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A STUDY OF FISH MOVEMENTS AND FISH PASSAGE AT CLAIBORNE AND MILLERS FERRY LOCKS AND DAMS ON THE ALABAMA RIVER, ALABAMA

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by

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A STUDY OF FISH MOVEMENTS AND FISH PASSAGE AT CLAIBORNE AND MILLERS FERRY LOCKS AND DAMS ON THE ALABAMA RIVER, ALABAMA

Maurice F. Mettee, Patrick E. O'Neil,
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ABSTRACT

Sampling operations completed below Claiborne and Millers Ferry Locks and Dams in 2003 and 2004 produced a total of 840 anchor tagged fishes representing 25 species including the hybrid striped bass. Anglers from Alabama, Florida, Georgia, and Mississippi recaptured 19 fish in 7 species from 11 to 288 days following release. One fall and two spring attraction flows followed by lock sampling efforts produced 303 fishes in 14 species at Claiborne Lock and Dam. Two days of lock operations followed by lock sampling produced 107 fishes in 10 species at Millers Ferry. Additional fish data provided by the U.S. Army Corps of Engineers from two lock chamber sampling efforts completed at Claiborne in 2000 and 2001 increased the total number of species collected to 24. Tagging and lock chamber sampling efforts completed during this study suggest a minimum of 35 species, including 10 that are either federally-listed or were identified as in need of immediate conservation action during a recent conference on imperiled wildlife in Alabama, could benefit from some type of fish passage effort at Claiborne, Millers Ferry, and perhaps Henry Locks and Dams. Noteworthy species on this list include the Gulf sturgeon, Alabama sturgeon, alligator gar, Alabama shad, skipjack herring, frecklebelly madtom, striped bass, crystal darter, freckled darter, and southern population of the walleye.

INTRODUCTION

Dam construction for inland navigation, hydroelectric generation, flood control, public and industrial use, and recreation has modified the physical characteristics and biological communities of many rivers in the United States. Free-flowing rivers have been fragmented into isolated slow-moving reservoirs (Jungwirth, 1998). Shoal habitats that once served as important reproductive habitats for fishes and many aquatic invertebrates, particularly snails and mussels, have been severely modified or eliminated. Seasonal flow patterns have been replaced by pulsed releases that alter water temperature and dissolved oxygen levels, nutrient transport, and other water-quality conditions including downstream sedimentation. Approximately 76,000 dams currently exist in the United States (U.S. Office of Technology Assessment (OTA), 1995), 2,350 of which were constructed for hydroelectric generation (Cada, 1998).

Dams have adversely affected the pre- and post-spawning movements of many anadromous and potamodromous fish species in North America. Lucas and Baras (2001) reported that the movements of numerous migratory fish species in Canada (Scott and Crossman,

1973) were adversely affected by dams. A report by The Nature Conservancy (2000) noted that dams and other impoundments had contributed to the decline of 91 percent of all endangered fish species and 99 percent of the endangered mussel species in the United States. Alabama was listed as the most extinction-prone state on the United States mainland, with 22 presumed and 74 possibly extinct species. The largest loss of a single North American fish species from dam construction occurred in the Pacific northwest where annual migratory stocks of Chinook salmon with populations estimated at 10 to 16 million individuals were reduced to less than 500,000 (Northcote, 1998). Warren and others (2000) surveyed the status of 662 species across 51 drainages in the southeastern United States and found that dam construction and habitat modification were responsible for a 125 percent increase in the number of jeopardized species over the past 20 years. Twenty-eight percent of all species included in their study were considered to be threatened, endangered, or vulnerable. O'Neil (2004) indicated that reservoir construction and habitat destruction were major causes for the dramatic increase in the number of imperiled fish species in Alabama. Garner (2004) reported that reservoir construction had contributed to a 25 percent decline in snail species and a 29 percent decline in freshwater mussel species in Alabama. The number of imperiled fish species in Alabama increased from 39 species in 1986 (Ramsey, 1986) to 47 species in 2002, the largest in the state's history (Mirarchi and others, 2004). High-lift navigational and hydroelectric dams were cited as the primary barrier to upstream movements of the anadromous Gulf sturgeon, Alabama shad, and the Gulf Coast population of the striped bass as well as the paddlefish and alligator gar.

Alabama's rivers are inhabited by approximately 150 species but, the life history of only a few have ever been investigated. Moss (1985) studied striped bass movements in the Alabama River in 1985. Alabama Power Company documented the movements of paddlefish, blue catfish, and striped bass in the upper Alabama and lower Coosa rivers in 1994, rainbow trout in the Sipsey Fork in 1999, and rainbow trout in the Sipsey and Mulberry Forks in 2001. Hoxmeier and DeVries (1997) monitored the pre- and post-spawning movements of juvenile and adult paddlefish in the Alabama River. Lein and DeVries (1998) investigated adult spawning migrations of paddlefish inhabiting the Cahaba and Tallapoosa Rivers. Fox and others (2000) monitored spawning migrations of the Gulf sturgeon in the Choctawhatchee River. Irwin and others (2001) documented alligator gar movements in the Mobile-Tensaw River Delta. Mettee and others (2004a) reported upstream paddlefish movement past Millers Ferry Lock and Dam

and upstream and downstream movement past Claiborne Lock and Dam in the Alabama River. Mettee and others (2004b) documented upstream and downstream movements of southeastern blue suckers past Claiborne Lock and Dam in the Alabama River.

Fish bypasses, fish ladders, slotted fishways, and fish elevators have been widely used to assist anadromous fish species in reaching their upstream spawning grounds along the Atlantic and Pacific Coasts (Cada, 1998), but their use in the southern United States has been relatively restricted (OTA, 1995). The first fish ladders used in Alabama were built by the U.S. Army Corps of Engineers (USCOE) from 1897 through 1915, when they constructed 18 locks and dams on the Black Warrior-Tombigbee Waterway (BWT) system. These structures proved ineffective because the low-lift spillways at most of these facilities were routinely submerged by winter floods. Ironically, the use of fish ladders was discontinued when the USCOE replaced the 18 original dams with five high-lift structures to decrease navigation time between Birmingham and Mobile. Claiborne, Millers Ferry, and Henry dams on the Alabama River do not have fish ladders.

Documenting long-range spawning migrations of freshwater fish species was difficult to accomplish prior to the advent of modern telemetry gear. Early capture and recapture studies were successful in estimating population size, but because of temporal and spatial restrictions, this method usually understated the magnitude of fish movements (OTA, 1995), a factor that led some researchers (Gerking, 1959) to propose that most stream and riverine fish species lead sedentary life styles. Large numbers of studies published during the past 20 to 30 years have proven this assumption was incorrect for many riverine species. The list of fish migration and fish bypass studies completed in the United States and throughout the world is too extensive to include in this report. Interested readers should refer to Jungwirth and others (1998), Ickes and others (2001), and Lucas and Baras (2001) for their excellent discussions of fish migrations, ways that fish migrations have been affected by human activities, and their extensive bibliographies.

