Technical/Agency Draft Recovery Plan

for the

Alabama Sturgeon
(*Scaphirynchus suttkusi*)

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By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the Daphne Field Office in Daphne, Alabama.

Literature citations should read as follows:

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Additional copies of this plan may be obtained from:

U.S. Fish and Wildlife Service
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Cover Photo: Alabama Sturgeon, by Dr. Paul Johnson (Alabama Department of Conservation and Natural Resources, Alabama Aquatic Biodiversity Center)

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Executive Summary

Current Status: The Alabama Sturgeon (*Scaphirhyncus suttkusi*) was listed as an endangered species on May 5, 2000 (65 FR 26438). Its historic range encompassed all major rivers in the Mobile Basin, below the Fall Line, including the Alabama, Tombigbee, and Cahaba River systems. Recent collections are restricted to the lower Alabama River below Millers Ferry Lock and Dam to the confluence of the Tombigbee River and in the lower Cahaba River near its confluence with the Alabama River; however, records are extremely rare. The last capture of an Alabama sturgeon was on April 3, 2007 by the biologists at the Alabama Department of Conservation and Natural Resources (ADCNR). The Alabama Sturgeon is one of the rarest fish in the nation and may be close to extinction.

Habitat Requirements and Limiting Factors: The Alabama Sturgeon occupies relatively stable river channels with flowing water. Little is known of its life history, although they are believed to migrate upstream during late winter and early spring to spawn. Its decline has been attributed to over-fishing, loss and fragmentation of habitat as a result of historical navigation development and historical water quality degradation. Current threats are primarily a result of a reduced range and extremely low population numbers.

Recovery Strategy: The historic decline of the Alabama Sturgeon was probably triggered by unrestricted commercial fishing. Its present-day decline is likely the result of more than 100 years of cumulative impacts to the rivers of the Mobile River basin, as they were developed for navigation, hydropower production, flood control, recreation and other human uses. Impacts from these activities have eliminated the sturgeons' ability to move freely between feeding areas, suitable sites for spawning and development of eggs and larvae, and other areas that are necessary to carry out, and sustain, its life cycle.

The primary threats currently facing the management and conservation of Alabama Sturgeon are its low numbers and its inability to offset mortality with natural reproduction and recruitment. Since 1997, more than 5000 personnel hours and $1 million have been expended in an attempt to capture and propagate the Alabama Sturgeon; however, this intense effort has only yielded 6 individuals (the last captured in 2007). It is recommended that sampling efforts continue at or near the same level until further steps are made to increase suitable habitat, primarily, to implement measures to allow the safe and timely passage of fish through, or over, Claiborne and Millers Ferry Lock and Dam. Considering the life expectancy of the Alabama Sturgeon (10-15 years) and the time at which Claiborne and Millers Ferry were completed on the Alabama River (35 years), this may be the last viable effort to protect the species from further decline and possibly, extinction. **Therefore, the strategy of this recovery program is to prevent possible extinction of the Alabama Sturgeon by protecting existing riverine habitat, explore ways to pass fish through Claiborne and Millers Ferry Lock and Dam, and eventually, increase numbers of Alabama Sturgeon through hatchery propagation and augmentation**. Actions should be undertaken to protect all wild Alabama Sturgeon from harm, harassment, or death (take), protect remnant habitats, and

to restore functions of the river ecosystems believed important to recover self-sustaining, viable populations of the Alabama Sturgeon. Viable populations are defined as wild, naturally reproducing populations which are large enough to maintain sufficient genetic variation to enable the species to evolve and respond to natural changes in the riverine environment without human intervention. Viable populations are represented by multiple age classes of individuals, including newly recruited juveniles.

Recovery Objectives: The primary recovery objective is to prevent extinction of the Alabama Sturgeon by establishing a captive broodstock population and producing hatchery raised fingerlings for population augmentation in areas that continue to sustain the species. In light of the difficulty of obtaining Alabama Sturgeon broodstock, it is apparent that any effort to use hatchery-reared fingerlings for augmenting wild populations will require a long-term commitment.

The long-term recovery objective is to downlist the Alabama Sturgeon to threatened status when viable populations exist in the Alabama and Cahaba rivers. Delisting is not currently foreseeable due to extreme curtailment of range and extensive modification to the riverine habitats.

Other objectives include developing better understanding of Alabama Sturgeon life history and habitat requirements, and applying that knowledge to improve conditions in the lower Alabama and Cahaba rivers to a degree that a viable population of the species can survive.

Recovery Criteria:
There is some evidence that Alabama Sturgeon may currently number fewer than 50 individuals (see: Part I: *Reasons for Decline: Small Population Numbers and Genetic Consequences*, above). It has been estimated that in randomly mating populations of vertebrate animals, an effective population size of at least 500 individuals is needed to avoid deleterious effects of genetic drift over several generations (Franklin, 1980). Therefore, downlisting may be considered when the following criteria are met:

1. A population consisting of approximately 500 sexually mature Alabama Sturgeon is shown to be surviving and naturally reproducing in the Alabama/Cahaba Rivers.

2. Population studies show that the Alabama Sturgeon population is naturally recruiting (consisting of multiple age classes) and sustainable over a period of 20 years (2-3 generations), and no longer requires hatchery augmentation.

3. An agreement is in place that ensures adequate flows are being delivered down the Alabama River to allow for successful development of sturgeon larvae, and that fish are being successfully passed both upstream and downstream at dams on the Alabama River.

Actions Needed:

1. Capture Alabama Sturgeon broodstock;
2. Continue hatchery program and maintaining holding facilities at Marion State Hatchery;
3. Protect and maintain existing habitat in the Alabama River;
4. Conduct life history studies;
5. Coordinate all activities and revise recovery plan as appropriate

Total Estimated Cost of Recovery:

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Total
2012	200	^	50	^	*	250
2013	200	^	50	^	*	250
2014	200	^	50	^	*	250
2015	200	^	^	^	*	200
2016	200	^	^	^	*	200
Total	1000		150			1150

* Costs may be absorbed under existing State and Federal programs
^ TBD
Dollar amounts listed above in thousands of dollars ($000s)

Total Estimated Cost of Recovery: $1,150,000 [Note: We cannot estimate costs for some actions at this time, until success is maintained for Action 1.0]

Date of Recovery: Undeterminable at this time.

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Part I. Background

Status of the Species

The Alabama Sturgeon (*Scaphirhynchus suttkusi*) was listed as an endangered species on May 5, 2000 (65 FR 26438) and critical habitat was designated for the species on June 2, 2009 (74 FR 26488). Endemic to the Mobile River Basin, its historical range encompassed major rivers downstream of the Fall Line, including the Alabama, Tombigbee, Black Warrior, Coosa, Tallapoosa, and Cahaba River systems. Despite extensive efforts to capture Alabama Sturgeon over the past two decades, only nine specimens have been collected: eight from the lower Alabama River, and one from the lower Cahaba River. The last confirmed records of the Alabama Sturgeon were one each in 1999, 2000, and in 2007.

River sturgeons (*Scaphirhynchus* spp.) require extensive areas of flowing water habitats to complete their life cycle. The decline of collection records and anecdotal accounts of captures of Alabama Sturgeon over the past century coincides with construction of dams and the cumulative loss and fragmentation of riverine habitat in the Mobile River Basin over time. These habitat changes, coupled with what is known about life history requirements and life span of other species of river sturgeon, suggest that the Alabama Sturgeon may be close to extinction.

Species' Description and Taxonomy

The Alabama Sturgeon is a member of the family Acipenseridae, which includes eight native North American sturgeon species, three of which occur in the Mobile River Basin. These include the Alabama Sturgeon, Gulf Sturgeon (*Acipenser oxyrinchus desotoi*), and Lake Sturgeon (*A. fulvescens*). There are two records of White Sturgeon (*Acipenser transmontanus*) taken from the Coosa River system (M. Pierson, APC, pers comm., 2005; Dan Catchings, ADCNR, pers comm. 2005), however, the White Sturgeon is native to the Pacific slope of the United States and both records are considered to be escapes from a North Georgia private aquaculture facility where the species is reared for commercial purposes.

The Mobile Basin's three native sturgeon species differ morphologically and genetically, and have different life history requirements. The Lake Sturgeon (*A. fulvescens*) is widespread in the United States and Canada (Mettee *et al.* 1996; Boschung and Mayden, 2004), but is only known in the Mobile River Basin from historical records in the upper Coosa River. Lake Sturgeon spend their entire lives in freshwater, unlike other species of *Acipenser*, which are anadromous – migrating into marine environments as young adults and returning to freshwater to spawn. The Lake Sturgeon has been recently reintroduced into the upper Coosa River in Georgia in an attempt to re-establish the species into

historical habitat. Additional information about this program can be found at the following website, (http://georgiawildlife.dnr.state.ga.us). The historical and current range of Lake Sturgeon in the Mobile River Basin is now separated from the range of the Alabama Sturgeon by 5 major dams on the Coosa River.

The Gulf Sturgeon is an anadromous species that migrates up rivers, including those of the Mobile River basin, from the Gulf of Mexico to spawn. Although its' range overlaps with that of the Alabama Sturgeon, the Gulf Sturgeon is considerably larger than the Alabama Sturgeon (obtaining lengths up to 4.3 m (14 ft)) and is easily separated by characters. Some of these include the number of lobes on the lower lip, its color (the Gulf Sturgeon is light brown to dark brown), the shape of the snout (the Gulf Sturgeon does not have the flattened shovel-shaped snout characteristic of the Alabama and shovelnose Sturgeons), and the lack of a filament on the upper part of the caudal fin (Mettee *et al.* 1996; Boschung and Mayden, 2004).

