

GEOLOGICAL SURVEY OF ALABAMA

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**PADDLEFISH (*Polyodon spathula*) MOVEMENT
IN THE ALABAMA RIVER, 2002-2004**

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by

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Prepared in cooperation with the
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CONTENTS

Abstract	1
Introduction.....	1
Acknowledgments.....	2
The study area.....	3
Objective.....	4
Methods.....	4
Results and discussion	6
Conclusions.....	11
Recommendations.....	17
Study plan for 2004-05	17
References cited.....	18

ILLUSTRATIONS

1. Sampling area for <i>Polyodon spathula</i> below Millers Ferry Lock and Dam.....	5
2. Detection locations for sonic fish 3-3-3-6 (69 mhz), 2003-2004.....	7
3. Detection locations for sonic fish 3-4-3-7 (78 mhz), 2003-2004.....	8
4. Detection locations for sonic fish 4-4-7-5 (74 mhz), 2004.....	10
5. Detection locations for sonic fish 3-3-6-7 (76 mhz), 2003-2004.....	12
6. Detection locations for sonic fish 3-3-7-6 (78 mhz), 2003-2004.....	13
7. Detection locations for sonic fish 3-4-3-5 (78 mhz), 2003-2004.....	14
8. Detection locations for sonic fish 3-3-6-6 (71 mhz), 2003-2004.....	15

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ABSTRACT

Thirty-three paddlefish were sonic tagged below Millers Ferry Lock and Dam from March 15 through April 8, 2004, and five were tagged below Claiborne Lock and Dam on April 14. Tracking operations detected 52 fish in 2004 including 1 fish tagged in 2002, 15 tagged in 2003, and 36 tagged in 2004. One fish tagged below Millers Ferry in March 2004 moved through Millers Ferry lock chamber and inhabited a 6- to 8-mile long reach of Dannelly Reservoir. Thirty-one fish were detected between Millers Ferry and Claiborne. Some fish occupied the same general area in 2003 and 2004 while others ranged from 10 to 15 miles up and down the river. Twenty fish moved downstream past Claiborne Lock and Dam. Twelve fish were found within 6 to 8 miles of Claiborne, two moved 20 miles downstream of the dam, and six fish continued 170 to 180 miles downstream into the Tensaw River below the Interstate 65 bridge. Study results suggest the Tensaw River is an important summer habitat for paddlefish that spawn in the Alabama River and possibly upstream in the Tombigbee and Black Warrior Rivers.

INTRODUCTION

The paddlefish (*Polyodon spathula*) originally inhabited many large river tributaries to the Mississippi and Mobile basins. Overfishing, dam construction, habitat modification, and pollution have dramatically reduced the distribution and abundance of this species (Burr, 1978; Robison and Buchanan, 1988; Williams and others, 1989; Etnier and Starnes, 1993; Mettee and others, 1996; Ross, 2001). As a result, it has been extirpated from four states and is listed as endangered, threatened, or of special concern by 11 others (Graham, 1997). Fearing a similar decreasing trend in Alabama, the WFFD banned paddlefish harvest in all Alabama rivers in 1988. Recent increased paddlefish sightings have renewed public interest in re-opening the season. In response to these inquiries, the WFFD will soon initiate a multi-year study to determine the size of paddlefish populations inhabiting the Alabama and Tombigbee Rivers and

Mobile-Tensaw River Delta. Unfortunately, paddlefish numbers have not recovered in the Tennessee River (Hoxmeier and DeVries, 1996) and, for this reason, the harvest ban will remain in effect across northern Alabama for the foreseeable future.

Paddlefish life history and movements are well documented in the upper Mississippi River (Rosen and others, 1982; Southall and Hubert, 1984; Moen and others, 1992; Lyons, 1993; Zeigler and others, 1999, 2003; Runstron and others, 2001), but relatively little information has been published on populations inhabiting Alabama rivers. Hoxmeier and DeVries (1997) reported that juvenile Alabama River paddlefish used oxbow lakes as nursery areas until they reached sexual maturity at around 650 millimeters (mm) eye to fork length (EFL). Adults and juveniles remain in backwater habitats during the summer and fall and then move into main channel habitats in the winter and spring. Alabama River paddlefish had shorter life spans, higher fecundity rates, and the lengths for various age classes of Alabama River fish were generally shorter than those found in northern rivers. Lein and DeVries (1998) reported paddlefish populations in the Cahaba and Tallapoosa Rivers were functionally discrete units that resided in adjacent, non-connected reservoirs. Differences in population characteristics between these rivers were possibly influenced by a combination of factors, including flow, habitat size, and water temperature. The recapture of some anchor tagged individuals in the same spawning area in successive years suggested spawning site fidelity. Paddlefish growth was greatest during the first year of life, decreased with age, and was lowest in older, mature fish. The estimated ages of the oldest paddlefish collected in the Tallapoosa and Cahaba Rivers were 11 years and 9 years, respectively. Alabama paddlefish matured quicker, grew faster, possibly spawned more frequently, and produced more eggs than individuals in Louisiana (Reed and others, 1992) and Missouri (Rosen and Hales, 1981).

ACKNOWLEDGMENTS

Several agencies and individuals contributed to the success of this research. Section 6 funding was provided by the Wildlife and Freshwater Fisheries Division (WFFD) of the Alabama Department of Conservation and Natural Resources (ADCNR), U.S. Fish and Wildlife Service (USFWS), and Geological Survey of Alabama (GSA). The Mobile District Office of the U.S. Army Corps of Engineers (USCOE) altered the hydroelectric generation schedule at Millers

Ferry Lock and Dam to accommodate netting operations for the study. Ed Tybergein (Alabama Power Company) and Greg Lein (ADCNR) shared information from their previous studies on paddlefish populations in the Tallapoosa and Cahaba Rivers. Dennis DeVries (Auburn University) supplied a thesis on paddlefish populations in the Alabama River by Hoxmeier (1996) and published papers by Hoxmeier and DeVries (1997) and Lein and DeVries (1998).

THE STUDY AREA

The Alabama River is formed by the junction of the Coosa and Tallapoosa Rivers. 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-Tensaw River Delta, which extends about 30 miles (mi) before entering Mobile Bay.

The USCOE operates three 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 located on the west bank of the river as part of the gated spillway. The powerhouse at Millers Ferry was constructed as a separate facility on the east bank of the river about 0.5 mi 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 no hydroelectric generating facility.