The USCOE conducted the only two attraction flow tests completed by at Claiborne Lock and Dam. The first test occurred in November 2000 and involved an overnight attraction flow event and fish sampling effort followed by a lock sampling effort the next day. The second test was completed inside Claiborne lock chamber in April 2001. A total of 91 fishes comprising 20 species was collected during both tests. Suspected migratory species collected in their samples

included paddlefish, spotted gar, longnose gar, Alabama shad, skipjack herring, southeastern blue sucker, smallmouth buffalo, spotted sucker, blacktail redhorse, striped bass, hybrid striped bass, and freshwater drum.

In 2002, the U. S. Fish and Wildlife Service (USFWS) and Geological Survey of Alabama (GSA) initiated a cooperative study to collect additional fish passage data at Claiborne Lock and Dam and to initiate a similar effort at Millers Ferry Lock and Dam. This report summarizes the results of four work efforts completed during the study: (1) a tagging and recapture study completed below Claiborne and Millers Ferry, (2) fall and spring attraction flow tests followed by fish sampling efforts inside Claiborne lock chamber, (3) a spring lock operation test followed by fish sampling inside Millers Ferry lock chamber, and (4) a sonic tagging and tracking study.

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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 southeastern 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 (fig. 1). 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 0.3 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 uses 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 towns of Centreville and Marion. 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 Locks and Dams. Commercial barge traffic has declined significantly over the past 10 to 20 years, but the USCOE still maintains a 9-foot minimum depth throughout the 299-mile-long 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.

METHODS

TAGGING AND RECAPTURE STUDY

This phase of the study was designed to collect long term data on fish movements past Claiborne Lock and Dam. Fishes were collected during five time periods in 2003 and 2004 (table 1) with boat electrofishing gear and multi-filament nylon gill nets that were 200 feet long, 8 feet deep tied down to 6 feet and had 2.0- to 2.5-inch bar mesh, a foamcore float line, and a leadcore

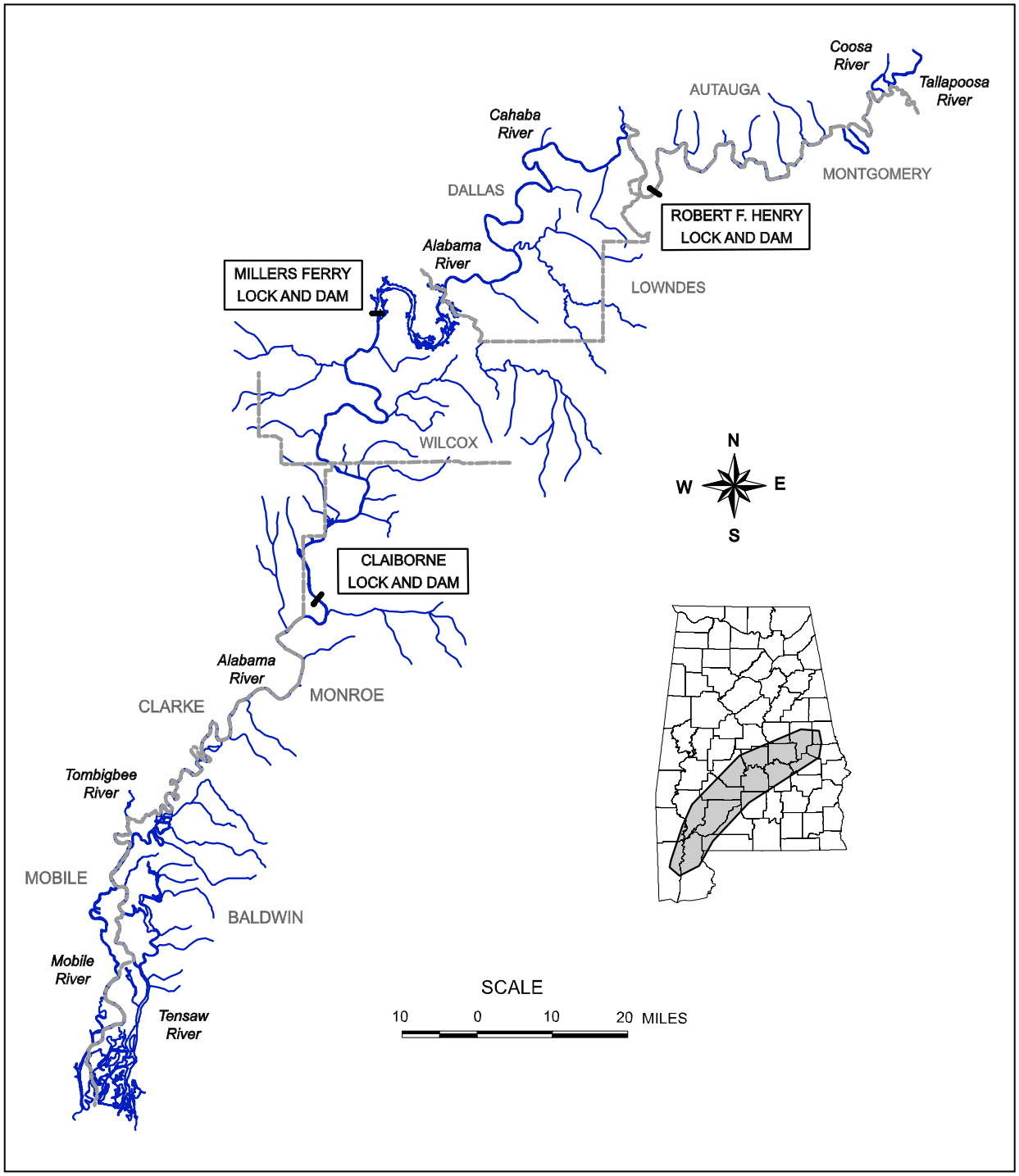

Figure 1. Locations of Claiborne, Millers Ferry, and Henry locks and dams on the Alabama River.

bottom line. All fishes were held in large aerated live wells until they were identified, tagged, and released. A numbered Floy internal anchor tag (Model FM-95W) was inserted in a small incision made through the left abdominal wall of each fish. All fishes were immediately returned to the river. A permanent record of the species collected and their associated tag numbers is on file in the GSA Fish Collection in Tuscaloosa.