The Alabama Sturgeon is in the genus *Scaphirhynchus*, which also contains two other species: the Shovelnose Sturgeon (*S. platyrhynchus*), and the Pallid Sturgeon (*S. albus*), neither of which occur in the Mobile River basin. The Alabama Sturgeon is endemic to rivers of the Mobile River Basin below the Fall Line (Metee *et* al., 1996; Boschung and Mayden 2004; Kuhajda, 2002). The Alabama Sturgeon is a small, elongate fish growing to about 80 centimeters (cm) (31 inches (in)) in length. It is the smallest of all the North American sturgeons, typically weighing only 1 to 2 kilograms (kg) (2 to 4 pounds (lbs.)) at maturity. The head is broad and flattened shovel-like at the snout, with a tubular and protrusive mouth. As with all sturgeon species, there are four barbels (whisker-like appendages) located on the bottom of the snout in front of the mouth that are used to locate prey. The body is lined with five rows of bony plates called scutes. Bony plates also cover the head, back, and sides, and the body narrows abruptly to the rear forming a narrow stalk between the body and tail. The upper lobe of the tail fin is elongated and ends in a long filament. Coloration of the upper body is light tan to golden yellow, with a creamy white belly.

The Alabama Sturgeon was first recognized in the literature as an isolated population of the Shovelnose Sturgeon (Chermock 1955). It was not until 1976 that Ramsey referred to the species as the "Alabama shovelnose" sturgeon. The species was formally described by Williams and Clemmer in 1991, with the Alabama River just upstream of the mouth of Little River, Monroe County, Alabama, designated as the type locality (a detailed taxonomic hierarchy and list of museum specimens used in the Alabama Sturgeon's formal description in included in Appendix I). Critics of Williams and Clemmer (1991) questioned the genetic and morphological distinctions between the Alabama and Shovelnose Sturgeon, and identified a variety of statistical and methodological errors and limitations of the original description (e.g., small sample size, clinal variation (characteristics of a species correlated with changing ecological variables), allometric growth (growth of parts of an organism at different rates and at different times), and inappropriate statistical tests (65 FR 26438). In 1996, many of these errors were corrected or addressed in a reexamination of the species by Mayden and Kuhajda (1996). New genetic techniques were also employed to examine relationships within the genus by

Campton *et al.* (2000). Today, the Alabama Sturgeon is considered a valid species both nationally and internationally.

Life History/Habitat Preferences

Spawning locations, preferences, cues, and other aspects of Alabama Sturgeon life history are unknown. Due to this absence of information, Williams and Clemmer (1991) as well as Mayden and Kuhajda (1996) had to rely on collection history along with information on its better known sister species, the Shovelnose Sturgeon, to deduce aspects of Alabama Sturgeon life history. The life history of the Shovelnose Sturgeon has also since been summarized by Keenlyne (1997), and other new information has recently been developed on aspects of the life history of both the shovelnose and its other sister species, the Pallid Sturgeon (e.g., Braaten and Fuller 2005, Kynard *et al*., 2005). Based on a review of collection history and information available on other closely related species, life history and habitat preferences of Alabama Sturgeon are summarized as follows:

Reproductive Biology: It is likely that Alabama Sturgeon migrate upstream during late winter and spring to spawn. The capture of 12 individuals (including several gravid females) during a single collection trip near the mouth of the Cahaba River on 21 March 1969 suggests directional movements during the spawning season (Williams and Clemmer, 1991). Gravid Alabama Sturgeon females with ripe eggs have also been collected during late March, April and early May, which may indicate prolonged spring spawning or yearly variations in the occurrence of preferred spawning temperatures. Actual timing of spawning during this period may also vary depending on temperature and river discharge. All sturgeon species produce eggs that are adhesive and require current for proper development. Although specific locations have not been identified, eggs are presumably deposited on hard bottom substrates such as bedrock, armored gravel, or channel training works in deep water areas, and possibly in some larger tributaries. Some sampling efforts have been conducted in portions of the lower Alabama River to capture Alabama Sturgeon larvae; however, none have been successful.

Age and Growth: Sexual maturity of the Alabama Sturgeon is believed to occur between 5 to 7 years of age. Spawning frequency of both sexes is likely influenced by food supply and fish condition, and presumably like other Shovelnose Sturgeon, may only occur at 2-3 year intervals (Mayden and Kuhajda 1996). Life span of the Alabama Sturgeon is unknown. Although few individuals probably exceed 12 to 15 years of age (Mayden and Kuhajda 1996), it is possible the species may live longer. Age determination was attempted on three preserved specimens by three different examiners using pectoral fin ray analysis; however, while all examiners agreed that the smallest sturgeon examined was two years old, no clear consensus on aging the larger specimens was attained. A 0.9 kg gravid female was at least 7 years old, and a 1.6 kg sturgeon was at least 10 years old (Burke and Ramsey, 1985). The individual collected in 2007 by the ADCNR was the second largest specimen ever collected (72 cm total length, 28.3 inches).

As with most riverine sturgeon, spawning is likely initiated by environmental cues such as, temperature, photoperiod, and an increase in river discharge during the late winter and early spring. The development of numerous large-river impoundments in the Mobile Basin may influence these cues (Mayden and Kuhajda 1996). Following spawning, *Scaphirhynchus* species larvae require highly oxygenated, flowing water for development. The larvae are planktonic, drifting with river currents for 12 to 13 days after hatching, and exhibit a swim-up and drift behavior while floating in currents (Kynard *et al*., 2005). Research indicates that Pallid Sturgeon larvae (*Scaphirhynchus albus*) can drift more than 200 km (125 mi) during the first 11 days of the larval life stage, depending on water velocities, before settling to a benthic existence (Braaten and Fuller 2005). This information suggests that Alabama Sturgeon may require some minimum distance of flowing river conditions for development of larval to juvenile stage, and for sustainable recruitment of the species.

Diet and Feeding Habitats: The examination of stomach contents of museum and captured specimens indicate that sturgeons feed in a broad range of habitat, including shallow water in swift currents, and maybe even in the water column. However, they generally tend to be opportunistic bottom feeders primarily preying on aquatic insects, plant material, and mollusks (Mayden and Kuhajda, 1996; Williams and Clemmer, 1991; Burke and Ramsey, 1985; Haynes *et al.*, 2005; and Keevin *et al.*, 2007); however, commercial fisherman report that sturgeon have been taken on trotlines using a variety of bait, including poultry parts, fish, and commercially prepared bait (Williams and Clemmer 1991). Taylor (2004) found that juvenile Shovelnose Sturgeon overwhelmingly preferred feeding in sandy substrates and actively avoided gravel areas. This behavior may also be displayed by Alabama Sturgeon (Keevin *et al.*, 2007).

Post-spawning downstream movements of Shovelnose Sturgeon have also been documented (Delonay, 2005). Adult Alabama Sturgeon may exhibit seasonal downstream migrations in search of feeding and summer refugia. Burke and Ramsey (1995) determined that Alabama Sturgeon were rare or absent from the free-flowing sections of the Mobile Delta and the lower Tombigbee River during the early 1980s, due to factors such as low flow and salt water intrusion. Therefore, downstream movements may currently be limited to the lower Alabama River.

Habitat Preferences: Very little is known of the habitat requirements of the Alabama Sturgeon. Based on capture data, it inhabits the main channel of large coastal plain rivers of the Mobile River Basin. Most specimens have been taken in moderate to swift current at depths of 6 to 14 m, over sand, gravel or mud bottom (Williams and Clemmer 1991). Similar preferences have also been observed in Shovelnose Sturgeon (Hurley *et al*., 1987; Curtis *et al*. 1997). The COE identified 30 locations on the Alabama River where 58 Alabama Sturgeon were reportedly captured between 1950 and 1998, and documented channel morphology and substrate types at 12 of the capture locations during low flow conditions. Substrates correlated with these capture sites included sand, gravel and limestone outcrops. All capture locations downstream of Claiborne Lock and Dam (L&D) were either on or within 300 meters of a sandbar. Most historical and recent sturgeon capture sites are at or near features presumably associated with feeding,

reproduction, or refugia and include, rock walls, channel training devices, deep pools, mussel beds, confluence with tributaries, and/or stable sand and gravel bottoms (Burke and Ramsey 1985; Mayden and Kuhajda 1996; Hartfield and Garner 1998; and Rider *et al*., 2009). The presence of mussel beds represents stable channel habitats with high aquatic invertebrate diversity and density that are likely important feeding areas for sturgeon; deeper holes and lower reaches of tributary streams may be used as thermal refugia during times of low flow (Hartfield and Garner 1998; Rider *et al*., 2009). Data collected from a radio-tagged Alabama Sturgeon released in 1985 near Millers Ferry L&D on the Alabama River and tracked for four months, showed that its preferred position was in swift current at 7.7 to 12.3 m (25 to 40 ft), but never at the deepest part at any location except where bottom contour was uniform (Burke and Ramsey, 1985). Irwin (2005) and Kynard (2000) found that adult Shovelnose Sturgeon are more active at night, but their habitat preferences did not vary from day to night. This type of behavior was also observed in juvenile Shovelnose Sturgeon (Kynard *et al.*, 2002). According to Rider *et al*. (2009), the Alabama Sturgeon collected in 2007 that was sonic tagged and tracked between April 2007 and June 2008, displayed varied movement patterns. During the summer months, the fish was stationary and resided around the confluence of a small spring-fed creek (Sizemore Creek) in the lower Alabama River. Water temperatures in Sizemore Creek were typically 4-5^{0}C cooler than the Alabama River, which suggests the area was being used as a thermal refuge. Movement was greatest during the spring as the fish was presumably attempting to make an upstream spawning run. The greatest movement was associated with water temperatures between 16 and 21^{0}C, and no clear correlations were made between upstream movement and increased river discharge.

Distribution and Abundance

Historical (pre-1990): The Alabama Sturgeon's historical range included nearly 1,600 kilometers (km) (1,000 mi) of riverine habitat in the Mobile River Basin in Alabama and Mississippi. There are records of Alabama Sturgeon from nearly all the major rivers in the Mobile River Basin including the Black Warrior, Tombigbee, Alabama, Coosa, Tallapoosa, Mobile, Tensaw, and Cahaba Rivers (Burke and Ramsey 1985, 1995) (Figure 1).

Alabama Sturgeon were once fairly abundant within this range. In a report to the U.S. Commission of Fish & Fisheries (USCFF 1898), the total commercial catch of “shovel-nose” sturgeons (i.e., Alabama Sturgeon) from Alabama was reported at 19,000 kilogram (kg) (42,900 pounds (lb)), of which, 18,000 kg (39,500 lb) was from the Alabama River and 1,000 kg (2,300 lb) from the Black Warrior River. Assuming that an average mature Alabama Sturgeon weighs about 1 kg (2 lb), the 1898 commercial catch would have totaled nearly 20,000 fish. This indicates a substantial historical population of Alabama Sturgeon.