Forest production and agriculture are the dominant land uses throughout much of the Alabama River watershed. Montgomery and Selma are the largest municipal dischargers into the Alabama River although the Cahaba River, its largest tributary, receives substantial municipal discharge and nonpoint runoff from the Birmingham Metropolitan area and the town of Centreville. Other major permitted dischargers include paper mills near Montgomery, Selma, Camden, and Monroeville. Depth and flow in the Alabama River fluctuate daily due to 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) deep navigational channel throughout the entire 299 mi of the river. Most dredging activities

are confined to the lower 73 mi 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 paddlefish movements and summer habitats in the Alabama River and Mobile-Tensaw River Delta.

METHODS

Paddlefish were collected in the generator outflow area below the Millers Ferry powerhouse in March and April from 2002-2004. On each sample day, the USCOE discontinued hydroelectric generation from 900-1200 hours. Five 200-ft-long and 8-ft-deep (tied to 6-ft) multi-filament nylon gill nets, each having a 2.0- to 2.5-inch- (in.) bar mesh, foamcore float lines, and leadcore bottom lines, were deployed in the outflow area (fig. 1), fished for approximately 60 minutes, and retrieved. All paddlefish collected were placed in large aerated tanks for later processing. Other species were identified, tallied, and released.

Processing and tagging operations were completed on the west bank of the river. The EFL was measured in mm and a Betadine-soaked Sonotronics sonic tag having a 48-month operating life was inserted into the abdominal cavity of each fish through a 2.0- to 2.5-in. long incision made near the ventral midline. Gender was determined when possible. The incision was sutured with black non-absorbable nylon thread and the surgical area was treated with Betadine. A numbered internal anchor tag was inserted through a small vertical incision made on the lower left side of the body. Each fish was placed in a livewell and observed for several minutes before release.

Listening trips were completed through the fall and summer using a Sonotronics DH-2 directional hydrophone and USR-5W sonic receiver. During each trip, the boat was stopped at about 0.3-mile intervals, the hydrophone was lowered into the water, and a minimum of two 360° sweeps were completed to detect tag signals in the 69-83 megahertz (mhz) range used during the study. 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

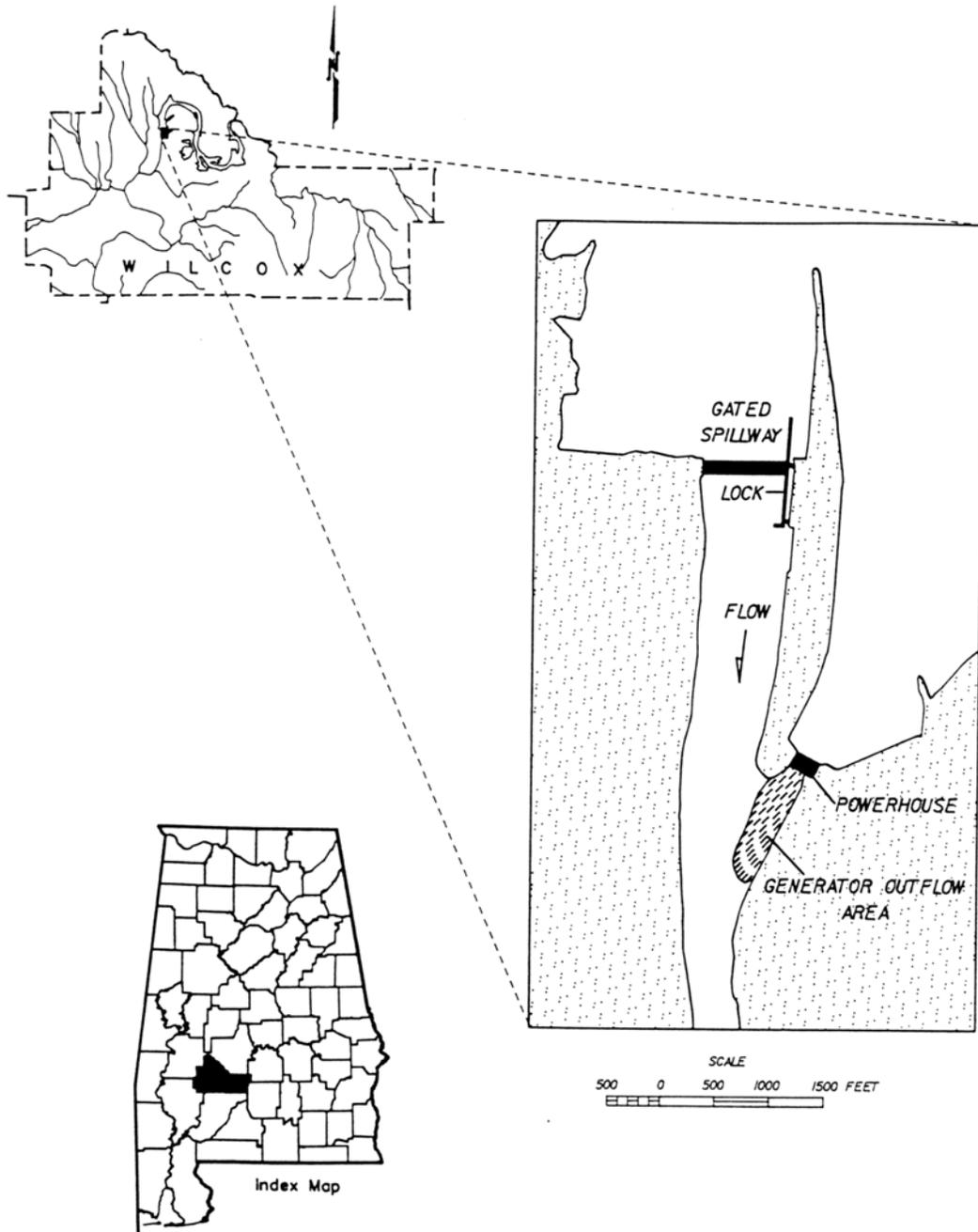


Figure 1. Sampling area for *Polyodon spathula* below Millers Ferry Lock and Dam.

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.