Table 1. Numbers of species and fishes anchor tagged below Claiborne and Millers Ferry Locks and Dams, 2003-2004

Claiborne	Species	Specimens
October 27-29, 2003	21	215
January 21-23, 2004	15	226
April 14-15, 2004	1	146
Totals	23	587
Millers Ferry		
March 15-April 8, 2004	12	215
May 3-5, 2004	1	38
Totals	12	253

CLAIBORNE ATTRACTION FLOW TESTS

Attraction flow and fish sampling were completed at Claiborne Lock and Dam on October 27-29, 2003, and April 14-15, 2004. Biologists from the GSA, WFFD, and USFWS collected, anchor tagged, and released 215 fishes in 21 species downstream of Claiborne on the afternoon of October 27 and morning of October 28 before the attraction flow test started. Most fishes were collected with boat electrofishing gear, although a few individuals were taken with a 200-foot long and 8-foot deep multifilament gill nets that were fished along a large gravel shoal on the west bank of the river and just downstream of the dam. The goal of this operation was to determine if tagged fishes would move into the lock chamber during the overnight attraction flow period on October 28. No tagged fish were collected inside Claiborne lock chamber, but two spotted bass, one largemouth bass, and one blacktail redhorse tagged on October 27 were recaptured in the same general area on October 28.

An attraction flow of approximately 4,800 cubic feet per second (cfs) was started through the lock chamber around 1630 on October 28 by opening the river side filling valve 100 percent and the bank side filling valve 50 percent. Attraction flow continued all night. Around 0700 on

October 29, one net boat launched upstream at Isaac Creek boat launch, proceeded downstream to Claiborne, and deployed a monofilament gill net that was 100 feet long and 18 feet deep and had 2.25 inch bar mesh, a foamcore float line, and a #30 leadcore bottom line across the upper lock chamber approach (fig. 2). About the same time, a second net boat and an electrofishing boat entered the lock chamber through the lower lock gates. The attraction flow was discontinued, the lower lock gates were closed, and the lock chamber was filled to upper pool level. The upper lock gates were opened and the second net boat deployed another monofilament gill net of the same dimensions over the top of the upper gate miter sill (fig. 2). With both nets securely tied to the lock wall, the electrofishing boat completed several downstream to upstream runs inside the lock chamber. The Lockmaster then created a 1,000-cfs fish-orienting flow by slightly opening one downstream lock emptying valve for about 10 seconds. The first orienting flow had to be stopped when it pulled several large rafts of water hyacinth into the nets. A second orienting flow was attempted after the nets were cleaned, but the net bottom lines were lifted off of the bottom so it too was discontinued. Both nets were allowed to fish for an additional 30 minutes after which they were retrieved. All fishes collected during the first test were transported to Claiborne upper pool where they were identified, anchor tagged, and released.

All sample boats left the lock chamber and the USCOE started a second attraction flow that lasted from 1000 to 1400. Shortly thereafter, the upstream boat returned to the upstream lock approach and redeployed its net. The second net boat and electrofishing boat entered the lock chamber through the lower lock gates. The attraction flow was stopped, the lower lock gates were closed, and the lock chamber was again filled to full capacity. The upper gates were opened and the second boat set its gill net across the upper gate mitre sill. The electrofishing boat worked in a downstream to upstream path in an effort to move fishes into the nets. A 1,000-cfs fish-orienting flow was successfully completed for 10 seconds, and the nets were allowed to fish from 1415 to 1515. Both nets were retrieved, and all boats left the lock chamber around 1600. All collected fishes were identified, tagged, and released in the lower pool.

Attraction flow and lock sampling procedures used during the April 2004 test essentially duplicated the methods used in 2003 with two exceptions. First, the lock chamber was sampled on the afternoon of April 14 to document fish species that might be inside the chamber before the

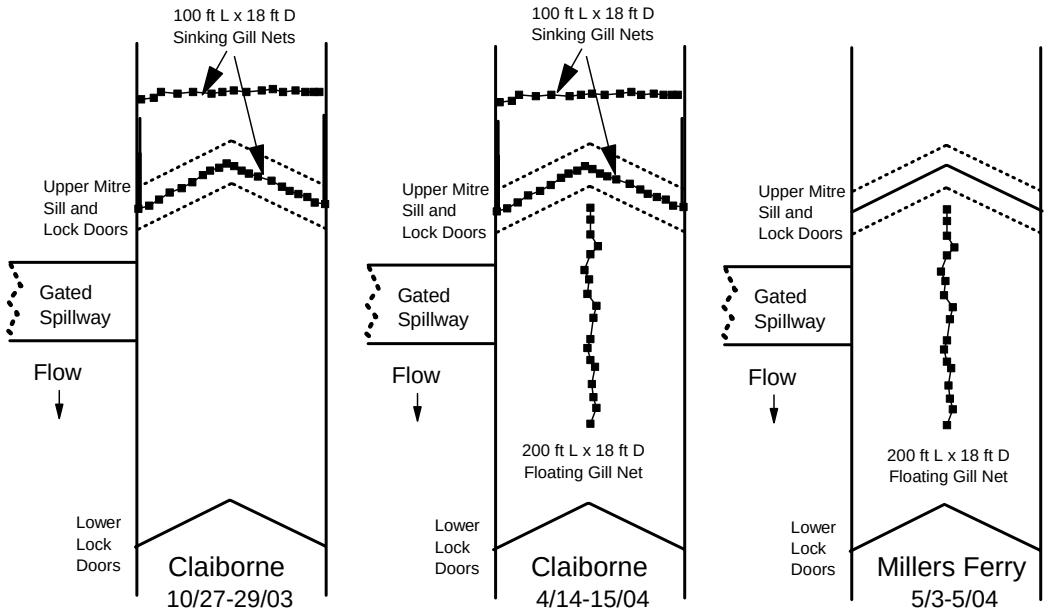

Figure 2. Sampling areas inside Claiborne and Millers Ferry lock chambers, 2003-2004.

attraction flow started. Second, an intensive sampling effort was completed inside the closed lock chamber in an effort to collect additional fishes after the sampling effort near the upper lock gates and approach had ended.

Around 1400 on the afternoon of April 14, two net boats and an electrofishing boat entered Claiborne lock chamber through the downstream gates. The gates were closed and a floating monofilament gill net that 200 feet long and 18 feet deep was deployed down the length of the lock chamber (fig. 2). The electrofishing boat worked back and forth inside the lock chamber to stimulate fish movement into the net and independently collect fish. The lock chamber was sampled for two hours. Paddlefish were placed in large aerated live wells for later processing; all other species were identified and released. Due to the large number of individuals collected, the tagging boat had to exit the lock chamber through the lower lock gates, tag and release fishes, and re-enter the lock chamber on several occasions. Sampling efforts were discontinued at 1600, and the 4,800 cfs overnight attraction flow was started through the lock chamber.

The second sampling effort was completed on April 15. After the gill nets were retrieved from the lock gate and upper lock approach, all sampling boats entered the lock chamber. The upper lock gates were closed, and the lock chamber was drained to the lower pool level. At this time, a floating monofilament gill net was deployed down the length of the lock chamber. The electrofishing boat worked back and forth inside the lock chamber to stimulate fish movement into the net and independently collect fish. Paddlefish were held in large aerated live wells; all other species were identified released. Due to the large number of individuals collected, the tagging boat had to exit the lock chamber through the lower lock gates, tag and release fishes, and enter the lock chamber on several occasions. Sampling continued until 1600. All boats left the lock chamber and the remaining paddlefish were processed and released into the lower pool.