The first documented record of a *Scaphirhynchus* species from the Mobile Basin was taken from the Alabama River, near Montgomery in 1880. The specimen was deposited and catalogued in the Smithsonian Institution as an *Acipenser*, which was later confirmed

to be a misidentification (Williams and Clemmer, 1991). The first published account of a *Scaphirhynchus* from the Mobile Basin was by Chermock (1955), which was catalogued as a Shovelnose Sturgeon (*S. platorynchus*). In the mid-1970's, Ramsey noted that there were morphological differences between the Alabama and shovelnose and began referring to the species as the "Alabama" shovelnose sturgeon (Ramsey, 1976).

Very little information was published about the Alabama Sturgeon and its abundance between 1898 and the early 1980's; however, collection data and anecdotal reports from commercial fishermen indicate a general decline in distribution, as well as a reduction in population size. An anonymous article published in the *Alabama Game and Fish News* in 1930 stated that the sturgeon was "not uncommon in Alabama, though it is found more abundantly farther north." Burke and Ramsey (1995) noted that Alabama Sturgeon were frequently collected in the Cahaba and Alabama rivers in the 1960's during surveys for river redhorse (*Moxostoma carinatum*). Other collections and fisheries surveys suggest that the species had essentially disappeared from the Coosa, Tallapoosa, Black Warrior, upper Tombigbee, and upper Alabama rivers by the 1960's.

During the mid-1980s, status surveys were conducted by Burke and Ramsey (1985) to determine the distribution and abundance of the Alabama Sturgeon. Interviews with experienced commercial fisherman on the Alabama, Tombigbee, Cahaba, and in the Mobile/Tensaw Rivers found that Alabama Sturgeon were infrequently taken in Claiborne Lake, although some fishermen reported large numbers on occasion. Reports from the Millers Ferry reach suggested a decline in the years preceding the interviews. Low annual catches of sturgeon were reported in the lower Alabama River, and in the Cahaba River. According to fisherman interviewed in the upper Tombigbee/Black Warrior system, sturgeon records were extremely rare, even in the 1950s and 60s. In 1985, a single Alabama Sturgeon was captured from the Tensaw River upstream of the I-65 Bridge in a gill net. The specimen was apparently misplaced or improperly preserved; however, the specimen was positively identified, from photographs, by several reputable ichthyologists (M. Mettee, GSA, pers comm. 2005).

After evaluating their interviews, Burke and Ramsey (1985) focused their sampling efforts on areas identified by commercial fisherman as currently supporting the species. As a result, they collected five Alabama Sturgeon, including, two males, two gravid females, and one juvenile estimated to be 2 years old. They concluded that the Alabama Sturgeon was restricted to the most lotic habitats of the Alabama and Cahaba Rivers, and had been extirpated from 61 percent (1159 km or 626 mi) of its historical range. They also suggested that another 444 km (240 mi) of its historical habitat was of marginal value to the sturgeon.

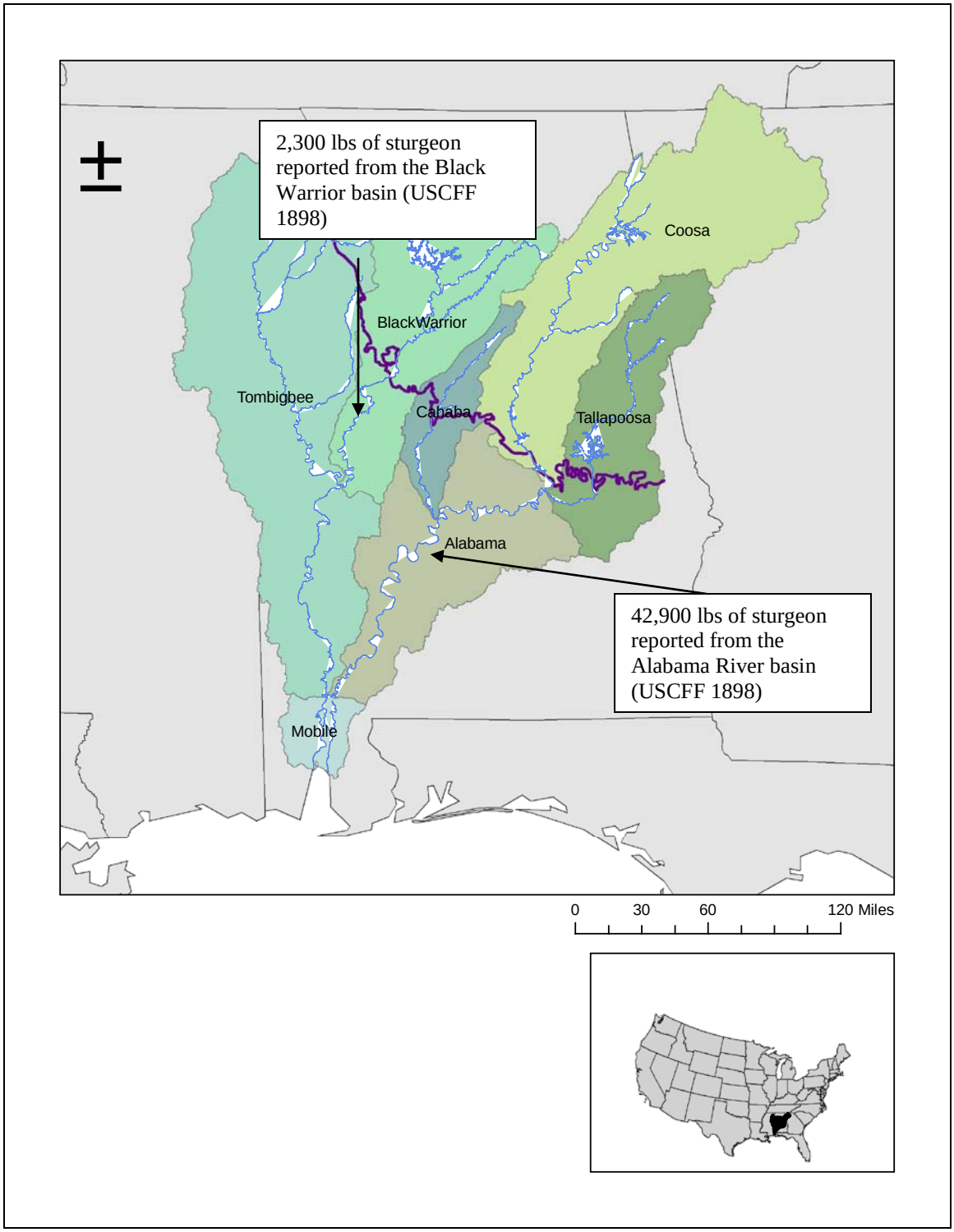
Current (post-1990): Since 1990, all reports or collections of the Alabama Sturgeon have been extremely rare, despite significant publicity and notoriety surrounding the species, and concentrated efforts to capture the species. Collections and reports have been restricted to the Alabama River and the Cahaba River. Only 9 confirmed Alabama Sturgeon captures have occurred, despite focused efforts to collect the species. Of these,

two were released apparently unharmed, five died in captivity, one is known to have died shortly after release, and the fate of one is unknown.

Between 1990 and 1994, biologists from the Alabama Department of Conservation and Natural Resources (ADCNR) and the Corps conducted searches for the Alabama Sturgeon in the Cahaba and Alabama rivers using a variety of sampling techniques, including gill nets, trotlines, and electroshocking (Tucker and Johnson 1991, 1992, 1993, 1994). These efforts resulted in the observation, but not the collection, of a single small sturgeon while electrofishing below Millers Ferry Dam. No other sturgeon were encountered. Tucker and Johnson (1992) also conducted interviews with licensed commercial fishermen, and distributed posters soliciting reports of sturgeon sightings along the lower Alabama and Cahaba Rivers. Four small sturgeon were reported from the study area by the commercial fishermen, and an additional 6 small sturgeon were reported by the general public. Tucker and Johnson, however, were unable to verify these reports or to determine whether they were Alabama Sturgeon or juvenile Gulf Sturgeon.

In 1993, ADCNR and Service biologists collected a mature male in a gill net downstream of Claiborne L&D. That specimen represented the first confirmed record of Alabama Sturgeon in about nine years, however, this fish died shortly after it was delivered to the state hatchery at Marion. On April 18, 1995, an Alabama Sturgeon which had been captured by recreational fishermen below Claiborne L&D was transferred over to

Figure 1. Map illustrating the major river basins in the Mobile River Basin.

