55)
Totals	149	3	11	15	25	39	22	36	22	11	111 (75)

Nine sonic fish, including three tagged in 2002, one in 1999, three in 1998, one in 1997, and one in 1996, released at Millers Ferry and found below Claiborne in the same year were detected in or near the Millers Ferry tailwater the following year. None of the four sonic fish recaptured below Millers Ferry would have been recognized had it not been for their numbered anchor tags. Their surgical scars had healed, the non-absorbable sutures had disappeared, and most abdominal scales had regenerated in their original configuration. Three fish were released in good condition with still functioning sonic tags. One fish released in 1998 and recaptured in 1999 was preserved and later dissected to retrieve the still functioning sonic tag. Observations during dissection indicated that the tagging process had no adverse effects on the internal organs of this individual although the sonic tag was enclosed in a thick layer of adipose tissue.

Tracking data from sonic fish 3-4-7-4, a 585-mm TL male tagged below Millers Ferry on March 19, 2002, (fig. 4) illustrate the annual upstream and downstream movement patterns of this species past Claiborne Lock and Dam. Following its release, 3-4-7-4 moved downstream past Claiborne and was discovered at ARM 5 on May 21 and ARM 14 on July 31 and August 27.

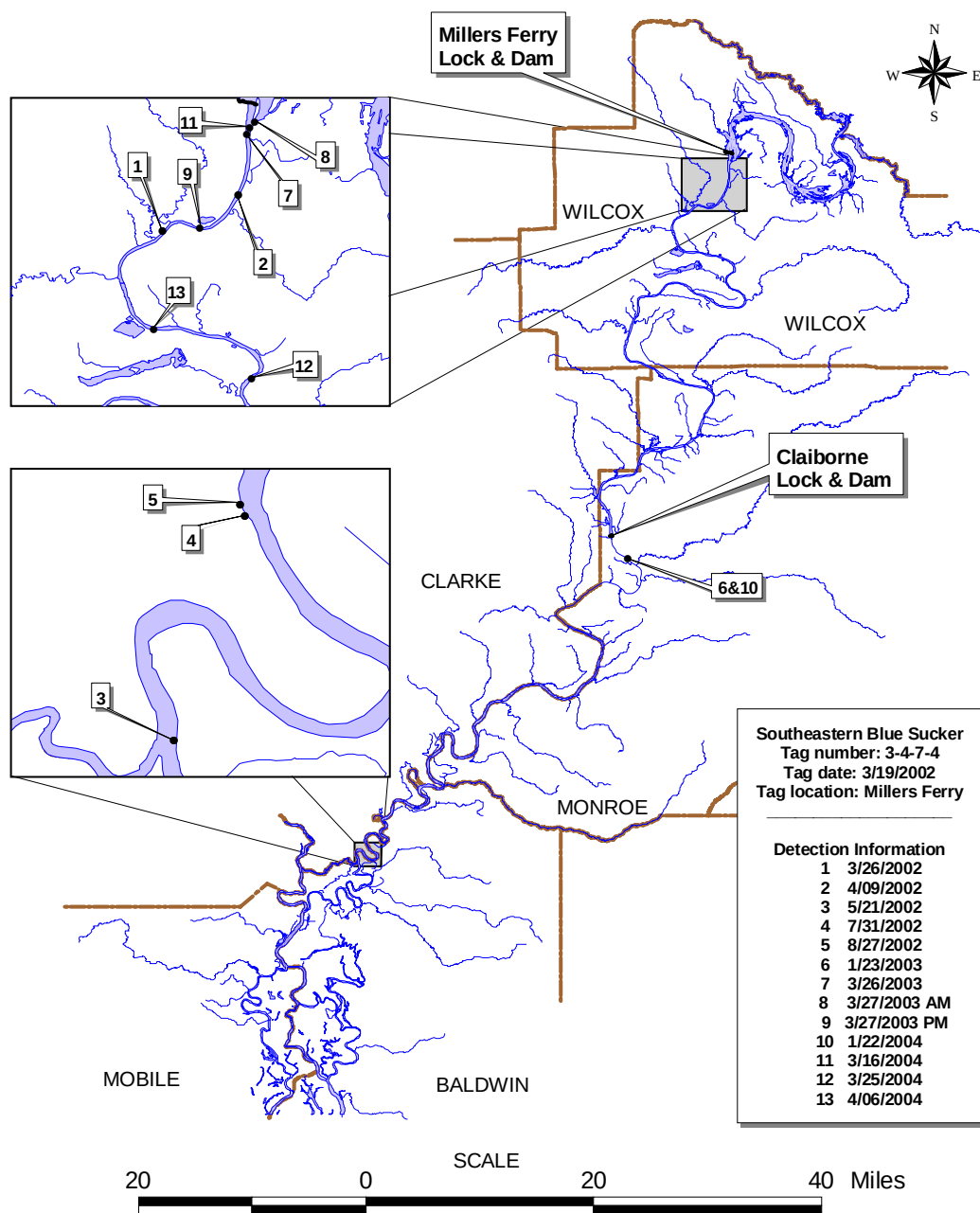


Figure 4. Detection locations for sonic fish 3-4-7-4, 2002-2004.