MILLERS FERRY ATTRACTION FLOW TESTS

Two attraction flow and lock sampling efforts were scheduled for completion at Millers Ferry, but plans changed in December 2003 when the USCOE informed the GSA that it would not be able to allow prolonged discharge through the lock chamber due to safety concerns. As an alternate plan, we suggested the possibility of completing one or more nighttime lock operations in hopes that this activity would attract fishes into the lock chamber. The USCOE approved this

plan and two nights of lock operation followed by fish sampling inside the lock chamber on the following mornings were scheduled from May 3-5, 2004.

One upstream and one downstream lock operation were completed during the nights of May 3 and 4. A floating gill net and boat electrofishing gear were used to collect fishes inside the lock chamber on May 4 and 5. Around 0700 on each morning, two net boats and one electrofishing boat launched at Cobbs Landing below Millers Ferry, motored upstream, and entered Millers Ferry lock chamber. The lower lock gates were closed. Water depth inside the lock chamber remained at lower pool level. The floating monofilament gill net described earlier was deployed down the length of the lock chamber (fig. 2). The electrofishing boat worked back and forth inside the lock chamber to stimulate fish movement into the net and independently collect any stunned fishes. All paddlefish collected were held in large live wells for later anchor tagging. Once again, the large number of individuals collected using this method mandated that the tagging boat leave the lock chamber through the lower lock gates, tag and release paddlefish, and re-enter the lock chamber on several occasions. Other species were identified, recorded, and released inside the lock chamber. Collection efforts continued each day until sampling success diminished, at which time all boats left the lock chamber. All paddlefish collected were measured, anchor tagged, and released into the lower pool.

SONIC TAGGING AND TRACKING STUDY

Ultrasonic tags manufactured by Sonotronics, Inc. and having a 48-month operating life were implanted in five paddlefish collected at Claiborne on April 14 and two paddlefish collected at Millers Ferry on May 4. Each sonic tag was soaked in Betadine and inserted through a 2.5- to 3.0-inch 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. Anesthesia was not administered since most fish remained calm during the tagging process. A numbered Floy anchor tag (Model FM-95W) was implanted through the left abdominal wall of each paddlefish for visual identification if collected during future sampling efforts.

Listening trips were completed down the lower 134 miles of the Alabama River from May through August. 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 megahertz (mhz) range of tags used throughout the project. When a tagged fish was detected, its position was determined by triangulation and it 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 Fish Collection in Tuscaloosa.

PHOTOGRAPHY

All aspects of each work task were recorded with a digital camera. Photographs were delivered to primary cooperators at the USFWS, USCOE, and WFFD. Copies are available from the senior author.

RESULTS AND DISCUSSION

CAPTURE AND RECAPTURE STUDY

Anchor tags were implanted in 840 fishes comprising 25 species during this phase of the study (table 2). Twenty-three species and 587 fishes were tagged below Claiborne in eight days of sampling while 12 species and 253 fishes were tagged below Millers Ferry in 10 days. Dominant groups tagged included seven species of suckers (39% of total catch), the paddlefish (29%), four species of sunfishes (11%), and three species of freshwater catfishes (7%). The river redhorse is the only species in table 2 that does not occur throughout the study area.

The tagging study was not locally advertised and no rewards were offered for recapture data or tag returns. Nevertheless, 19 anglers from 12 communities in four states (table 3) captured 19 tagged fish representing seven species (table 4) from 11 to 288 days following release. Most recaptures were released downstream of Claiborne; one paddlefish and one black crappie were released and recaptured downstream of Millers Ferry. Species with the highest recapture rates included the blue catfish (17.7%), black crappie (15.4%), and largemouth bass (13.3%). Several recaptures provided some interesting distance and time records for tagged fish species in Alabama. For example, a blue catfish released at Alabama River mile (ARM) 60 was caught 57 days later and 83 miles downstream below Barry Steam Plant in the Mobile River. A striped mullet was collected 68 miles downstream and 177 days following its release. The movements of neither of these species have been thoroughly investigated in Alabama. The

Table 2. Fish species anchor tagged below Claiborne and Millers Ferry Locks and Dams, 2003-2004			
Species Tagged	Claiborne	Millers Ferry	Total
Polyodon spathula – paddlefish	148	99	247
Lepisosteus oculatus– spotted gar	18	--	18
L. osseus – longnose gar	2	--	2
Amia calva – bowfin	6	--	6
Hiodon tergisus – mooneye	1	--	1
Cyprinus carpio – common carp	8	--	8
Carpiodes cyprinus – quillback	--	13	13
C. velifer – highfin carpsucker	56	46	102
Cycleptus meridionalis – southeastern blue sucker	1	42	43
Ictiobus bubalus – smallmouth buffalo	17	8	25
Minytrema melanops – spotted sucker	14	--	14
Moxostoma carinatum - river redhorse	--	27	27
M. poecilurum – blacktail redhorse	100	2	102
Ictalurus furcatus – blue catfish	17	--	17
I. punctatus – channel catfish	43	--	43
Pylodictis olivaris – flathead catfish	1	--	1
Morone chrysops – white bass	4	1	5
M. chrysops x *M. saxatilis* – hybrid striped bass	4	4	8
M. saxatilis – striped bass	3	--	3
Micropterus punctulatus – spotted bass	33	7	40
M. salmoides – largemouth bass	29	1	30
Pomoxis annularis – white crappie	6	--	6
P. nigromaculatus – black crappie	10	3	13
Aplodinotus grunniens – freshwater drum	42	--	42
Mugil cephalus – striped mullet	24	--	24
Species	23	12	25
Specimens	587	253	840

Table 3. Residence data for anglers that caught anchor tagged fish in the Alabama and Mobile Rivers in 2003 and 2004	
Residence	Number of Anglers
Brewton, Alabama	2
Camden, Alabama	2
Castleberry, Alabama	1
Coy, Alabama	1
Evergreen, Alabama	1
Excel, Alabama	1
Frisco City, Alabama	1
Monroeville, Alabama	5
Uriah, Alabama	1
Pensacola, Florida	2
Dawsonville, Georgia	1
Richton, Mississippi	1
Totals	19

Table 4. Fish species tagged and recaptured in the Alabama River, 2003-2004		
Species	Tagged	Recaptured
Polyodon spathula – paddlefish	247	1
Ictalurus furcatus – blue catfish	17	3
I. punctatus – channel catfish	43	2
Micropterus punctulatus – spotted bass	40	4
M. salmoides – largemouth bass	30	4
P. nigromaculatus – black crappie	13	2
Mugil cephalus – striped mullet	24	3

longest time between release and recapture was of a largemouth bass that was caught 288 days later and approximately 5 miles downstream of its release point. Experiences from previous capture/recapture work, aw well as these new records, suggest that the anchor tagging likely had little or no adverse effect on the swimming and survival rates of these fishes.