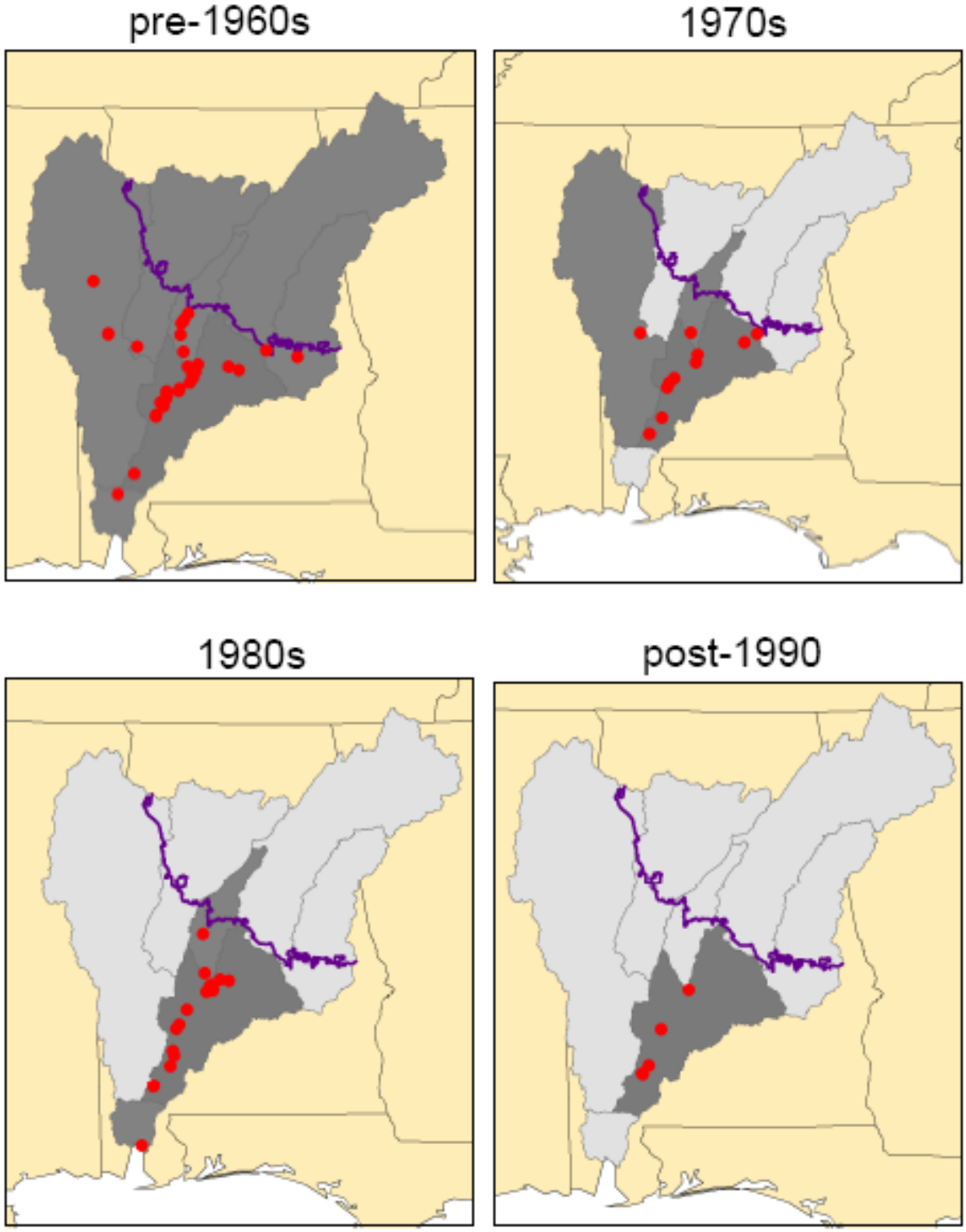


ADCNR and Service biologists. The fish was examined, radio-tagged, and returned to the river where it was tracked for four days before the signal was lost. Another Alabama Sturgeon was collected downstream of Claiborne L&D on May 19, 1995, by Service biologists. Unfortunately, shortly after this fish was tagged and released, it was found entangled and dead in a vandalized gill net lying on the bottom of the river. On April 26, 1996, a commercial fisherman caught, photographed, and released an Alabama Sturgeon in the Alabama River downstream of Millers Ferry L&D (N. Nichols, ADCNR, pers. comm., 2005).

The most intensive fishing effort to capture Alabama Sturgeon was initiated in 1997, and included fisheries biologists from the ADCNR, COE, and the Service. Since that time, more than 3,000 days (24,000 personnel-hours) of fishing effort have been logged by fisheries biologists toward collecting the Alabama Sturgeon (Rider and Hartfield 2007). As in previous efforts, commercial and recreational fishermen were asked to report any captures they encountered. Between 1997 and 1999, there were a total of five specimens collected. Since 2000, only two specimens have been collected, one captured, photographed, and released by a fisherman in the lower Cahaba River in 2000, and the other sonic tagged and released in the lower Alabama River below Claiborne L&D in 2007 (Rider et al. 2009).

The collection history of the Alabama Sturgeon, supported by anecdotal reports from commercial fishermen, suggest that the species has disappeared from at least 85 percent of its historical range, and has experienced a significant decline in the remaining range since the 1960s (Figure 2). The species has been extirpated from the upper Tombigbee, lower Black Warrior, lower Tallapoosa, upper Alabama, and middle Cahaba rivers, where it was last reported in the 1960s; the Mobile-Tensaw Delta, last reported in 1985; the lower Coosa River, last reported ca. 1970; the lower Tombigbee River, last reported ca. 1975; (Clemmer *et al.*, 1975; Burke and Ramsey 1985, 1995; Williams and Clemmer, 1991; Mayden and Kuhajda, 1996; M. Mettee, GSA, pers comm., 2005). The species continues to be only rarely collected from the lower portion of the Cahaba River and in the Alabama River from Millers Ferry Lock and Dam downstream to its confluence with the Tombigbee River (Burke and Ramsey 1985, 1995; N. Nichols, ADCNR, pers comm. 2005; Rider and Hartfield 2007; Rider et al. 2009; Rider and Powell 2009).

Figure 2. Map of the Mobile River Basin showing the decline in range of the Alabama Sturgeon. Shaded areas represent hydrologic units occupied by the species at the time reflected. Red circles represent actual locations were sturgeon were collected.



Reasons for Decline

Exploitation

The historical decline of the Alabama Sturgeon was presumably triggered by unrestricted commercial harvesting near the end of the 19th century and in the early 20th century (CAS 2000). Although there are no reports of commercial harvests of Alabama Sturgeon after the U.S. Comm. Fish & Fisheries 1898 report, it is likely that the sturgeon continued to be affected by commercial fishing, even if there was no market. For example, in the Mississippi River, the Shovelnose Sturgeon (also known as the hackleback) was once considered a nuisance species by commercial fishermen and were destroyed when caught (Coker 1930). According to local testimonies, it was common practice to break their backs or simply toss them on the bank to die. However, sometime during the early twentieth century, the rising price of sturgeon roe (used for caviar) and "hog-dressed" fish for smoking discouraged such waste in the Mississippi River (Coker 1930).

Studies of other sturgeon species suggest that newly exploited sturgeon fisheries typically show an initial high yield followed by rapid declines (CAS 2000). Almost all sturgeon species throughout the country experienced dramatic range-wide declines from historical abundance levels around the turn of the 19th/20th centuries (1880-1930) due to over-fishing, habitat loss and watershed development. With continued exploitation and habitat loss, there has been little or no subsequent recovery (Birstein 1993). That same phenomenon apparently occurred in the Mobile River basin with the Gulf, lake, and Alabama Sturgeon. Even so, interviews with fisheries biologists and commercial and recreational fishermen along the Alabama River indicated that Alabama Sturgeon continued to be taken into the 1980s incidental to the harvest of other commercial species (Burke and Ramsey 1985).

Habitat Alteration

Although commercial harvesting may have significantly reduced sturgeon numbers initially, the more recent decline in the Alabama Sturgeon's range and numbers, since 1960, is more likely the result of cumulative impacts as the rivers of the Mobile River basin were developed for navigation, hydropower production, flood control, recreation, waste assimilation and other human uses (65 FR 26438). A decline of Shovelnose Sturgeon in the Mississippi River reportedly coincided with the development of that river for navigational purposes (Barnickol and Starrett 1951). Nevertheless, while these existing structures and activities appear to be permanent in the Mobile Basin, the present effects of their operations, such as, flow regulation, and navigation maintenance activities on the Alabama Sturgeon are poorly understood.

Impoundments: The majority of rivers in the Mobile River basin are now controlled by more than 25 locks and/or dams forming a series of impoundments that are interspersed with short, free-flowing reaches (Figure 3 and Table 1). Within the Alabama Sturgeon's historical range there are three dams on the Alabama River (completed between 1969 and 1971), two on the Black Warrior River (completed by 1971), and six on the Tombigbee

River (Figure 3) (completed between 1955 and 1985). These 11 dams impounded and fragmented over 583 miles (970 km) of riverine habitat once occupied by sturgeon. Riverine (flowing water) habitats are required by the Alabama Sturgeon to successfully complete its life cycle (see Life History, above). Therefore, it is unlikely that Alabama Sturgeon habitat and life cycle requirements can be met in impoundments, where decreased flows typically cause silt and other fine sediments to accumulate over bottom habitats, creating unsuitable conditions for spawning, feeding, and larval development.

Prior to the construction of locks and dams (L&Ds) in the Mobile Basin, Alabama Sturgeon could move freely between feeding areas, and from feeding areas to sites that were suitable for spawning and development of eggs and larvae. Additionally, the sturgeon may have also used large tributary streams or deep mainstem pools as thermal refugia during the summer months. Sturgeon movements were likely extensive and covered long distances. Other *Scaphirhynchus* species like the pallid (*S. albus*) and shovelnose (*S. platorynchus*) have been reported to migrate greater than 250 km (155 mi) (Moos 1978, Bramblet 1996, Delonay *in litt.* 2005).

With their migration routes impeded by dams (Figure 3), isolated subpopulations of Alabama Sturgeon were unable to successfully recruit adequate numbers to replenish the population. Reduced numbers of recruited sturgeon and surviving adult fish became more vulnerable to localized declines in water and habitat quality caused by hydropower releases, local riverine and land management practices, or by polluted discharges. Dams also reduced the possibility that sturgeon could re-colonize certain areas when subpopulations became extirpated (CAS 2000).