RESULTS AND DISCUSSION

Thirty-three paddlefish were sonic tagged below Millers Ferry Lock and Dam from March 15 through April 8, 2004, and five fish were tagged below Claiborne Lock and Dam on April 14. Fifty-two sonic fish (1 from 2002, 15 from 2003, and 36 from 2004) were detected from one to eight times and from one to 677 days after release. One 2004-tagged fish moved upstream through Millers Ferry lock chamber and into a 6- to 8-mi long section of Dannelly Reservoir. Thirty-one fish (1 from 2002, 5 from 2003, and 25 from 2004) were detected in the 60-mi-long section of the Alabama River between Millers Ferry and Claiborne Locks and Dams. Twenty fish moved downstream past Claiborne. Twelve fish remained within 6 to 8 mi of Claiborne, two moved 20 mi downstream of the dam, and six fish continued 170 to 180 mi downstream into the Tensaw River below the I-65 bridge.

Several paddlefish were not detected every year or at the same locations. Six fish tagged and found several times in 2003 were not detected in 2004. Conversely, two fish tagged and not found in 2003 were detected in the Mobile-Tensaw River Delta in 2004. One fish tagged below Millers Ferry in 2002 was detected five times from ARM 97-95 in 2002, but then it moved to an unknown location and was not detected throughout 2003. In 2004, this fish reappeared at ARM 97 and was detected on the opposite side of the river. Five of 15 fish discovered between Millers Ferry and Claiborne in 2003 were found in the same sections of river in 2004, but four moved downstream past Claiborne, and six were never detected upstream or downstream of Claiborne.

Two fish tagged below Millers Ferry in 2003 moved downstream into the Claiborne tailwater area in 2003 and returned to the Millers Ferry tailwater area in 2004. Sonic fish 3-3-3-6 (69 mhz), a 683-mm EFL fish tagged on April 2, 2003, was found below Claiborne dam on eight occasions from June 2003 through January 2004 (fig. 2). This fish moved upstream past Claiborne when it was inundated by winter flooding and reappeared below Millers Ferry on March 23. After the spawning season concluded, it returned to the Claiborne tailwater area where it was detected seven times from April through August 2004. Sonic fish 3-4-3-7 (78 mhz), a 855-mm EFL fish tagged on April 1, was detected at ARM 98 above Claiborne on April 22, 72.8

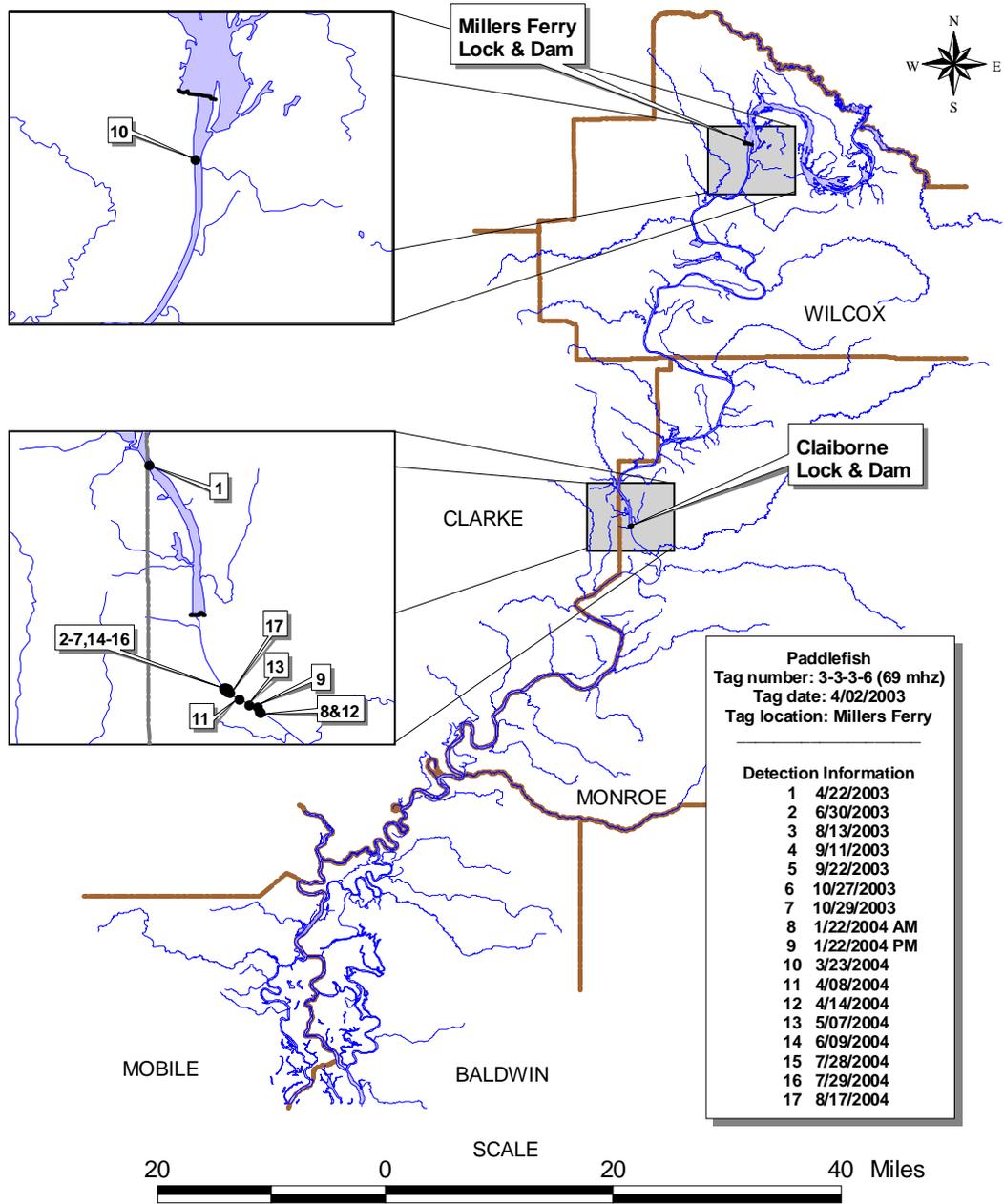


Figure 2. Detection locations for sonic fish 3-3-3-6 (69 mhz), 2003-2004.

below Claiborne on October 27, and at ARM 128, approximately five miles downstream of Millers Ferry, on March 15, 2004 (fig. 3). Although not found later in 2004, this fish probably moved back downstream past Claiborne.