Brief telephone conversations with anglers who reported catching tagged fish suggest that the Alabama River is a favorite but underutilized fishery resource for both sport and subsistence fishermen. One way to increase angler participation and data return during future fish movement studies would be to distribute waterproof posters to Alabama and Mobile-Tensaw River fish camps and public boat launches that publicize tagging operations, offer a reward for tag returns, and solicit a minimal amount of data on angler habits and fishing experiences in Alabama. A toll-free telephone number would be printed on each poster and anchor tag to report recaptured fish. Rewards would be distributed after each tag and angler data are received.

CLAIBORNE ATTRACTION FLOW TESTS

Three samples collected during this study produced a total of 303 fishes in 14 species (table 5). Two additional samples collected inside Claiborne lock chamber by the USCOE in 2000 and 2001 increased the total catch to 394 fishes in 24 species (table 5). The collection of twice as many species (22 versus 11) and over four times as many fishes (326 versus 68) in April than in October or November suggests that future lock sampling and fish passage efforts should be scheduled during the spring spawning season rather than in the fall, when movements may be more restricted. Differences in individual sample results probably reflected variations in species spawning seasons and migration times, river discharge, lower pool depth, attraction flow volume and duration, collection methods used, and sampling duration.

Several species collected either inside Claiborne lock chamber during this study and near Claiborne in recent years could benefit from future fish passage efforts in the Alabama River. Paddlefish usually begin their pre-spawning movements in February and March (Hoxmeier and DeVries, 1997; Lein and DeVries, 1998), spawn from late March through April, depending on water temperatures and flow conditions, and some return to the same river reach they occupied the previous year (Mettee and others, 2004a). The 146 individuals collected inside Claiborne lock chamber on April 14 and 15 (table 5) were probably spawning below the dam or waiting to move upstream. Most paddlefish leave tailwater areas below Claiborne and Millers Ferry in May. The collection of 45 individuals inside Claiborne lock chamber before the attraction flow started was probably influenced by the fact that the USCOE snagboat *Ross* had moved upstream and downstream for several days prior to the April 14 test, while it was removing sediment and other debris from this section of the Alabama River. Some of the fish that entered the lock chamber with the *Ross* probably moved upstream into Claiborne reservoir, while others remained

inside the lock chamber. We collected 101 individuals inside the lock chamber on April 15, but sampling success indicated that some to many individuals still remained inside the lock chamber when sampling ended at 1600.

Table 5. Fish species collected inside Claiborne lock chamber by the USCOE in 2000 and 2001 and the GSA in 2003 and 2004.

	USCOE		GSA			
Species Collected	11/8/00	4/26/01	10/28/03	4/14/04	4/15/04	Totals
Polyodon spathula – paddlefish	9	--	1	45	101	156
Lepisosteus oculatus – spotted gar	--	4	--	--	--	4
L. osseus – longnose gar	3	--	--	--	1	4
Alosa alabamae – Alabama shad	--	1	--	--	--	1
Alosa chrysochloris – skipjack herring	--	7	--	1	2	10
Dorosoma cepedianum – gizzard shad	2	8	--	--	1	11
Cyprinus carpio – common carp	--	--	1	--	1	2
Hypopthalmichthys nobilis – bighead carp	--	--	1	--	--	1
Cycleptus meridionalis – southeastern blue sucker	4	--	--	--	--	4
Ictiobus bubalus – smallmouth buffalo	4	--	--	3	2	9
Minytrema melanops – spotted sucker	--	1	--	--	--	1
Moxostoma poecilurum – blacktail redhorse	--	2	--	--	--	2
Ictalurus furcatus – blue catfish	3	1	1	--	1	6
I. punctatus – channel catfish	--	1	1	--	--	2
Pylodictis olivaris – flathead catfish	--	--	--	--	1	1
Morone chrysops – white bass	1	3	--	--	2	6
M. chrysops x *M. saxatilis* – hybrid striped bass	--	4	1	--	54	59
M. mississippiensis – yellow bass	--	1	--	--	--	1
M. saxatilis – striped bass	1	1	--	--	--	2
Lepomis macrochirus – bluegill	--	1	--	--	--	1
Micropterus punctulatus – spotted bass	--	1	--	--	--	1
M. salmoides – largemouth bass	--	3	--	--	--	3
Pomoxis nigromaculatus – black crappie	--	--	--	1	--	1
Aplodinotus grunniens – freshwater drum	22	3	13	6	62	106
Species	9	16	7	5	11	24
Specimens	49	42	19	56	228	394

Paddlefish have been extirpated in four states and are listed as endangered, threatened, or species of concern in 11 others (Graham, 1997). This important commercial species occurred throughout the Tennessee River in Alabama, but their numbers were decimated by overfishing in the early 1900s, and the species has never recovered (Hoxmeier and DeVries, 1996). Paddlefish harvest in Alabama was banned by the WFFD in 1988 for fear the same process could occur in the Mobile Basin. Paddlefish numbers have increased throughout most rivers in south Alabama, but the status of the population inhabiting the upstream 165 miles of the Alabama River is

unknown. Jon Hornsby with the WFFD (2004 personal communication) indicated that paddlefish were once abundant in the Tallapoosa River near Tallassee, but their numbers have declined in recent years. Fish passage could improve paddlefish abundance in the upper Alabama River since upstream migrations are currently blocked by the gated spillways at Millers Ferry and Henry, and fish movement past Claiborne is restricted to a limited number of days in most but not all years when the crested spillway is inundated by winter floods.

The anadromous Alabama shad was described in 1896 from four specimens collected in the Black Warrior River near Tuscaloosa. The species disappeared in the upper Tombigbee and Black Warrior Rivers after the USCOE completed high-lift locks and dams at Coffeeville and Demopolis. The GSA collected the only Alabama shad reported from the Black Warrior River in over 100 years in May 1998. This individual probably reached Seldon Lock and Dam by swimming 240 river miles upstream and crossing over Coffeeville and Demopolis Locks and Dams during prolonged winter floods that occurred in late 1997 and early 1998.

Collection records from Tulane University indicate that the Alabama, Cahaba, and Coosa Rivers provided excellent spawning habitat for large numbers of Alabama shad as late as the 1970s, but large-scale shad migrations effectively stopped a few years after Claiborne, Millers Ferry, and Henry Locks and Dams were completed. Recent collection records suggests a relict population may still attempt to spawn in the Alabama River and Mobile-Tensaw River Delta. We collected three adult shad while sampling below Millers Ferry Lock and Dam in March and April from 1995-2004. The USCOE collected an adult Alabama shad inside Claiborne lock chamber in April 2001 (table 5). In 2004, the Marine Resources Division of the Alabama Department of Conservation and Natural Resources collected an adult male in Mississippi Sound. The Alabama shad is a species of High Conservation Concern (Priority 2) in Alabama (Mettee, 2004), and it is a candidate species for endangered species listing by the National Marine Fisheries Service. Alabama shad spawn in Alabama from late February through March (Mettee and O'Neil, 2003). Implementing fish passage at Claiborne and Millers Ferry Locks and Dams during their spawning migration period could assist this species in reaching historic spawning sites in the Alabama River drainage.