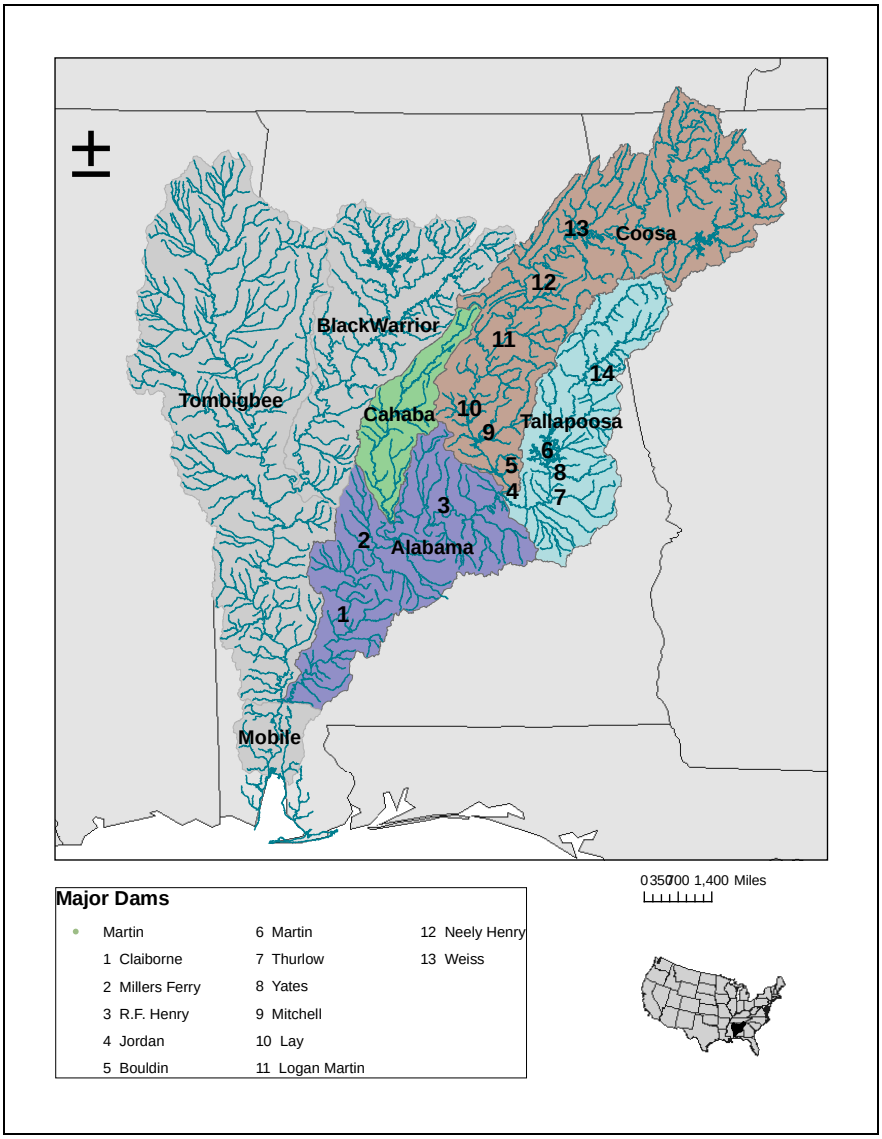
The extirpation of Alabama Sturgeon from specific drainages appears to coincide directly with impoundment construction and operation. The earliest dams constructed within the range of the species were in the Tombigbee and Black Warrior rivers (Demopolis L&D, 1928; Selden L&D, 1946; Coffeeville L&D, 1960), where Alabama Sturgeon were last reported in the 1960s. By the 1960s, only the Alabama and Cahaba rivers provided an extensive length of unimpounded large river habitat in the Mobile River Basin. The last reported captures of Alabama Sturgeon from the lower Coosa/Tallapoosa and upper Alabama rivers (1960-70) coincide with construction of R.F. Henry L&D (1971), which impounded the river almost to the Fall Line in the Coosa River. Construction of Bouldin Dam (1967) resulted in a significant reduction of flows from Jordan Dam into the lower Coosa River and the extreme upper Alabama River.

Although Alabama Sturgeon continued to be reported from the lower Alabama and Cahaba Rivers, the decline in abundance of these populations is related to the construction of Claiborne L&D (1969) and Millers Ferry L&D (1970) and the loss and fragmentation of habitat within that reach. Reports and captures of Alabama Sturgeon from the lower Alabama/Cahaba rivers declined precipitously from the mid-1980s to the present. Given that the average lifespan of adult Alabama Sturgeon is probably 12 to 15 years (Mayden and Kuhajda 1996), the timing of dam construction coincides with a reduction in successful recruitment, along with attrition of the small, limited adult Alabama Sturgeon population due to natural mortality. Similar declines have been

reported for other species when populations fall below sustainable levels (e.g, Soule, 1987; Belovsky, 1987; Schaffer, 1987).

Recruitment failure has also been reported in Pallid Sturgeon from fragmented habitats in the upper Missouri River (U.S. Fish and Wildlife Service 1991). Pallid Sturgeon populations isolated by major impoundments and restricted to less than 300 km (240 mi) of riverine habitat conditions have experienced total recruitment failure over the past few decades (e.g., U.S. Fish and Wildlife Service 1991, Braaten and Fuller 2002).

Figure 3. Map illustrating the major dams within each major river basin.



The lower Alabama River extends for only 216 km (130 mi) below Millers Ferry L&D, and this reach is bisected by Claiborne L&D. The lower Cahaba flows freely 137 km (85 mi) to the impounded Alabama River. Although there is evidence of some recruitment of

Alabama Sturgeon within these areas, larval and juvenile sturgeon survival may be reduced by the limited extent of riverine conditions and ultimately inadequate to offset natural mortality.

Table 1. Major lock and dams constructed in the historic range of the Alabama Sturgeon. Refer to figure 1 for locations.

Reference number (Figure 1)	Dam (name)	Date completed	Reference number (Figure 1)	Dam (name)	Date completed
0	* Claiborne Lock and Dam	1969	13	Weiss Dam	1961
1	* Coffeeville Lock and Dam	1960	14	R.L. Harris Dam	1982
2	* Millers Ferry Lock and Dam	1970	15	* Demopolis Lock and Dam	1928
3	* R.F. Henry Lock and Dam	1971	16	* John C. Heflin Lock and Dam	1978
4	* Walter Bouldin Dam	1967	17	* Tom Bevill Lock and Dam	1979
5	* Jordan Dam	1929	18	* Selden Lock and Dam	1946
6	Martin Dam	1926	19	* William Bacon Oliver Lock and Dam	1940
7	Yates Dam	1928	20	Holt Lock and Dam	1976
8	Thurlow Dam	1930	21	Lewis Smith Dam	1960
9	Mitchell Dam	1923	22	John Hollis Bankhead Lock and Dam	1928
10	Lay Dam	1914	23	* Columbus Lock and Dam	1978
11	Logan Martin Dam	1964	24	* Aberdeen Lock and Dam	1981
12	H. Neely Henry Dam	1966	1966		

(Source, Johnson *et al*. 2000)
* Locks and dams within the historic range of the Alabama Sturgeon (i.e., those lying below the Fall Line)

Small Population Size and Genetic Consequences

The primary problem currently affecting the Alabama Sturgeon is its small population size and its apparent inability to offset mortality rates with current recruitment rates. As noted previously, incidents of capture of Alabama Sturgeon have been steadily diminishing for the past two decades. Although there are no population estimates available for the Alabama Sturgeon, recent collection efforts demonstrate its increasing rarity (see Distribution and Abundance, above). Over the past 15 years, only nine Alabama Sturgeon have been reported or captured, despite its relatively narrow range and extensive publicity surrounding the species. Intensive efforts to collect broodstock for propagation during the past decade resulted in the capture of only five sturgeon, four of which died in captivity, and one was released unharmed in 2007 with a 48-month radio-tracking tag.

Franklin (1980) has estimated that an effective population size of at least 50 individuals is necessary for the conservation of genetic diversity and the avoidance of short term inbreeding effects in randomly mating populations of animals. He also considered that an effective population size of at least 500 individuals is needed to avoid the deleterious effects of genetic drift over several generations. It is possible that Alabama Sturgeon currently number fewer than 50 individuals and it is unknown if there is even enough riverine habitat to support 500 individuals. For example, in a short 280 km (174 miles) reach of the upper Missouri River isolated by dams, Pallid Sturgeon have apparently experienced total recruitment failure for the past several decades. Yet Pallid Sturgeon have continued to be captured with sufficient regularity to estimate population size. Following 15 years of mark/recapture sampling, approximately 45 wild Pallid Sturgeon are estimated to continue to survive in this reach (Gardner 2004). In contrast, more regular and intensive sampling of the 216 km (134 miles) reach of the lower Alabama River has produced only eight Alabama Sturgeon captures over the same time period. While river conditions and capture susceptibility may vary to some degree between the two river reaches and the two species, these data suggest Alabama Sturgeon are very few in numbers, may currently experience short term inbreeding effects, and are possibly subject to long-term deleterious effects through loss of genetic variation.

Conservation Measures

Several conservation efforts, including those by State and Federal agencies, universities, and private organizations have been implemented since about 1990 in an attempt to prevent further population declines and extinction of the Alabama Sturgeon. These include, (1) a report jointly prepared by the COE and Service to address COE activities in the Alabama River, (2) a conservation plan developed by the ADCNR, (3) a voluntary conservation agreement and strategy prepared by the COE, ADCNR, Alabama-Tombigbee Rivers Coalition, and the Service, (4) a multi-species recovery plan for the Mobile Basin, (5) a sturgeon sound detection study, (6) creation of a national repository for tissues and specimens, and (7) a habitat and feeding investigation.

The White Paper (Biggins 1994)*:* In 1994, a document entitled, "Activities That May Affect the Alabama Sturgeon and the Anticipated Section 7 Consultations on These Activities", was developed jointly by the Corps and the Service (Appendix II). The purpose of the document was to address routine and anticipated Federal actions in the lower Alabama River that could impact the Alabama Sturgeon. Specifically, the paper addressed, (1) maintenance dredging by the Corps to remove rock shelves, (2) use of training devices (e.g., channel-training dikes, jetties, sills, and revetments) by the Corps, (3) maintenance dredging for non-Federal activities, (4) changes in river flow patterns, (5) State water quality standards, (6) extraction of coalbed methane, (7) in-stream gravel mining, and (8) other regulatory activities (e.g., pipelines, piers, wharfs, and small boat channels) of the COE. This review was published in the final rule listing the Alabama Sturgeon as endangered (65 FR 26458).