It subsequently moved back upstream and was detected at ARM 69.5 near Claiborne on January 23, 2003. This fish was collected in the generator discharge area between 1000 and 1100 on March 27, measured, weighed, and released. By late afternoon of the same day, it had moved five miles downstream to ARM 127.4. Sonic fish 3-4-7-4 was not detected again in 2003, but on January 22, 2004, it reappeared below Claiborne at ARM 70.5. This fish moved upstream past Claiborne a second time and was detected at ARM 132 near the generator discharge area on March 16, at ARM 116 on March 25, and at ARM 121.5 on April 6. Although not detected later in 2004, tracking data suggests this fish probably moved back downstream past Claiborne and is living somewhere in the lower Alabama River.

Several sonic tagged fish detected one or more times following release subsequently disappeared, which prompted the conclusion that they may have died and the tag was buried in the substrate, removed from the river by a scavenger, or the tag had ceased to function. Some fish probably did die, but at least one fish lived and eluded detection for over two years. Sonic fish 3-4-5, a 460-mm SL male, was anchor tagged and released below Millers Ferry on April 9, 1996. When recaptured below Millers Ferry three years later (March 8, 1999), this fish received a new anchor tag; and a 48-month sonic tag having a 3-4-5 ping sequence was implanted in its abdominal cavity. This fish was detected near ARM 32, 41 miles downstream of Claiborne and 100 miles downstream of its recapture and release point at Millers Ferry, on five occasions from June through December 1999 (fig. 5). When not detected in either 2000 and 2001, sonic fish 3-4-5 was presumed dead, but this assumption turned out to be incorrect. It was rediscovered near ARM 124 on August 22 and September 20, 2002, 93 miles upstream and 980 days after its last sighting. The 1,288-day capture/recapture and sonic tracking file compiled on this fish is the longest known movement record for any freshwater fish species in Alabama.

Forty-four tagged fish were detected between Millers Ferry and Claiborne Locks and Dams (ARM 133 to 73) (Table 7). Fifty-seven fish were found in the lower 73 miles of the Alabama River (ARM 73 to 0) and one fish was discovered at lower Tombigbee River mile 8.7. Nine fish were detected in the Mobile-Tensaw River Delta, including one in the Tensaw River below Interstate 65 (I-65), two fish in the Middle River just upstream of I-65, and six in the Mobile River from Mobile River miles (MRM) 44.5 to 33.