The skipjack herring is widespread but not usually abundant in Alabama (Mettee and others, 1996). This species exhibits strong migratory behavior, and individuals frequently spawn in tailwater areas below dams. In addition to its sport fish attributes, the skipjack is an important

host species for several freshwater mussels, including the ebonyshell and elephantear. Wlosinski (2000) reported that ebonyshell mussel populations were almost extirpated in Wisconsin following the disappearance of spawning populations of skipjack in the upper Mississippi River. Miller and Payne (2000) reported the elephantear mussel was eliminated in the Ohio River for the same reason. The skipjack was listed as a species of special concern in Minnesota and South Dakota and is protected in Ohio. Mirarchi and others (2004) listed the skipjack as a species of Moderate Conservation Concern in Alabama due to a lack of information concerning its distribution, abundance, life history, and importance as a host species for Alabama mussels. Fish passage at Claiborne and Millers Ferry would likely improve the status of the skipjack herring and the abundance of ebonyshell and elephantear mussels in the Coosa and Tallapoosa Rivers.

The Alabama River is inhabited by a small population of southeastern blue suckers that spawn in March and April below Claiborne and Millers Ferry Locks and Dams (Mettee and others, 2004b). The number of adult fish that spawn below Millers Ferry appears to be directly related to the ability of fish living in the lower Alabama River to move upstream past Claiborne when it is inundated by winter floods. Spawning has not been documented below Henry Lock and Dam, but small populations inhabit the lower reaches of the Cahaba, Coosa, and Tallapoosa Rivers. Fish passage at Claiborne and Millers Ferry would likely increase the ability of this species to reach spawning habitats in the upstream 165 miles of the Alabama River and perhaps the lower Coosa and Tallapoosa Rivers.

Recapture records and collections of blue, channel, and flathead catfish inside Claiborne lock chamber suggest that these species may move further than previously believed in the Alabama River. The current status of catfish populations in the upper 165 miles of the Alabama River is unknown. Flathead catfish abundance in the Tallapoosa River has apparently been adversely affected by pulsed discharges from hydroelectric dams in the Tallapoosa River (Elise Irwin, 2003, personal communication). Providing fish passage at Claiborne, Millers Ferry and Henry Locks and Dams could increase the opportunity for reservoir exchange and improve catfish populations in the upper Alabama and lower Coosa and Tallapoosa Rivers.

No Gulf sturgeon were collected during this study, but newspaper articles, photographs, and anecdotal records confirm that Gulf sturgeon routinely moved upstream and spawned in the Alabama, Cahaba, and Coosa Rivers as late as the 1940s. The combined effects of overfishing, water pollution, and increased siltation contributed to the decline of the Gulf sturgeon in the

Alabama River prior to construction of Claiborne, Millers Ferry, and Henry Locks and Dams. However, recent (since 1991) collection records suggest populations of unknown size still utilize the lower Alabama and Tombigbee Rivers, Tensaw and Blakeley Rivers in the Mobile-Tensaw River Delta, and the Fish River tributary to Mobile Bay (Hastings and Parauka, 2004) The Gulf sturgeon was listed as a Threatened Species by the USFWS in 1991, but the Mobile Basin was not included as critical habitat because reproduction has never been confirmed there. Hastings and Parauka (2004) ranked the Gulf sturgeon as a species of High Conservation Concern in Alabama. The preferred spawning habitat of the Gulf sturgeon includes rock walls and ledges and semi-permanent shoals, all of which are distributed along the Alabama River and may provide the last inland spawning habitat for this species in Alabama. Gulf sturgeon distribution has never been thoroughly investigated in Alabama, and for this reason, it is impossible to predict the effect of future fish passage on the status of this majestic species in the Alabama River.

MILLERS FERRY ATTRACTION FLOW TESTS

Two consecutive nights of limited lock operation and lock chamber sampling produced a total of 10 species and 107 fishes at Millers Ferry (table 6). Lower than anticipated catch probably resulted from a combination of three factors. First, samples were collected in May, which is near the end of usual spawning movement periods for many riverine fish species in the Alabama River. As an example, southeastern blue suckers spawn below Millers Ferry in March and early April based on the collection of over 1,000 individuals from 1995 through 2004 (Mettee and others, 2004b). None were collected in our lock chamber samples because spawning had concluded and most individuals had already left the tailwater spawning area. Second, when the test was conducted, all of the discharge from Millers Ferry was going through the hydroelectric generators, which are located approximately 0.3 miles downstream of the gated spillway and lock chamber. Even though the lower lock gates remained opened for an extended period prior to each sampling effort, most fishes had no incentive to leave the discharge area below the powerhouse and swim upstream through standing water to reach the lock chamber. Third, only one upstream and one downstream lock operation were completed during this test. Sampling when even a minimum amount of water was being released through one or more spill gates positioned nearest to the outer lock wall would probably have increased the catch during these tests.

Fish sampling at Millers Ferry did produce several interesting results. A dull body color and lethargic movements suggested that many of the 31 individuals collected on May 4 had been inside the lock chamber for an extended period of time. All of the seven paddlefish collected on the second day were more intensely colored and their movements were more active, indicating that they probably moved into the lock chamber during the night. Mettee and others (2004a) reported the first record of any sonic tagged species moving upstream through a USCOE lock chamber in Alabama. This fish was sonic tagged below Millers Ferry on March 23, 2004, and found within a 10- to 12-mile section of Dannelly Reservoir from June through August (fig. 3).

Table 6. Fish species collected inside Millers Ferry lock chamber in May 2004

Species	5/4/04	5/5/04	Totals
Polyodon spathula – paddlefish	31	7	38
Lepisosteus osseus – longnose gar	8	1	9
Dorosoma cepedianum – gizzard shad	1	--	1
Ictiobus bubalus – smallmouth buffalo	11	4	15
Ictalurus furcatus – blue catfish	5	1	6
I. punctatus – channel catfish	7	1	8
M. chrysops x *M. saxatilis* – sunshine bass	9	--	9
Micropterus punctulatus – spotted bass	1	--	1
Pomoxis nigromaculatus – black crappie	2	--	2
Aplodinotus grunniens – freshwater drum	14	4	18
Species	9	7	10
Specimens	89	18	107