***1997 Conservation Plan*:** In 1996, the ADCNR, Service, and other partners developed a conservation plan for the Alabama Sturgeon that attempted to address the most immediate threat to the species, its small population size. The immediate focus of the plan was to prevent extinction through a captive breeding program and release of propagated fish. Other objectives of the plan included genetic conservation, habitat restoration, and determining life history information essential to effective management of the species. Broodstock collection efforts began in March 1997 and the ADCNR hatchery at Marion, Alabama, was upgraded to accommodate sturgeon propagation. Five Alabama Sturgeon were captured between 1997 and 1999 and an unsuccessful attempt to spawn captive sturgeon was conducted during March 1999. All five fish died from unknown causes after being held in captivity from a few days to almost 5-years; however Service and State biologists were able to cryopreserve genetic material from the last Alabama Sturgeon in captivity prior to its death in August 2002. This genetic material will be available for propagation activities once a mature female is captured. Studies were initiated in 1997 to identify and quantify stable riverine habitat in the Alabama River, and to develop strategies for its management; however, to date (spring, 2007), these studies have only been partially completed. Life history and habitat studies were also initiated in 1997, including habitat characterization at historical sturgeon collection sites, prey density studies, and larval sturgeon surveys. Due to difficulty in capturing specimens, these tasks have only been partially completed. To date, the 1997 Conservation Plan has not been effective in decreasing the threat of extinction to the species to the point where protection under the ESA is not necessary.

2000 Conservation Agreement and Strategy: On February 9, 2000, (prior to listing) the ADCNR, COE, Alabama-Tombigbee Rivers Coalition, and Service initiated a formal 10-year Conservation Agreement and Strategy (CAS) for the Alabama Sturgeon (CAS 2000). The goal of the CAS was to eliminate or significantly reduce current threats to the Alabama Sturgeon and its habitat. To attain this goal, the following objectives were identified: (1) restore and maintain sufficient numbers of Alabama Sturgeon in the lower Alabama River to ensure long-term survival through hatchery propagation and augmentation; (2) identify and protect existing occupied habitat quantity and quality; (3) develop information on the sturgeon's life history and habitat needs; and (4) apply this information to implement appropriate conservation measures and adaptive management strategies for the Alabama Sturgeon and its habitat. However, the effectiveness of these efforts in removing existing threats remains unproven and is dependent upon many factors, some of which are beyond human control. The Alabama-Tombigbee Rivers Coalition discontinued their participation in the CAS following the listing of the sturgeon under the ESA, and COE broodstock collection efforts have been decreased due to budgetary and other considerations.

As noted previously, ADCNR and Service efforts to capture and propagate Alabama Sturgeon have been partially successful. Specific actions that were identified and have been completed under the 1997 Conservation Plan and the CAS include:

Development of a Hatchery Program: Since 1997, a voluntary five-year $2-million conservation effort to capture and propagate Alabama Sturgeon has been implemented

and coordinated by the ADCNR. Facilities have been constructed, and equipment purchased to hold and propagate Alabama Sturgeon at the ADCNR's Marion Fish Hatchery. Methods to determine sexual reproductive status have been developed and successfully used with captive fish, and propagation methods and protocols have been identified. Hatchery personnel have also been trained in handling, sexing and propagating sturgeon (Conte *et al.* 1988). Mature male and female sturgeon captured during 1997 were induced to spawn on March 27, 1999. The female produced over 4,000 mature eggs; however, the male failed to produce sperm and the fertilization attempt was unsuccessful. Subsequently, the female died from a bacterial infection that was apparently triggered by the spawning process. The male died on August 16, 2002 at the Marion Hatchery from unknown causes. The individual collected in 2007 was transferred to the Marion Hatchery for gender verification, tagging, and later released.

Broodstock Collection: The most critical component in protecting the sturgeon is being able to successfully collect broodstock. ADCNR, with federal funding provided through the Service, has provided the majority of manpower for this effort. In addition, personnel from the COE, Geological Survey of Alabama (GSA), Alabama Power Company (APC), and the Service have also provided various levels of assistance. These organizations have collectively logged more than 2,447 days (24,000 personnel-hours) of fishing effort to collect Alabama Sturgeon broodstock. Successful protocols have also been established for handling and transporting captured sturgeon (ADCNR, unpublished report, 1997).

Habitat Protection Studies: Alabama Sturgeon spawning, feeding and refuge habitats, and other life history requirements are not currently documented and must be identified and prioritized for effective species management and protection. Until these essential basic requirements are understood, management strategies that focus on riverine habitat protection, stability, and water quality have been emphasized. Numerous federal and state actions and regulatory activities have been reviewed for effects on Alabama Sturgeon. One such action was the White Paper (Biggins, 1994) as described above. Other coordinated studies have been conducted by the ADCNR, COE, and Service to identify and quantify existing stable riverine habitats in the lower Alabama (Hartfield and Garner 1998, Irwin *et. al*. 2005). The COEs Alabama River Navigation Maintenance Dredging Program was also examined for its effects on stable instream habitats. This examination, as indicated in Biggins (1994), suggests that there is no evidence that maintenance dredging for navigation currently constitutes a limiting factor to the Alabama Sturgeon or its habitat. The location of mussel beds, which are characterized as stable sections of the channel, have also been identified and delineated for avoidance during dredging activities (Hartfield and Garner 1998). Bathymetric data has been developed by the COE for the lower Alabama River downstream of Claiborne L&D and in the Claiborne pool. Habitat attributes at historical sturgeon collection sites and bathymetry data of the lower Alabama River have been partially compiled into a GIS database (Irwin *et al.* 2005).

Life History Studies: Prey density studies and larval fish surveys have been partially completed in the lower Alabama River (Irwin *et al.* 2005). Additional information has also been developed for the shovelnose and Pallid Sturgeon in the Mississippi River

Basin as a result of other existing hatchery programs and surveys for those species. This information is being examined for its applicability to the Alabama Sturgeon.

Mobile River Basin Aquatic Ecosystem Recovery Plan: The Mobile River Basin Aquatic Ecosystem Recovery Plan (USFWS 2000) is a multi-species recovery plan developed by the Mobile River Basin Coalition (Coalition). The Coalition is a partnership composed of diverse business, environmental, private landowner, and agency interests that was originally organized to develop a basin-wide recovery plan for 15 listed aquatic species in the Mobile River Basin. The Plan, approved in November 2000, outlines the recovery strategies for 22 aquatic species including 4 fish and 18 mollusks. The Plan also compliments existing recovery plans for 17 other listed aquatic species in the Basin. The timely implementation of this Plan has the potential to benefit all aquatic species in the Basin, including the Alabama Sturgeon (USFWS 2000). All aquatic habitats, including sturgeon habitat, have and will continue to benefit from measures outlined in the Plan if properly implemented.

Sound Production Studies in Sturgeon: Research has been conducted to investigate sound production in the genus *Scaphirhynchus* to determine the possibility of developing acoustical monitoring techniques that can be used in the field for locating Alabama Sturgeon (Johnston and Phillips, 2003). The study consisted of recording trials of reproductively mature, captive held species of *Scaphirhynchus* during the spawning season and analyzing and describing differences of the fish that were successfully recorded. Research determined that Pallid Sturgeon (*S. albus*) and hybrid shovelnose X Pallid Sturgeon (*S. platorynchus* X *S. albus*) produce sounds during the breeding season. These signals may be helpful in efforts to locate populations of sturgeon in the field, including the Alabama Sturgeon. However, this work has not yet been applied to this species.

Creation of a Repository for Alabama Sturgeon Tissues and Specimens: The University of Alabama Ichthyological Collection (UAIC) is currently the National Repository for all *Scaphirhynchus* material, including the Alabama Sturgeon. Established in 2003, the UAIC stores tissue samples for molecular and biochemical studies and whole specimens for morphological examinations. Storage of these materials ensures the long-term maintenance and availability of the materials for the scientific community. Isolated and stored genomic DNA has also been processed from specimens for use in the scientific community. The availability of museum specimens and a tissue collection facilitates studies in population genetics, viability, and conservation studies.

Habitat Evaluation Studies: Preferred habitat features for adult and juvenile Alabama Sturgeon were investigated by Irwin *et al.* (2005). Using Shovelnose Sturgeon as a surrogate species, Irwin et al. (2005) observed habitat preferences and feeding behavior in a simulated riverine environment (i.e., re-circulating tank). Results indicate that juvenile sturgeon prefer sandy habitats over gravel habitats. Irwin *et al.* (2005) also evaluated riverine habitat features associated with historical and current Alabama Sturgeon capture sites, including the location of mussel beds (i.e., stable channel habitats)

and the quality of benthic macroinvertebrates in those areas. Results suggest that historical and current capture sites were associated with mussel beds and that the quality of macroinvertebrates was higher in those areas than in non-stable areas. These results may aid in selecting future sample sites for juvenile and adult Alabama Sturgeon.

Part II. Recovery

Recovery Strategy

The primary threats currently facing the management and conservation of Alabama Sturgeon are its low numbers and its inability to offset mortality with natural reproduction and recruitment. Therefore, the strategy of this recovery program is to increase the number of individuals in the population through hatchery propagation, protect existing riverine habitat, and pursue fish passage at dams on the Alabama River.

Recovery Objectives

The primary recovery objective for the Alabama Sturgeon is to prevent its extinction by establishing a captive broodstock population, and producing hatchery raised fingerlings for population augmentation in areas that continue to sustain the species. Expanding the range of the species into historically occupied river reaches is not currently considered feasible due to the extensive alteration of those areas by impoundment. The long-term recovery objective is to downlist the Alabama Sturgeon to threatened status when viable populations exist in the Alabama and Cahaba rivers. Delisting is not currently foreseeable due to extreme curtailment of range and extensive modification to the riverine habitats.

Other objectives include developing better understanding of Alabama Sturgeon life history and habitat requirements, and applying that knowledge to improve conditions in the lower Alabama and Cahaba rivers to a degree that a viable population of the species can survive.

Population Criteria for Reclassification to Threatened Status

Little is known of the Alabama Sturgeon other than it is extremely rare, declining in numbers, and the surviving population is apparently unable to offset mortality with natural recruitment. Therefore, downlisting will be considered when that trend has been reversed, and a viable population occurs within the Alabama and Cahaba Rivers (see priority recovery-management areas below). A viable population is defined as a wild reproducing population which naturally sustains itself, and is large enough to maintain sufficient genetic variation to enable the species to evolve and respond to natural changes in the riverine environment without human intervention. Viable populations are represented by multiple age classes of individuals, including naturally recruited juveniles.