Paddlefish movements through lock chambers have not been well studied in the Mississippi River (Zigler and others, 2004) or in Alabama. The upstream movement of a paddlefish tagged in March 2004 through the Millers Ferry lock chamber represents the first observation of this behavior in Alabama. Sonic fish 4-4-7-5 (74 mhz), a 1,045-mm EFL fish tagged below Millers Ferry on March 23, was detected near the closed gated spillway below the dam on March 26 and March 30 (fig. 4). When rediscovered on June 14, this fish was moving upstream about 3 mi above Millers Ferry Lock and Dam. On June 30, it was located inside the upper end of the pool that supplies the Miller Ferry powerhouse. Within a few minutes, it swam upstream around the point that separates the powerhouse pool from the reservoir above the gated spillway and began moving downstream along the rip-rap toward the upper lock approach. It swam across the navigation channel in front of the upstream lock approach and then moved out into the reservoir above the gated spillway.

Tracking operations had to be suspended due to an impending lightning storm, but when relocated the next morning (July 1), the fish was swimming upstream about 4 mi above Miller Ferry Lock and Dam. A simple time and travel study determined its swimming speed was about 1 mi per hour (mph). Assuming paddlefish can maintain this or a slightly faster speed for several days, then fish living anywhere in the lower Alabama River or Mobile-Tensaw River Delta could easily move upstream to spawn in the Millers Ferry tailwater in a few days, provided they could navigate past Claiborne spillway during winter flooding.

Paddlefish receive serious, possibly life threatening, wounds while trying to negotiate their way through the hydraulic currents that occur near the submerged crested spillway and through the fully opened spill gates at Claiborne during winter flooding. Several fish collected during the study had recently broken and splintered paddles as well as small cuts and abrasions on their bodies that were obviously not inflicted by boat propellers or during spawning activity.

Continuous flooding severely hampered tracking success in the lower Alabama River and Mobile-Tensaw River Delta throughout much of 2003, but much improved conditions in 2004

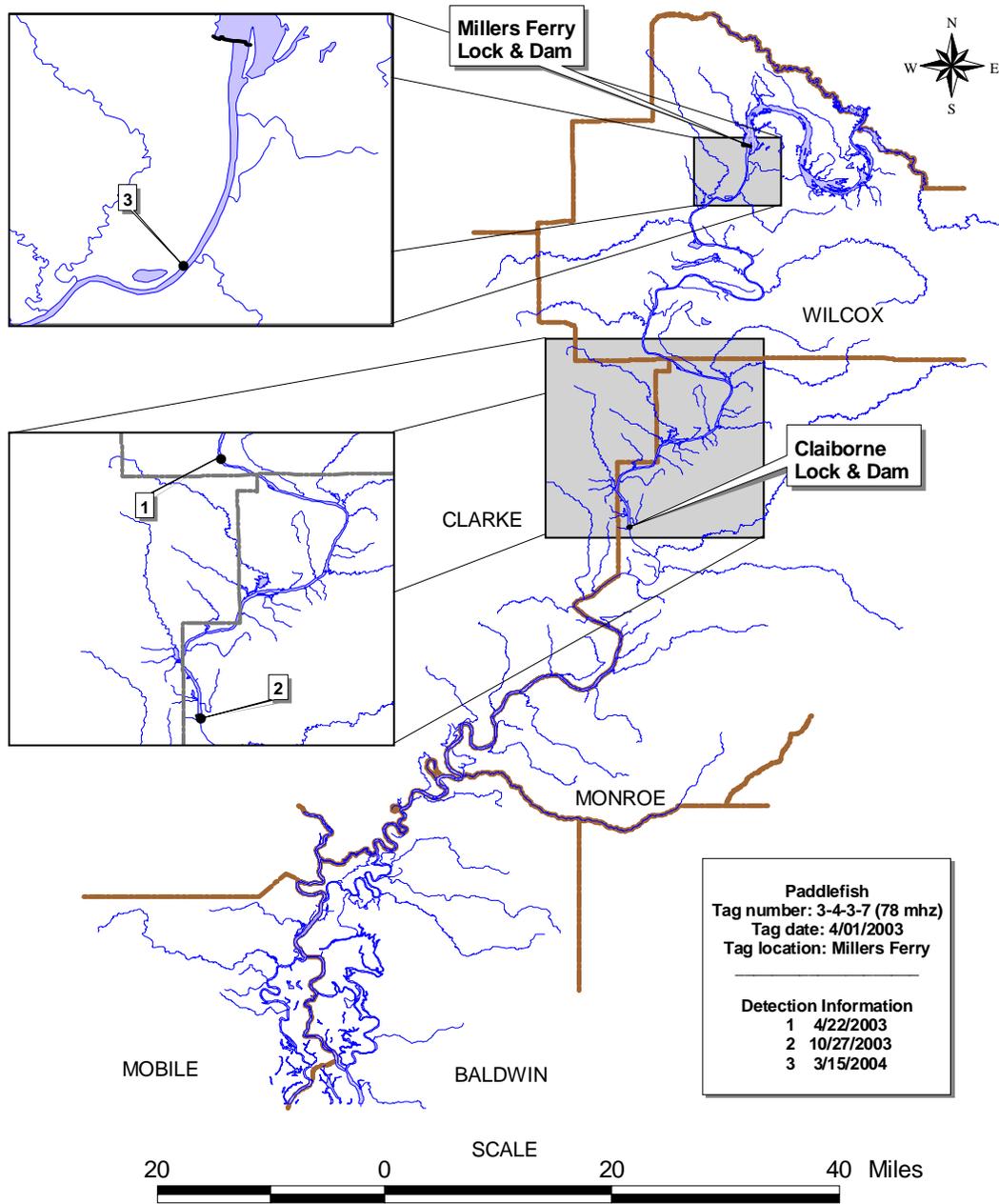


Figure 3. Detection locations for sonic fish 3-4-3-7 (78 mhz), 2003-2004.