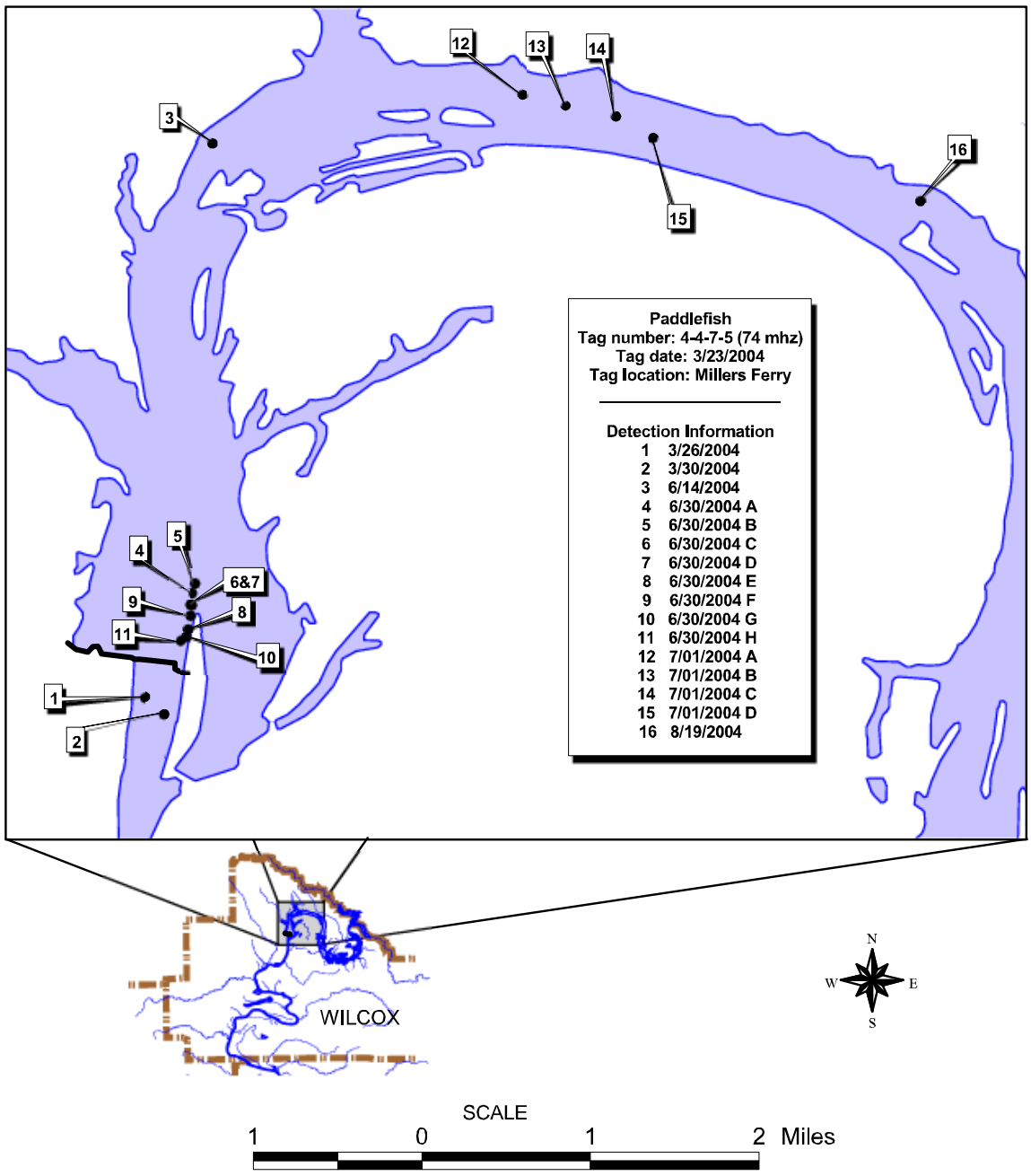

Figure 3. Detection locations for sonic paddlefish 4-4-7-4, 2004.

Another potential upstream movement record came from a spotted bass that was anchor tagged below Millers Ferry on March 15, 2004, and collected inside the lock chamber on May 4. This record and collections of limited numbers of bluegill, largemouth and spotted bass, and black crappie at Claiborne and black crappie at Millers Ferry suggest that several species of sunfishes could benefit from fish passage opportunities at both Claiborne and Millers Ferry.

More blue and channel catfish were collected at Millers Ferry (table 6) than at Claiborne (table 5). This observation was probably influenced by the fact that much of the tailwater area lying between the gated spillway and hydroelectric generating facility at Millers Ferry is littered with submerged trees and logs that provide excellent habitat for catfish species. Abundant prime habitat near this lock chamber could increase the likelihood that several catfish species would utilize fish passage opportunities if they were available at Millers Ferry.

SONIC TAGGING AND TRACKING STUDY

Three of the five paddlefish that were sonic tagged below Claiborne on April 14 and two paddlefish that were sonic tagged below Millers Ferry on May 4 were detected from one to four times and from 1 to 124 days following release (table 7). Sonic fish 5-5-5-5 (70 megahertz (mhz)) and 5-5-8-8 (79 mhz) remained within a few miles of Claiborne Lock and Dam. Sonic fish 5-5-5-7 (71 mhz) moved downstream to the vicinity of ARM 53-54 and occupied a pool area with another paddlefish that was tagged below Millers Ferry in 2004 and subsequently moved downstream to the Tensaw River south of the Interstate 65 bridge. Sonic fish 5-5-7-6 (80 mhz) was detected only once, at ARM 96.5, about 36 miles downstream of Millers Ferry. Sonic fish 5-6-6-6 (72 mhz) was detected four times from ARM 120 to 127. Failure to detect sonic fish 5-5-5-8 (72 mhz) and 5-5-8-6 (78 mhz) does not necessarily infer that these fishes are dead. Mettee and others (2004a) reported that several paddlefish tagged below Millers Ferry disappeared for weeks to a year and were subsequently detected in good condition from 70 to 180 miles downstream of their release location. We will assume that both of these fish are still alive until they are not detected for two or three years.

Table 7. Ultrasonic tagging and detection data for five paddlefish collected inside Claiborne Lock and Dam and two paddlefish collected inside Millers Ferry Lock and Dam in 2004.						
Tag Number (Mhz)	Release Location	Detection Date	North	West	Near ARM	River Depth (ft)
5-5-5-5 (70)	Claiborne	5/4/04	31.59895551	87.54780466	71	19.8
		7/28/04	31.5935968	87.54327093	69.7	15.4
		7/29/04	31.59301331	87.54324389	69.9	26.9
		8/17/04	31.55636903	87.55919756	64.4	19.3
5-5-5-7 (71)	Claiborne	5/7/04	31.59265246	87.54272112	73	29.1
		6/9/04	31.61284988	87.55119369	71	21
		7/29/04	31.47450483	87.56201875	53.6	25.6
		8/17/04	31.47447408	87.56201875	54	19.8
5-5-5-8 (72)	Claiborne		Not Detected			
5-5-8-6 (78)	Claiborne		Not Detected			
5-5-8-8 (79)	Claiborne	5/7/04	31.59044131	87.53885438	69.7	23.8
		8/17/04	31.61343324	87.55206798	72.5	15.4
5-5-7-6 (80)	Millers Ferry	6/5/04	31.83201345	87.50718138	96.5	25.4
5-6-6-6 (72)	Millers Ferry	6/14/04	31.97444456	87.45213671	121.5	25.1
		6/15/04	31.97471981	87.45595838	121.3	45.8
		7/1/04	32.03060946	87.42596188	127	32
		7/30/04	31.97438339	87.4566434	120.8	28.6

CONCLUSIONS AND RECOMMENDATIONS

The Alabama River is the best river system in Alabama for implementation of some type of fish passage for the following reasons.