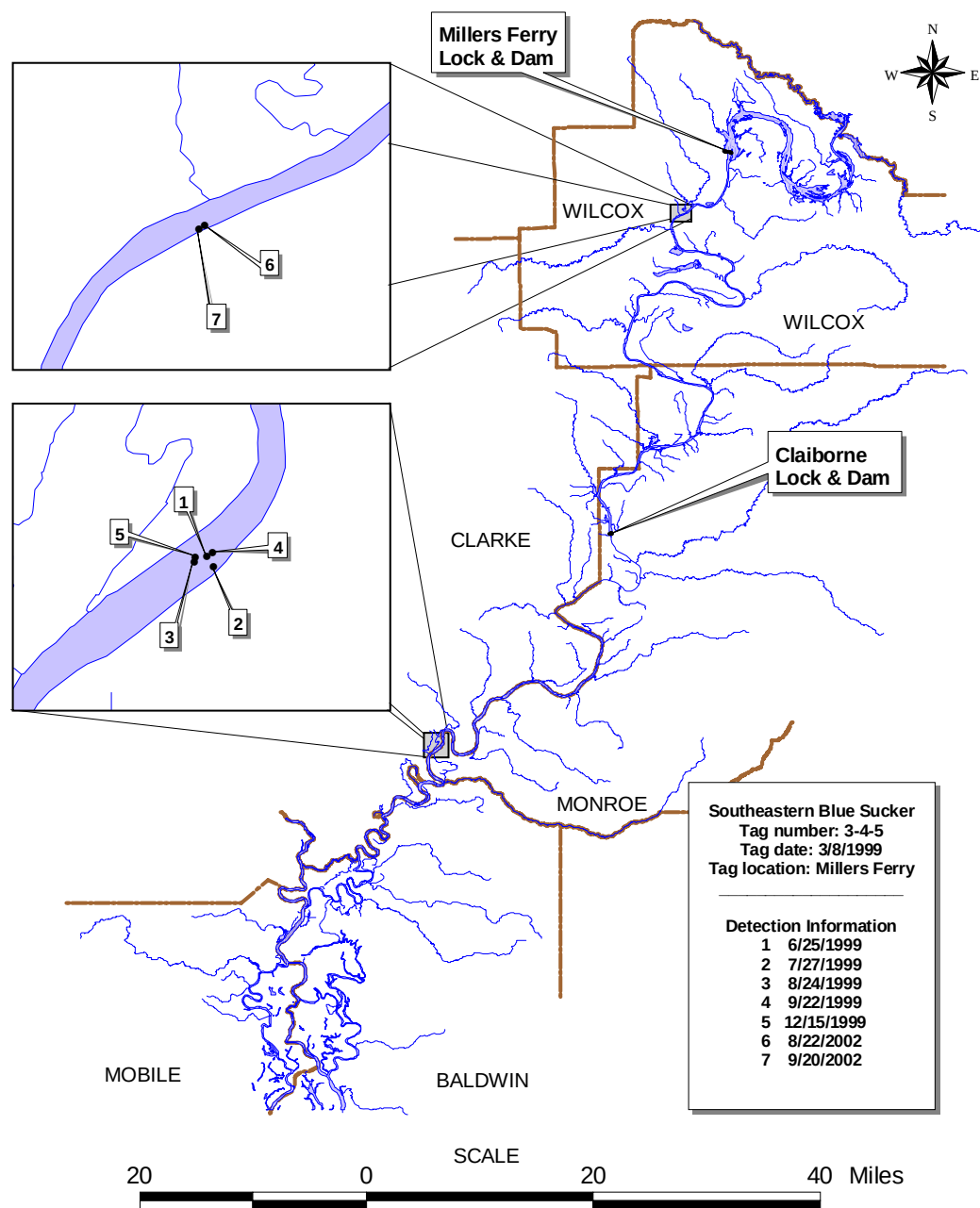


Figure 5. Detection locations for sonic fish 3-4-5, 1999-2002.

Table 7. Downstream detection locations for 111 <i>Cycleptus meridionalis</i> in the Alabama and Tombigbee Rivers and Mobile-Tensaw River Delta, 1996-2004.					
Tag Year	ARM 133 to 73	ARM 73 to 0	Tombigbee River Mile 8.7	Mobile-Tensaw River Delta	Total Found
1996	0	2	0	2	4
1997	1	5	0	2	8
1998	4	7	0	1	12
1999	8	11	0	0	19
2000	10	11	1	1	23
2001	4	5	0	1	10
2002	9	15	0	0	24
2003	8	1	0	2	11
Totals	44	57	1	9	111

Many *Cycleptus meridionalis* tagged throughout the study spent their summers in one of four areas below Claiborne Lock and Dam . These four areas were ARM 73 to 64 (downstream of Claiborne Lock and Dam), ARM 48 to 41 (above and below Eureka Landing), ARM 31 to 24 (above and below Dixie Landing), and ARM 13 to 0 (South Carlton to the mouth of the river). In addition to inhabiting the same river area, several individuals returned to the same submerged treetop they occupied the previous year. *Cycleptus meridionalis* may be one of the only freshwater fish species in North America documented to exhibit this degree of post-spawning homing skill.

The movements of sonic fish 2-8-5, a 631-mm male tagged below Millers Ferry on March 29, 1999, demonstrate both post-spawning homing skill and the inability to move upstream past Claiborne Lock and Dam during the prolonged drought of 2000. Following its release, this fish moved downstream past Claiborne to inhabit a very restricted area of riverbank near ARM 8 where it was detected four times from June through September (fig. 6). Later in 1999, it moved back upstream to the Claiborne tailwater area where it was discovered on December 14 and 15. Claiborne was not inundated from late 1999 through early 2001 due to an extended drought. When this individual could not move past the dam, it probably spawned in the Claiborne tailwater or at some other suitable location and then returned to the same immediate