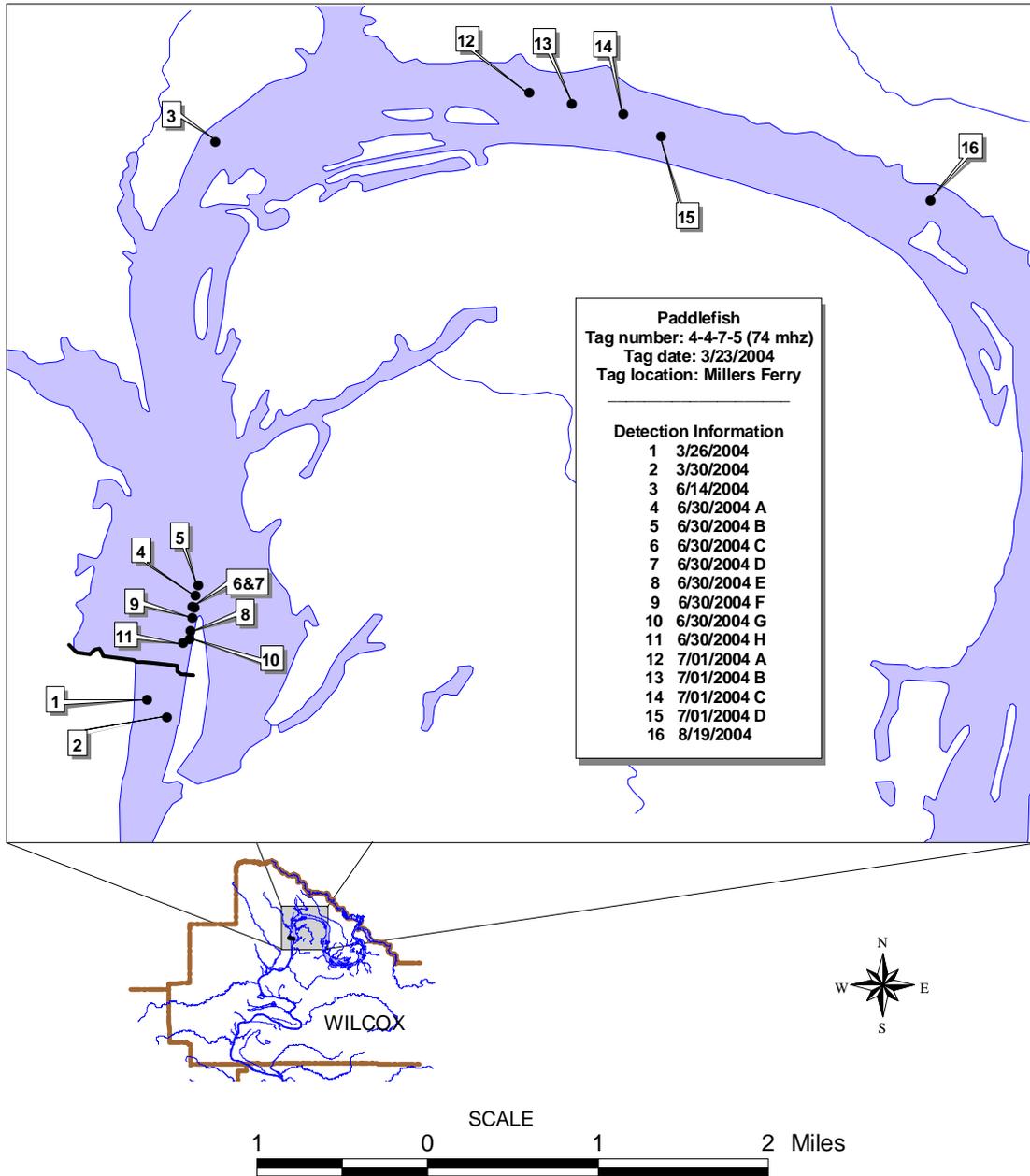


Figure 4. Detection locations for sonic fish 4-4-7-5 (74 mhz), 2004.

resulted in the detection of six tagged fish (2 from 2004 and 4 from 2003) in the Tensaw River south of the I-65 bridge. Two fish tagged in 2004 were detected only once. Both fish appeared to be alive because the signal from each tag was detected from a considerable distance and it exhibited a slight variation in intensity which indicated swimming activity. Sonic fish 3-3-3-7 (69 mhz), a 730-mm fish tagged on March 16, 2004, was found at the junction of the Raft and Tensaw Rivers near the south end of Gravine Island and then it disappeared. Sonic fish 4-5-6-8 (77 mhz), a 748-mm fish tagged on March 26, 2004, was detected between ARM 128 and ARM 132 five times from March 26 to April 16 and then it disappeared. This fish was discovered at the mouth of Bat Creek, a western tributary to The Basin which is a tributary to the Tensaw River, and then it disappeared. Future tracking will probably detect both of these fishes in the Mobile-Tensaw River Delta.

Sonic fish 3-3-6-7 (76 mhz), a 975-mm EFL fish tagged on March 28, 2003, was never detected later in the year. It was detected in a 12-mi reach of the Tensaw River that extended from upstream of Cliff's Boat Landing south to the junction of the Apalachee and Blakeley Rivers in May and June 2004 (fig. 5). Sonic fish 3-3-7-6 (78 mhz), an 815-mm EFL fish tagged on April 1, 2003, remained undetected in 2003. It was discovered at the downstream junction of the Middle and Tensaw Rivers on May 20 and June 11, 2004, and 5 miles further downstream on June 23 (fig. 6). Sonic fish 3-4-3-5 (78 mhz), a 710-mm fish tagged on April 1, 2003, was found at ARM 128 on April 16 and ARM 114.5 on April 21 and then it disappeared for the remainder of 2003. This fish was detected again near the southeastern tip of Gravine Island on May 13, 2004 (fig. 7). Tracking data suggest the feeding area for this fish extends from The Basin, a major tributary to the west side of the Tensaw River, downstream to McVay's Lake near the southern end of Gravine Island. Sonic fish 3-3-6-6 (71 mhz), an 830-mm fish tagged on April 1, 2003, was detected at ARM 123.5 on March 27 and ARM 98 above Stein Island on April 22 and then it disappeared during the remainder of 2003. This fish was detected in the Tensaw River between the mouth of Byrnes Lake and the eastern side of Gravine Island in May and June 2004 (fig. 8).