1. With 144 species, the Alabama River contains the richest fish fauna of any river system in the Mobile Basin (Mettee and others, 1996). The Coosa River system actually contains slightly more species (147), but several are endemic to the Conasauga, Oostanaula, and Etowah Rivers in Georgia, and for this reason, are not included in the Alabama total.
2. The Alabama River proper is inhabited by 10 fish species that are federally listed or were identified as in need of immediate conservation action during the Second Nongame Wildlife Conference held in Auburn, Alabama in July 2002. Federally

listed species include the Gulf sturgeon (Threatened) and the Alabama sturgeon (Endangered). Mirarchi and others (2004) listed the Alabama sturgeon as a species of Highest Conservation Concern, and the Gulf sturgeon, Alabama shad, and frecklebelly madtom as species of High Conservation Concern. The alligator gar, skipjack herring, striped bass, crystal darter, freckled darter, and southern population of the walleye were listed as species of Moderate Conservation Concern because insufficient data exist on population size and life history of each species in this category.

3. Data collected during this study and earlier USCOE sampling efforts have already documented that the longitudinal movements of a minimum of 35 species, 24 percent of the entire Alabama River fauna, could possibly benefit from some type of fish passage operations and/or structures at Claiborne and Millers Ferry Locks and Dams. Continued sampling with large nets and the addition of small mesh nets could increase the number of species to between 50 and 100 that would utilize fish passage to move upstream.
4. Even though the USCOE continues to operate three navigational locks and dams on the Alabama River, commercial barge traffic has significantly declined throughout the entire 299 miles of the Alabama River over the past 10 years. Millers Ferry and Henry Locks and Dams continue to produce hydroelectric power for regional use, but generation schedules are severely reduced by low discharges during the summer and fall months. Declining river traffic and marginal hydroelectric operations have caused Congress to consider reducing or possibly eliminating Federal appropriations for Alabama River operations. Incorporating fish bypass operations into the USCOE mission at all three Alabama River locks and dams may provide additional justification to continue waterway funding, particularly if fish passage has no adverse impact on navigational operations and maintaining in-stream water-quality standards.
5. Several years ago, the USCOE maintained an aggressive dredging program in the Alabama River, particularly downstream of Claiborne, but operations have steadily diminished in recent years. As a result, natural gravel and sand bars that once provided critical spawning and feeding habitat for both small and large channel fish species are beginning to reappear along the river. Continuation of this natural aging

process should improve the status of game and nongame fish populations throughout the river.

6. For the past several years, Alabama elected officials and state and federal resource managers have been involved in negotiations with the State of Georgia over sharing water in the Alabama, Coosa, and Tallapoosa (ACT) River systems. At the same time, state and federal resource managers are involved in negotiations with the Federal Energy Regulatory Commission (FERC) to re-license all Alabama Power Company hydroelectric generating dams in the Coosa and Tallapoosa Rivers in Alabama. The results of these management actions could affect the discharge, water-quality, and biological integrity of the Alabama River for the next 50 years. Implementing some type of proactive fish passage operation at all three Alabama River locks and dams would give Alabama officials additional justification to request optimum discharge through the ACT.
7. This study has produced some interesting new data on fish species movements in the lower Alabama River and Mobile-Tensaw River Delta. It has increased the list of species that would potentially benefit from some type of fish passage operations at Claiborne and Millers Ferry Locks and Dams. Collection of 146 paddlefish inside Claiborne lock chamber in April and 38 paddlefish inside Millers Ferry lock chamber in May are excellent examples. Ongoing Section 6 studies have documented that paddlefish (Mettee and others, 2004a) and southeastern blue suckers (Mettee and others, 2004b) move upstream past Claiborne Lock and Dam, but passage opportunities are limited to only a few days when Claiborne spillway is inundated by winter floods. Increasing the number of fish passage days at Claiborne should have a beneficial effect on the movements of these and other riverine species past this dam. Mettee and others (2004a) provided the first evidence that paddlefish can move upstream through Millers Ferry lock chamber.
8. Implementing a regular lock operation program from late February through early May should increase the numbers of paddlefish and other riverine species that reach the next upstream 100 miles of the Alabama River between Millers Ferry and Henry Locks and Dams and the Cahaba River which contains one of the richest fish faunas in Alabama for a drainage of its size (Pierson and others, 1989). Increasing fish

passage opportunities will increase gene exchange between populations of species that are currently isolated by the gated spillways at Claiborne, Millers Ferry and Henry Locks and Dams for most of each year. Over time, fisheries biologists may be able to quantify incremental improvements in the status of some imperiled species, including frecklebelly madtoms, crystal darters, and freckled darters, whose populations have declined in this section of the Alabama River.

More work is needed to justify the large expenditure of time and funds necessary to implement fish passage in the Alabama River. Low budget anchor tagging operations should continue, and local advertisement and tag rewards should be incorporated into this work task to increase data return on species movements in the Alabama River. All fish passage tests completed at Claiborne to date have used attraction flow to attract fishes into the lock chamber. Tests had to be completed when lower pool depths reached the vicinity of 10 feet to satisfy USCOE safety regulations. Delaying these tests until mid-April probably missed a number of species that spawn earlier in the year and underestimated the abundance of some species that were collected in our samples but spawned earlier in the spring. Four lock operation tests should be completed in late February and March to compare the effectiveness of using this passive fish passage method and attraction flow as effective means of transporting maximum numbers of species past Claiborne.

Only one lock operation and fish sampling data set has been collected at Millers Ferry. Three additional data sets tests should be collected in March and early April to increase the database for future fish passage considerations at this facility. Fish passage has never been investigated at Henry Lock and Dam. Four lock operation tests followed by fish sampling efforts inside the lock chamber are recommend at Henry Lock and Dam. Existing data and information obtained from the 11 proposed tests should provide sufficient information to direct future fish passage development in the Alabama River.

The status of fish populations, including imperiled species, inhabiting the upstream 165 miles of the Alabama River is virtually unknown. Comprehensive fisheries studies may never be completed in this area due to budget and time constraints. As an alternate plan, resource agencies should consider implementing a well designed program to collect fisheries data twice annually at 15 to 20 long-term monitoring sites located between the junction of the Coosa and Tallapoosa Rivers downstream to Henry Lock and Dam. Finally, a qualitative and quantitative fish

community database must be developed to assess the upstream effects of fish passage on fish communities inhabiting the upper Alabama River and document future changes in fish communities that could occur following resolution of surface-water negotiations between Alabama and Georgia.

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