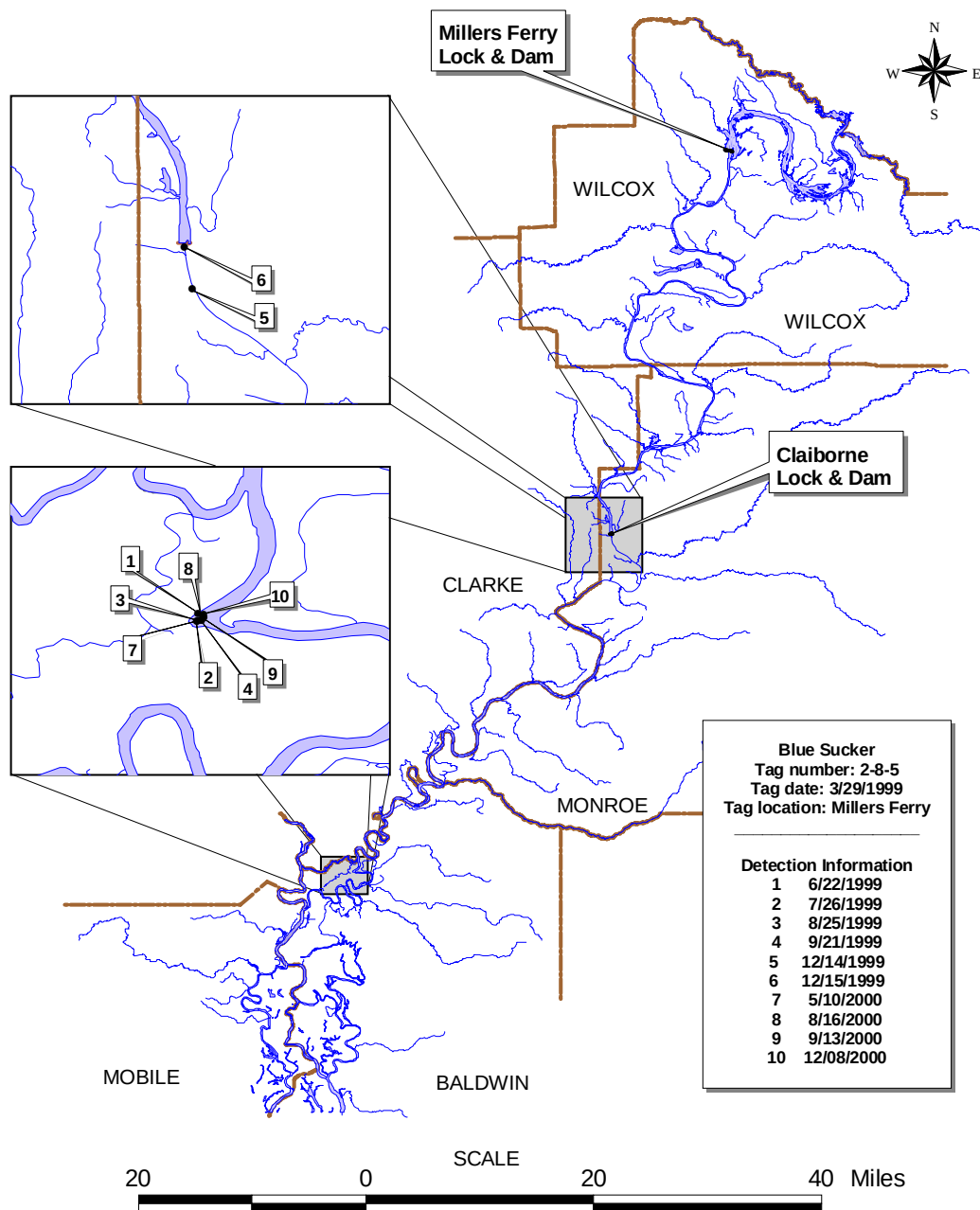


Figure 6. Detection locations for sonic fish 2-8-5, 1999-2000.

habitat it occupied the previous summer where it was detected on four occasions from May through December. At least two other *Cycleptus* tagged below Millers Ferry from 1999 through 2000 and subsequently found downstream of Claiborne exhibited this same type of movement pattern.