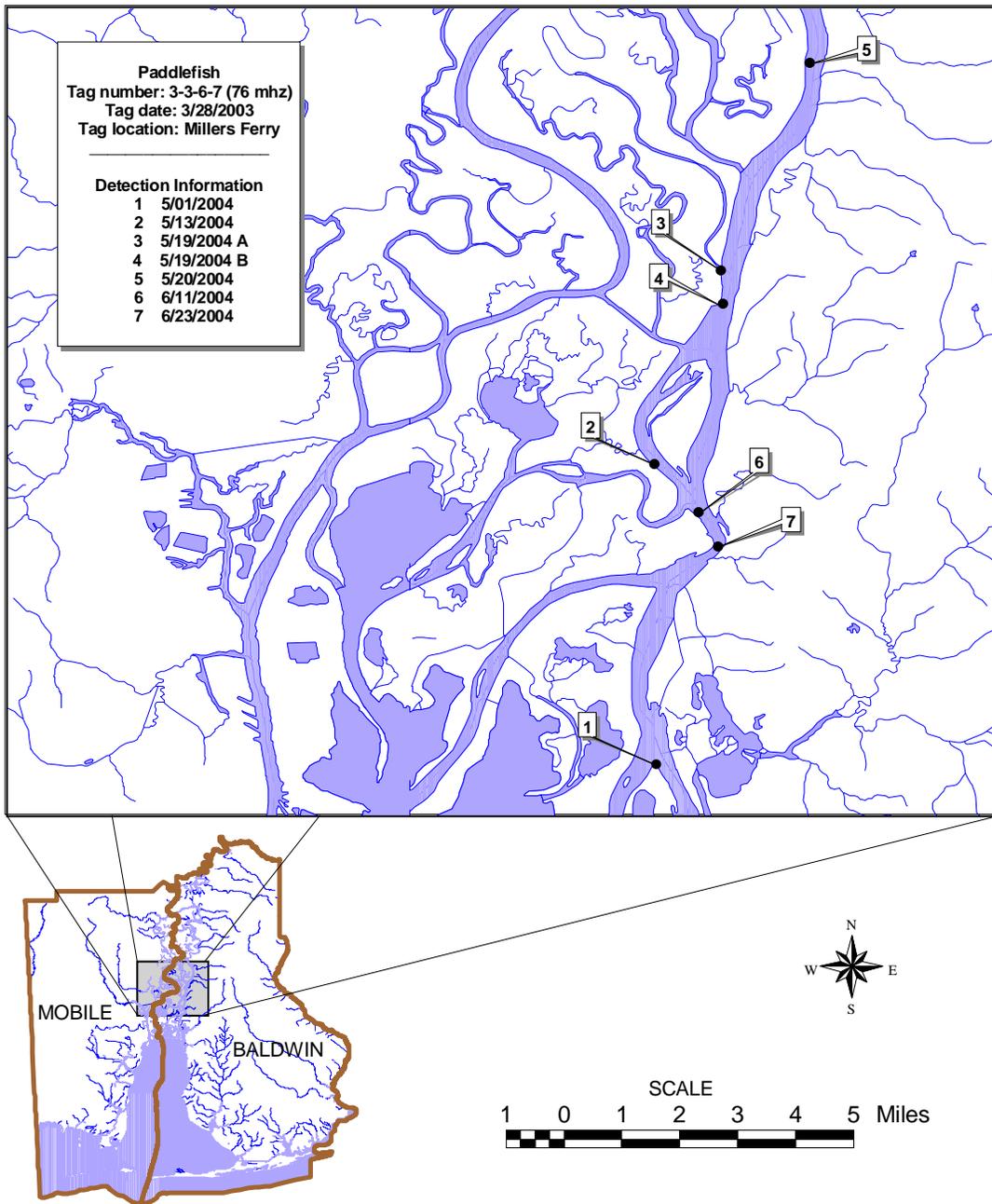


Figure 5. Detection locations for sonic fish 3-3-6-7 (76 mhz), 2003- 2004.