There is some evidence that Alabama Sturgeon may currently number fewer than 50 individuals (see: Part I: *Reasons for Decline: Small Population Numbers and Genetic Consequences*, above). It has been estimated that in randomly mating populations of vertebrate animals, an effective population size of at least 500 individuals is needed to

avoid deleterious effects of genetic drift over several generations (Franklin, 1980). Therefore, downlisting may be considered when the following criteria are met:

1. A population consisting of approximately 500 sexually mature Alabama Sturgeon is shown to be surviving and naturally reproducing in the Alabama/Cahaba Rivers.

2. Population studies show that the Alabama Sturgeon population is naturally recruiting (consisting of multiple age classes) and sustainable over a period of 20 years (2-3 generations), and no longer requires hatchery augmentation.

3. An agreement is in place and completed with the U.S. Army Corps of Engineers and the Alabama Power Company to ensure adequate flows are being delivered down the Alabama River to allow for successful development of sturgeon larvae, and that fish are being successful being passed both upstream and downstream at dams on the Alabama River

All recovery tasks identified in the *Recovery Narrative*, below are necessary to successfully address these benchmarks.

Listing/Recovery Factor Criteria

The following criteria (Factors A through E) are linked to specific recovery tasks and will serve to measure progress in removing threats to the species.

Factor A: **The present or threatened destruction, modification, or curtailment of its habitat or range.**

In order to achieve the Alabama Sturgeon population criteria threats to its habitat must be addressed as specified under this factor. The Alabama Sturgeon has declined and has experienced significant curtailment of its range due to extensive habitat modifications to its' historical habitats (e.g., dam construction, changes in natural flow regimes, navigational channel dredging). Many of these modifications are essential components of the human economic infrastructure and are unlikely to be eliminated or significantly modified within the foreseeable future. However, there is existing technology that may be implemented to mitigate for some of their impacts, such as facilitating movement of sturgeon over dams, and improving flows and water quality.

The following tasks shall serve to indicate a reduction in habitat threats:

1. Remaining riverine habitat in the Alabama/Cahaba River has been monitored and protected. Recovery Tasks 3.1-3.6, 4.1, and 4.3 will contribute to this criterion.

2. Habitat requirements for Alabama Sturgeon in the Alabama/Cahaba River are defined and are shown to be considered by agencies/partners responsible for

working to recover the Alabama sturgeon in the Mobile River Basin. Recovery Tasks 1.1, 4.1-4.2, and 5.1 will contribute to this criterion.

3. Sturgeon movements in the lower Alabama River and between the Priority Recovery-Management Areas, identified below, have been considered by agencies/partners responsible for working to recover the Alabama sturgeon in the Mobile River Basin and improved where possible through opportunities that may increase fish passage. Recovery Tasks 1.2 and 3.2 will contribute to this criterion.

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes.

Although overutilization has been implicated in the decline of the Alabama Sturgeon, it is not now a factor affecting the species due to State and Federal protection, as well as rarity of the species.

Factor C: Disease or predation.

There are no known threats to the Alabama Sturgeon due to disease or predation.

Factor D: The inadequacy of existing regulatory mechanisms.

Under the consultation requirements of the Endangered Species Act, existing regulatory mechanisms (e.g., the Clean Water Act and associated State Laws, Rivers and Harbors Act, etc.) afford consideration of the species when projects are reviewed. Information derived under Recovery Tasks 3.0, 4.0, and 5.0 will facilitate these consultations.

Factor E: Other natural or manmade factors affecting its continued existence.

One of the primary threats to the Alabama Sturgeon is its small population size and its apparent limited recruitment success. Finding and successfully collecting brood stock (Task 1.1) and establishing a hatchery program (Task 2.1 – 2.4) will help reduce vulnerability to this threat. Further protecting the sturgeon's habitat as defined under Factor A will also help protect this species from natural or manmade events like drought and other flow/water quality modifications.

1. A successful hatchery program is in place. Recovery Tasks 1.0 and 2.0 are essential to this criterion.

2. The Alabama Sturgeon population in the Alabama/Cahaba River has been successfully increased through augmentation with hatchery produced juveniles, and the sturgeon population in the wild exceeds 500 individuals of multiple age classes.

3. Natural recruitment rates are shown through rigorous sampling to meet or exceed mortality rates and are adequate to sustain the population over a period of 20 years. Recovery tasks 1.1, 5.5, 6.3 and 7.0 address this criterion.

Priority Recovery-Management Areas

Priority Recovery-Management Areas (PRMAs) are those areas where it is believed conditions are optimal to meet the life history requirements of Alabama Sturgeon, and where initial recovery objectives are most likely to be achieved. The PRMAs also correspond to critical habitat designated for the species in 2009 (74 FR 26488). The PRMAs identified for the Alabama Sturgeon include the Alabama River from its confluence with the Tombigbee River upstream to Robert F. Henry L&D in Monroe, Clarke, Autauga, Lowndes, Dallas, and Baldwin counties, Alabama; and the Cahaba River from its confluence with the Alabama River upstream to the Fall Line at Centreville in Bibb, Perry, and Dallas counties, Alabama. These areas are considered PRMAs because they have been the only areas in recent years to provide evidence that the species continues to persist.

It is believed, at this time, that with proper management these PRMAs can provide suitable habitat for recovery of the Alabama Sturgeon. The Cahaba River represents the least degraded habitat, with high habitat diversity, including side channels, sandbars, and islands, along with a natural flow regime and varied depths and velocities. The lower Alabama River consists of the large river habitats that appear to be essential for *Scaphirhynchus* species. PRMAs may change as additional information on important habitats and spawning areas becomes available.

All other portions of the Alabama and Tombigbee River systems within the Alabama Sturgeon's historical range have not been designated as PRMAs, nor were they designated as critical habitat, because the species has not been reported from these areas in two or more decades, and they have been altered to the extent that they no longer contain habitats adequate to sustain the species or adequate for completion of its' life cycle. Although Alabama Sturgeon may eventually be found in, or occasionally use areas such as the upper Alabama, lower Tombigbee, or Tensaw/Mobile rivers, major modifications would be necessary to restore natural physical and hydrological characteristics required to sustain the species in these areas.

Recovery Narrative

The following recovery tasks are modified from the Alabama Sturgeon Conservation Strategy (CAS 2000).

1.0 Capture Alabama Sturgeon broodstock. The primary threat to the Alabama Sturgeon is its small population size and its apparent inability to offset mortality rates with current recruitment rates. Survival and recovery of the species requires the development of a hatchery program to augment the existing population and prevent extinction until habitat requirements are known and addressed. Successful capture of broodstock is of paramount importance in establishing a hatchery program.

1.1 Conduct annual collection efforts in the Alabama River. Alabama Sturgeon captures by fisheries personnel as well as anecdotal reports by commercial and recreational fishermen have declined over the past two decades. Increased efforts to collect broodstock are therefore vitally important to the successful implementation of this plan.

1.2 Identify opportunities to enhance fish passage at Claiborne and Millers Ferry L&D's by manipulating flows and modifying lock operations. A series of tests will be conducted to determine if spawning, or otherwise non-spawning, sturgeon can be attracted to the lock chambers at Claiborne and Millers Ferry L&Ds. Such tests have been attempted on a limited basis by Mettee *et al.* (2005); however, additional tests should be conducted seasonally using variable releases. The collection methodology should be designed by the ADCNR, the Service, the GSA, and the Corps. If properly executed, this effort will also benefit numerous other anadromous, catadromous, and diadromous species including the threatened Gulf Sturgeon.

1.3 Develop an Alabama Sturgeon population augmentation plan. An augmentation and stocking plan that includes optimal stocking sizes, stocking densities, season, locations, tagging methods, and transport and release methods will be developed. Family groups will be designed and used to maintain maximum genetic diversity and reduce potential deleterious effects of stocking.

1.4 Develop a monitoring plan for hatchery reared Alabama Sturgeon. A monitoring plan will be developed that includes monitoring of survival, health, and movement of released hatchery reared Alabama Sturgeon.

2.0 Continue hatchery program and maintaining holding facilities at Marion State Hatchery. The State Fish Hatchery, located in Marion, Alabama, has been designated with the primary lead in maintaining and propagating Alabama Sturgeon. Much work has been completed to prepare the hatchery for this role;

however, additional actions are required in the event of successful broodstock capture.

2.1 Complete hatchery modifications for sturgeon culture. Maintain existing facilities for future captured fish.

2.2 Revise propagation, culture, and fingerling protocols as necessary. Protocols for holding, propagating and culture of Alabama Sturgeon developed in the 1990s will be reviewed and updated.

2.3 Develop and implement a genetic conservation plan for Alabama Sturgeon broodstock. Genetic samples will be collected from all captured sturgeon. A genetic conservation plan will be developed to ensure that genetic variability will be maintained through the hatchery program.

2.4 Continue to collect and cryopreserve sperm from all captured males. Sperm from one deceased male Alabama Sturgeon has been cryopreserved for future use. Because of the potential of mortality in the hatchery, and to maintain genetic variability, sperm will be collected and cryopreserved from all future captured male sturgeon.

2.5 Evaluate information developed by other river sturgeon hatchery programs. Continue utilizing existing information from hatchery programs producing other *Scaphirhynchus* species (*i.e*., Pallid Sturgeon). Much information is currently being developed for Pallid Sturgeon augmentation and stocking which should be applicable to Alabama Sturgeon. This includes survival rates of hatchery progeny, genetic marking, tracking lineages, and stocking rates.

3.0 Protect and maintain existing habitat in the Alabama River. Habitat loss is the primary cause of range curtailment of the Alabama Sturgeon. Preserving and enhancing existing habitats is essential to the conservation of the species.

3.1 Use existing Federal/State coordination and permit review processes to protect and maintain channel integrity and flow in the Alabama River and its tributaries. Agency coordination and cooperation is essential to maintain riverine habitat functions in the Alabama River. Most major ongoing and potential activities have been reviewed and considered for their effects on Alabama Sturgeon.

3.2 Identify, map, protect, and monitor stable riverine habitats in the Alabama River. Stable riverine habitats in the Alabama River have been broadly identified by Hartfield and Garner (1998), Garner et al. (2011), and Buntin and Garner (2011). Better definition and GIS mapping of

these habitats, including all perennial tributary streams, will facilitate coordination, protection, and improvement of Alabama Sturgeon habitats.