CONCLUSIONS

1. The Alabama River contains the largest known population of *Cycleptus meridionalis* throughout its range, but recapture data suggest that the population size is relatively small. Combined recent sampling efforts by GSA, WFFD, USFWS, and Alabama Power Company biologists indicate that the Alabama River population of this obligate large river species is presently stable.
2. *Cycleptus meridionalis* completes one of the longest documented spawning runs of any freshwater fish species in North America. Several monitored fish traveled >300 miles and moved past Claiborne Lock and Dam twice during a single spawning run. This observation is particularly noteworthy since most, if not all, of these fish were probably not alive when Claiborne and Millers Ferry Locks and Dams were completed in the late 1960s and early 1970s.
3. A few *Cycleptus meridionalis* returned to the same summer habitats, even the same submerged log, they occupied downstream of Claiborne Lock and Dam the previous year. This level of post-spawning skill has not been demonstrated for many, if any, freshwater fish species in North America.
4. Annual sampling success below Millers Ferry was influenced by the number of days that Claiborne spillway was inundated by winter flood. More *Cycleptus meridionalis* were collected below Millers Ferry in years when Claiborne was inundated for 8 to 20 days. The lowest numbers of fish were collected in 2000 and 2001 when an extended drought prevented *Cycleptus* from moving upstream past Claiborne. The lowest CPH occurred in 1998 when continuous flooding postponed sampling until the end of the prime spawning season. Average CPH for *Cycleptus* was greatest in 1999 (4.4) (Table 2) after the flood of 1998 (Table 3) and in 2002 (4.4) and 2003 (9.9) following the drought that lasted from 1999 through early 2001.

5. Some to many *Cycleptus meridionalis* returned to the Millers Ferry tailwater area annually for up to 10 years. Regimented sampling during the prime spawning season would likely have increased the database to support this conclusion, but this was not possible because extreme flooding and USCOE generation schedules occasionally postponed netting operations.
6. Peterson and others (1999) suggested that members of this species inhabiting the Pearl and Pascagoula Rivers (MS) lived >30 years and did not reach sexual maturity until they reached age four. Age calculations using formulas in Peterson and others (1999) indicate Alabama River males probably live for 34 years and females for 33 years. Only a few age four fish were collected.
7. Movement information generated by this study has assisted the USCOE in their efforts to evaluate fish passage options in the Alabama River. The USCOE, USFWS, WFFD, and GSA are currently involved in discussions and field investigations to determine the feasibility of moving fishes upstream past Claiborne, Millers Ferry, and Henry locks and dams using attraction flow or lock operations.
8. Large river studies should extend over several hydrologic years in order to document seasonal and year-to-year variations in fish community structure, spawning seasons, population size, habitat use, and species movement patterns, particularly those that could involve upstream and downstream movements past locks and dams. These studies should not require excessive funding provided they are well designed and work tasks are efficiently completed. Information gathered during these studies will be critical to future watershed management and environmental assessments in Alabama.

RECOMMENDATIONS

Although it is impounded by three USCOE locks and dams and receives permitted and nonpoint discharges from several municipalities and paper mills, the Alabama River is one of the optimum riverine ecosystems in the southeastern United States in which to complete ecological and fish community studies. Inland water-borne commerce has significantly diminished in the Alabama River in the past 10 years. Several years ago, the USCOE maintained an aggressive dredging program in the Alabama River, particularly downstream of Claiborne, but operations

have steadily diminished due to declining Congressional appropriations and, for this reason, natural gravel and sand bars are reappearing at many places along the river. Continuation of this process should increase local fish production and angling success. The Cahaba River, a major tributary of the Alabama River upstream of Millers Ferry Lock and Dam, contains one of the richest fish faunas in the United States for a drainage of its size (Pierson and others, 1989).

Future water-quality conditions and the biodiversity of the Alabama River are uncertain at this time. Numerous state and federal agencies are currently involved in serious interstate water-use negotiations with the State of Georgia. Results of these negotiations could substantially increase the volume of water that Georgia withdraws from the Coosa and Tallapoosa Rivers, thereby decreasing the volume of water available to the Alabama River and Mobile-Tensaw River Delta. Alabama Power Company is currently preparing applications for Federal Energy Regulatory Commission (FERC) re-licensing of all of its hydroelectric generating dams in the Coosa and Tallapoosa Rivers in Alabama. Results of these two large-scale actions could alter the discharge regimes, surface-water quality, and biodiversity of the Alabama-Coosa-Tallapoosa (ACT) river drainage for the next 50 years.

Most ACT negotiations have focused on the Coosa and Tallapoosa Rivers, but they have not addressed potential downstream impacts to economic and environmental resources of the Alabama River and Mobile-Tensaw River Delta ecosystems. Failure to address these issues could become a major concern because discharges from the Alabama and Tombigbee Rivers directly affect erosion and accretion rates, fishery resources, seafood nursery areas, biodiversity, and hydrological conditions throughout the Mobile-Tensaw River Delta and Mobile Bay.

The State of Alabama is strongly encouraged to implement a science-based ecosystem study that would describe current aquatic resources in the Alabama River and Mobile-Tensaw River Delta. The database generated by this effort will be critical to assessing the positive or negative impacts that will likely result from these long-term upstream management actions. Delaying this initiative will reduce the size of the database for future assessments. Therefore, planning for this multi-disciplinary, multi-agency study should start immediately and be supported with legislative appropriations.

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