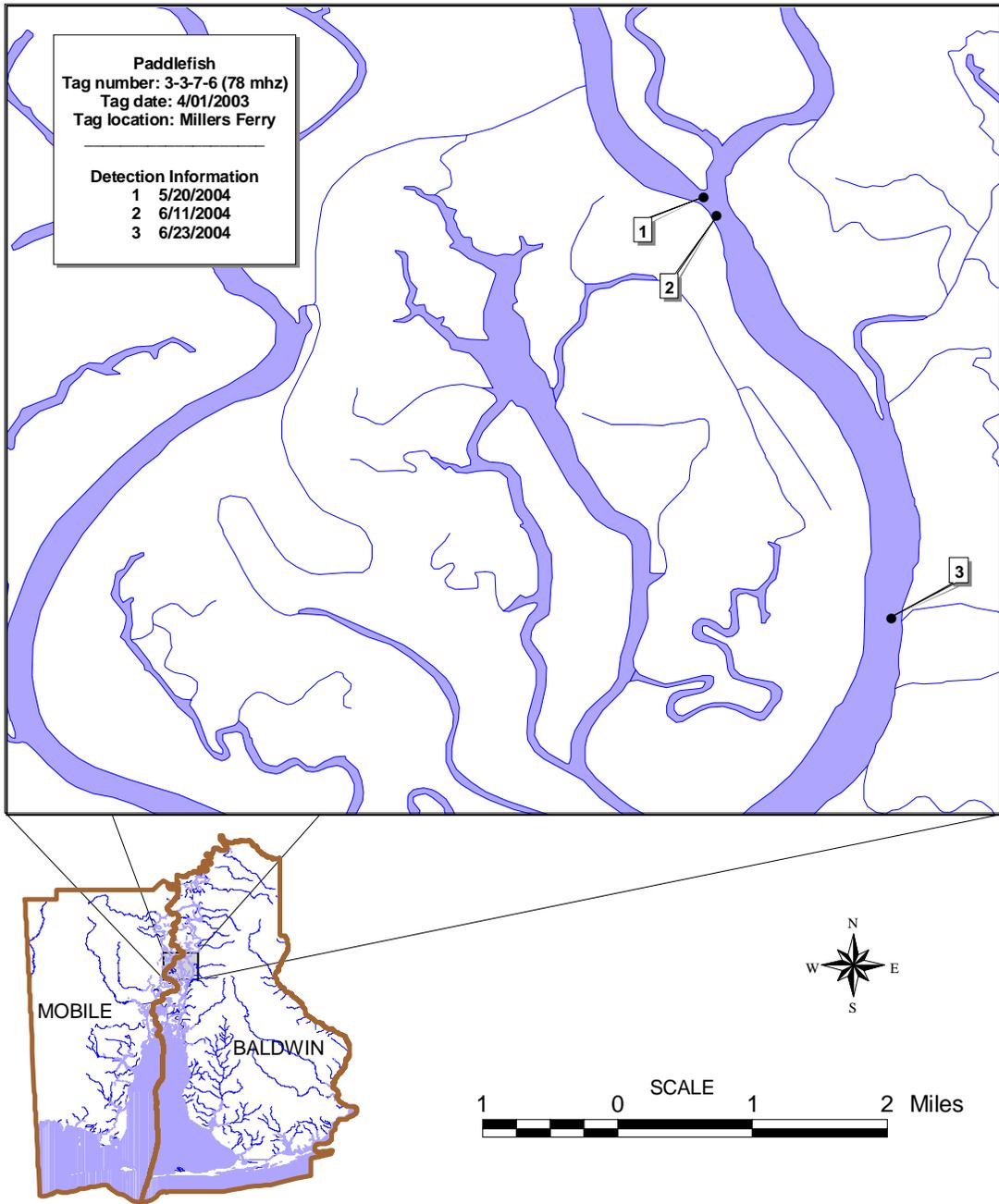


Figure 6. Detection locations for sonic fish 3-3-7-6 (78 mhz), 2003-2004.

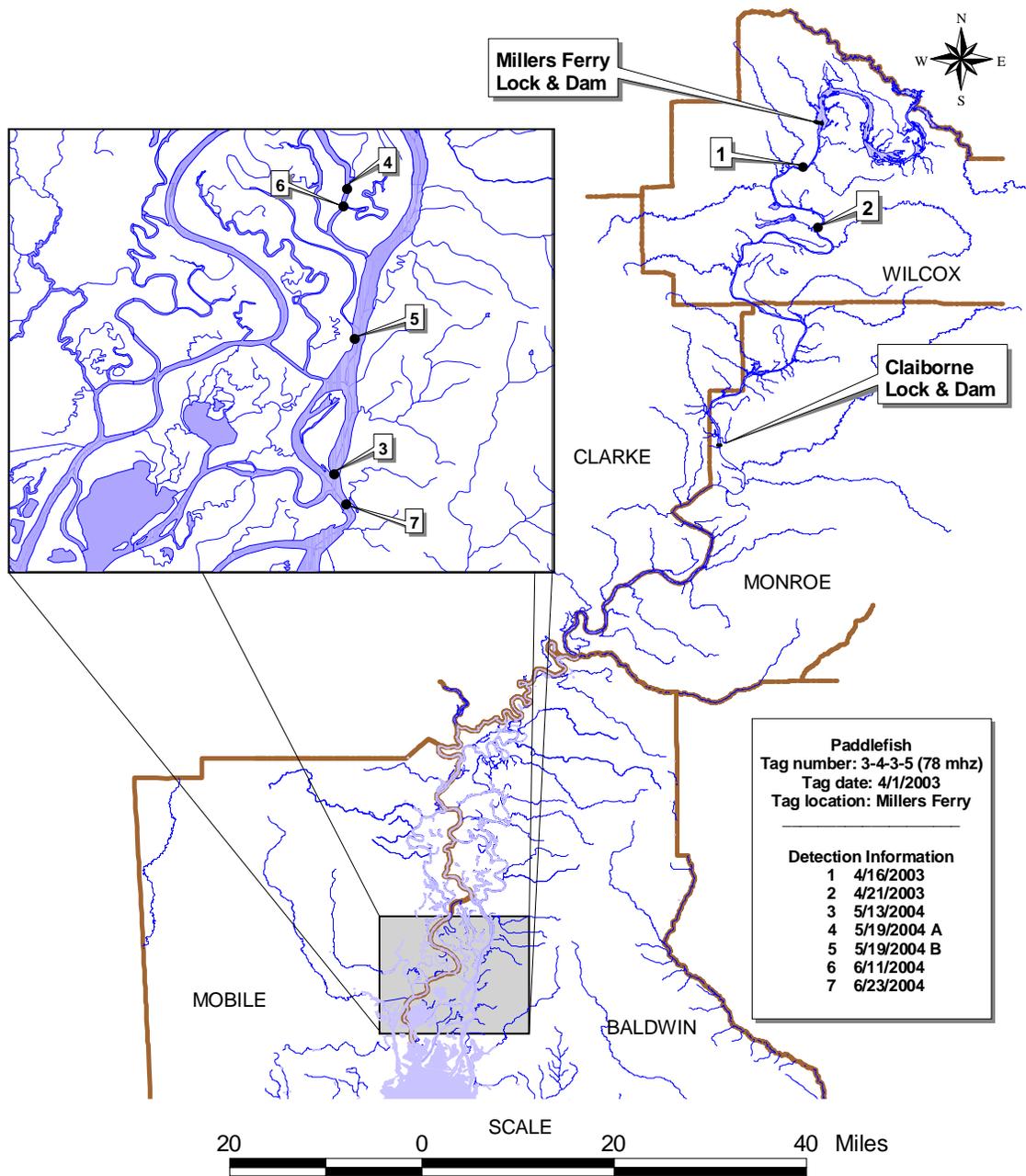


Figure 7. Detection locations for sonic fish 3-4-3-5 (78 mhz), 2003-2004.

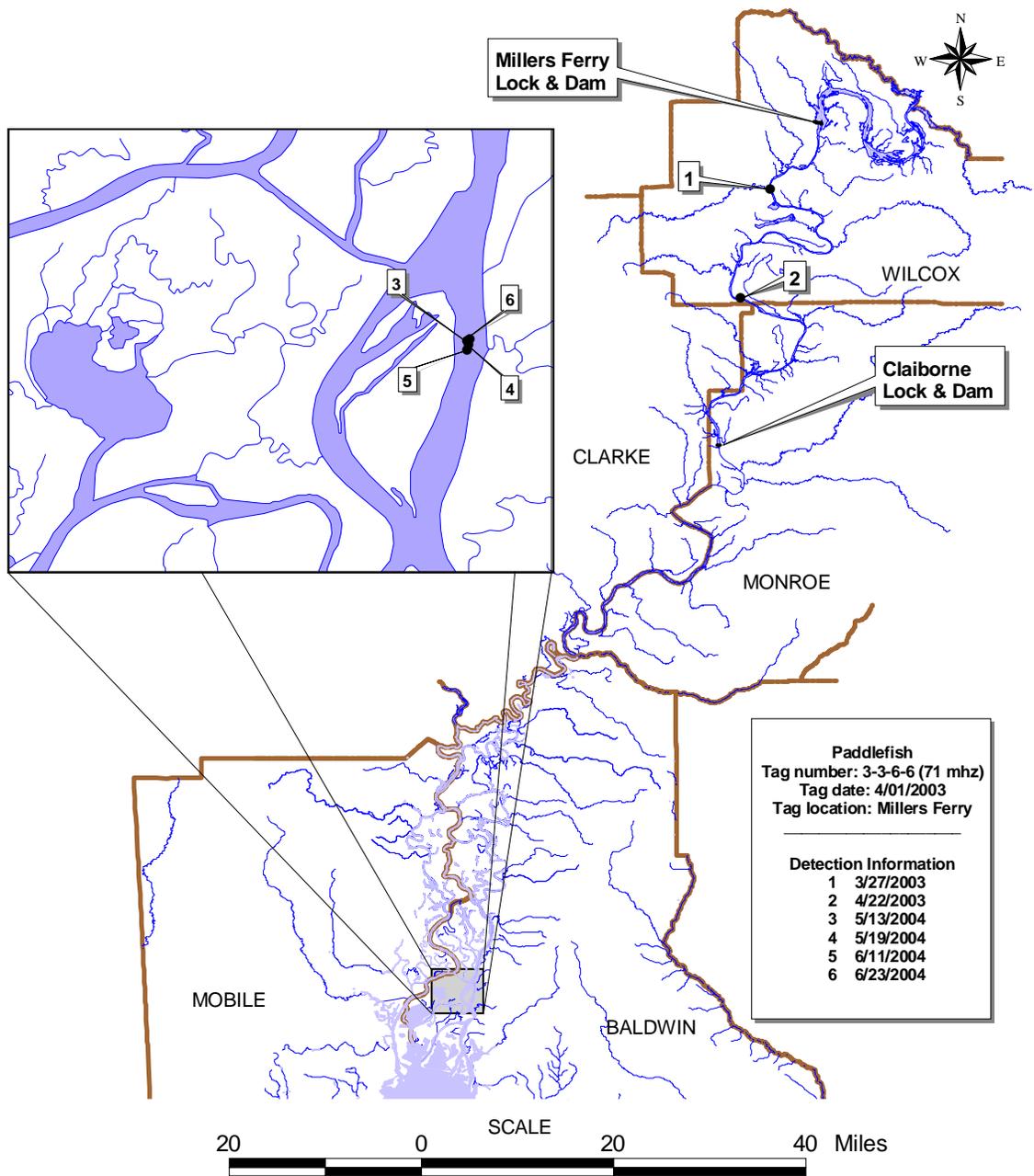


Figure 8. Detection locations for sonic fish 3-3-6-6 (71 mhz), 2003-2004.

CONCLUSIONS

1. Paddlefish, southeastern blue suckers (Mettee and others, 2004), and other riverine species move upstream past Claiborne Lock and Dam when it is inundated by winter floods, but passage is blocked when the dam is not submerged during low flow years. Attraction flow or lock operations could lengthen the period during which various fish species could move upstream past this dam.
2. Most upstream fish movements are blocked at Millers Ferry and Henry Locks and Dams unless the gated spillways at these facilities are temporarily opened to reduce upstream flooding or fish move through the lock chamber. These opportunities have occur less frequently during the past 10 years due to a steady decline in lock operations at both dams. Lock operations lasting from February through May could provide a low-cost option to increase upstream fish movement upstream past these facilities.
3. Observations of large numbers of jumping paddlefish suggests that the Tensaw River may provide an important summer habitat for this species in Alabama. Their abundance in this area is probably due to several factors including an abundant food supply, favorable water-quality and habitat conditions, and limited predation.
4. Spawning sites and nursery areas for Tensaw River paddlefish are unknown at this time. The detection of four fish tagged below Millers Ferry in 2003 and two fish tagged in 2004 suggests some Tensaw River paddlefish spawn in the Alabama River. Hoxmeier and DeVries (1997) provided additional support when they recaptured a paddlefish in Mifflin Lake, a tributary to the Tensaw River, that they had previously anchor tagged below Claiborne Lock and Dam. Tensaw River paddlefish may also spawn in the Tombigbee and Black Warrior Rivers, but this possibility has not been investigated.
5. Only one sonic tagged paddlefish has been found in the Mobile and Middle Rivers to date. This circumstance could be due to sampling error (failure to tag and track sufficient numbers of fish) or a combination of environmental factors, including increased sedimentation from bank erosion and resuspension of bottom sediments by large boat and barge traffic, upstream dredging activities, depressed plankton production, industrial and

nonpoint discharges, heated effluents from Barry Steam Plant, and lower habitat quality. Additional tagging and tracking efforts may resolve this unusual distribution pattern.

RECOMMENDATIONS

1. Tagging and recapture studies are needed to determine the size of paddlefish populations in the Alabama and Tombigbee Rivers and the Mobile-Tensaw River Delta.
2. Sonic tagging and tracking studies should be expanded to document paddlefish movement patterns between the Alabama and Tombigbee Rivers and the Mobile-Tensaw River Delta.
3. Data recording sonic tags should be implanted in a small number of fish collected below Millers Ferry and in the Mobile-Tensaw River Delta to gather information on the depth and specific conductance of paddlefish feeding zones in these areas.
4. Continuous sonic data collection and recording buoys (\$1,000 per unit) should be deployed above and below Claiborne to monitor upstream and downstream movements of sonic tagged fish between Millers Ferry and the lower Alabama River.
5. Water-quality and habitat studies are needed to identify the factors that support large numbers of paddlefish in the Tensaw River and apparent smaller numbers in the Mobile and Middle Rivers.
6. Cooperative efforts between the USFWS, USCOE, WFFD, and GSA should be expanded to test the effectiveness of using lock operations to move paddlefish and other riverine species upstream through lock chambers at Claiborne, Millers Ferry and Henry locks and dams.

STUDY PLAN FOR 2004-05

Paddlefish tagging and tracking operations will continue below Millers Ferry and Claiborne Locks and Dams in 2004-05. A final report summarizing the results of all previous work effort will be submitted to the Alabama Department of Conservation and Natural Resources in November 2005.

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