3.3 Develop and implement State sand and gravel mining regulations that are protective of tributary channel integrity. Mining for sand and gravel within river and stream channels should be strictly regulated and enforced. Activities such as mining of point bars can change the geometry of the channel and result in upstream channel degradation, and bank erosion, and downstream sediment deposition and turbidity. Although floodplain sand and gravel mines can be environmentally sound and economically lucrative, improperly designed mining operations can destabilize channels. The appropriate State agencies in the Basin should work cooperatively with the Service to develop and implement guidelines that ensure that floodplain mines are properly designed and located.

3.4 Maintain and gage flows in the Alabama River and its tributaries. Minimum continuous stream flow into the upper Alabama River should not be less than 3200 cfs (cubic feet per second). In addition, flow regimes should be identified and maintained at Claiborne, Coffeeville, Millers Ferry and Jones Bluff L&Ds at appropriate levels to mimic historical flow patterns. The appropriate stream gaging network should be maintained to ensure accurate data collection.

3.5 Maintain water quality and existing water use classifications in the lower Alabama River. State data and monitoring programs for the lower Alabama River will be assessed regularly to ensure and document compliance with current State water quality standards. Unpermitted discharges will be identified and brought into compliance. When appropriate, excess hatchery reared sturgeon can be used for toxicity studies to ensure standards and classifications are protective. Ensure that all Federal and State construction activities that might affect the lower Alabama River or its tributaries effectively implement Best Management Practices (BMP's) for stormwater runoff and sediment control.

3.6 Conduct sediment studies in the Alabama River. Identify sediment loads, sources and annual sediment movement associated with tributaries and the main channel.

4.0 Conduct life history studies. Little is known about life history of the Alabama Sturgeon, or of the habitat requirements of its various life stages. Defining the life history and habitat requirements will increase conservation opportunities with minimal impact to existing human uses.

4.1 Determine seasonal habitat usage and movements of Alabama Sturgeon. Telemetry studies will be conducted with Alabama Sturgeon

that are not needed for broodstock, and/or with hatchery reared sturgeon in order to determine seasonal movements and habitat use.

4.2 Complete prey density studies in the lower Alabama River to identify important feeding areas. Sturgeon captures have been associated with stable areas in the Alabama River (Hartfield and Garner 1998). Preliminary studies have indicated higher abundances of potential prey in stable channel areas (Irwin *et al.* 2005). Additional studies are needed to correlate invertebrate prey density with substrate, flow and other habitat features.

4.3 Develop drift models for larval and post-larval life stages. River sturgeon are planktonic as larvae, drifting with the current and eventually settling to a benthic existence (Kynard *et al.* 2005, Braaten and Fuller 2005). Due to severe fragmentation of Alabama Sturgeon habitat, information on larval and post-larval drift times and distances is essential to improving natural recruitment. Information on pallid and Shovelnose Sturgeon larval drift will be used in conjunction with flow data from various sections of the Alabama River to develop preliminary larval drift models. Successful capture and propagation of Alabama Sturgeon will allow development of information specific to this species.

4.4 Conduct feeding and growth studies on broodstock and progeny when propagation is successful. When available, captured broodstock or hatchery progeny will be used to determine diet, growth rates, and other basic biological information on the species. Nutritional needs of captive broodstock will be investigated to enhance fecundity and possibly reduce reproductive cycle intervals.

4.5 Identify and delineate larval and juvenile sturgeon habitats. Hatchery reared larval and juvenile sturgeon will be released and routinely sampled and monitored in order to determine habitat preferences and uses.

5.0 Coordinate all activities and revise recovery plan as appropriate. This recovery plan, its action items, and its implementation schedule, should be evaluated periodically to determine if the objectives are being achieved, and to incorporate new information or necessary modifications.

5.1 Coordinate and participate in workshops that encourage free exchange of information on the collection, propagation, reintroduction, and management of other sturgeon species. The agencies responsible for implementing this plan should meet on an annual basis to discuss progress of the recommended actions and share any new information gleaned from research on Alabama or any other sturgeon species that may aid in the implementation of this plan.

Literature Cited

Alabama Department of Conservation and Natural Resources –ADCNR. 1997. Freshwater sturgeon in Alabama: collecting, holding, and transporting protocol. unpublished report, 10 pp.

Anonymous. 1930. The sturgeon. Alabama Game and Fish News 1930 (1):13.

Belovsky, G.E. 1987. Extinction models and mammalian persistence. Pages 35-37, in: M. Soule (ed.), Viable Population for Conservation. Cambridge Univ. Press.

Biggins, R. 1994. Federal activities that may affect the Alabama sturgeon and anticipated section 7 consultations on these activities. Paper jointly prepared by the U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service.

Birstein, V.J. 1993. Sturgeons and paddlefishes: threatened fishes in need of conservation. Conservation Biology 7(4): 773-787.

Braaten, P.J., and D.B. Fuller. 2005. Drift dynamics of larval pallid sturgeon in a side channel of the upper Missouri River, Montana. In: Evolution, Ecology and Management of Scaphirhynchus. St. Louis, MO, January 2005. Abstract.

Boschung H.T., and R.L. Mayden. 2004. *The Fishes of Alabama*. Smithsonian Books, Washington, D.C. 736 pp.

Buntin, M.L., and J.T. Garner. 2011. Quantitative sampling of *Pleurobema taitianum* in the Alabama River. Report to the U.S. Fish and Wildlife Service, Alabama Field Office, 7 p.

Burke, J.S., and J.S. Ramsey. 1985. Status survey of the Alabama shovelnose sturgeon (*Scaphirhynchus* sp. cf. *platorynchus*) in the Mobile Bay drainage. Report to the U.S. Fish and Wildlife Service, Jackson, Mississippi. 61 pp.

------. 1995. Present and recent historic habitat of the Alabama sturgeon *Scaphirhynchus suttkusi* (Williams and Clemmer), in the Mobile River Basin. Bull. Ala. Mus. Nat. Hist. 17:17-24.

Conservation Agreement and Strategy for the Alabama Sturgeon (*Scaphirhynchus suttkusi*) (CAS). 2000. Agreement prepared jointly by the ADCNR, COE, Alabama-Tombigbee Rivers Coalition, and the Service. 24 pp.

Campton, D.E., A.L. Bass, F.A. Chapman, and B.W. Bowen. 2000. Genetic distribution of pallid, shovelnose, and Alabama sturgeon: emerging species and the U.S. Endangered Species Act. Conservation Genetics 1:17-32.

Chermock, R.L. 1955. First record of the shovelnose sturgeon, *Scaphirhynchus platorynchus*, from the Tombigbee River, Alabama. Copeia 1:154.

Clemmer, G.H., R.D. Suttkus, and J.S. Ramsey. 1975. A preliminary list of endangered and rare fishes of Mississippi. Pages 6-11 *in* A preliminary list of rare and threatened vertebrates in Mississippi. Mississippi Game and Fish Commission, Jackson.

Conte, F. S., S. I. Doroshov, P .B. Lutes and E. M. Strange. 1988. Hatchery manual for the white sturgeon (*Acipenser transmontanus* Richardson), with application to other North American Acipenseridae. University of California, Division of Agriculture and Natural Resources, Cooperative Extension, Oakland.

Coker, R.E. 1930. Studies of common fishes of the Mississippi River at Keokuk. U.S. Bur. Fish. Bull. 45:141-225.

Curtis, G.L., J.S. Ramsey, and D.L. Scarnecchia. 1997. Habitat use and movements of the shovelnose sturgeon in Pool 13 of the upper Mississippi River during extreme low flow conditions. Environmental Biology of Fishes 50:175-182.

Deloney, A.J. 2005. Pallid sturgeon movement. Email: U.S. Geological Survey, Columbia Environmental Research Center, Columbia, MO.

Fain, S.R., B. Hamlin, and D. Straughn. 2000. Genetic variation in the river sturgeon Scaphirhynchus (Acipenseridae) as inferred from partial mtDNA sequences of Cytochrome b. Unpublished report, National Fish and Wildlife Forensics Laboratory, Ashland, Oregon. 14 pp.

Franklin, I.R. 1980. Evolutionary change in small populations. Pages 135-149; in: M.E. Soule and B.A. Wilcox (eds.), Conservation Biology: an Evolutionary-Ecological Perspective. Sinauer Associates, Inc., Suncerland, MA.

Garner, J.T., M.L. Buntin, and T.B. Fobian. 2011. Survey for Tulotoma magnificia in the mainstem of Alabama River. Report to the U.S. Fish and Wildlife Service, Alabama Field Office, 22 p.

Hartfield, P., and J. Garner. 1998. Summary of dive surveys in the Alabama River. Unpublished data, 15 pp..

Haynes, C., R.L. Mayden, and B.R. Kuhajda. 2005. Food habits of the Alabama sturgeon, *Scaphirhynchus suttkusi*-Williams and Clemmer, an endangered species. Poster presentation at the 2005 Scaphirhynchus Conference, St. Louis, MO., January 11-13, 2005.

Hurley, S.T., W.A. Hubert, and J.G. Nickum. 1987. Habitats and movements of shovelnose sturgeons in the Upper Mississippi River. Transactions of the American Fisheries Society 116:655-662.

Irwin, E., M. Taylor, G. Turner, K. Mickett, and C. Weber. 2005. Delineation of important habitat features for adult and juvenile Alabama sturgeon (*Scaphirhynchus suttkusi*). Final Report to the U.S. Fish and Wildlife Service, Jackson, Mississippi Field Office. 65 pp.

Johnson, J.E. 1987. Protected Fishes of the United States and Canada. Amer. Fish Soc., Bethesda, Maryland. 42 pp.

Johnston, C. E., and C.T. Phillips. 2003. Sound production in sturgeon (*Scaphirhynchus albus)* and *S. platorynchus* (Acipenseridae). Environmental Biology of Fishes 68: 59-64.

Johnson, G.C., R.E. Kidd, C.A. Journey, H. Zappia, and J.B. Atkins. 2002. Environmental setting and water-quality issues of the Mobile River basin, Alabama, Georgia, Mississippi, and Tennessee. U.S. Geological Survey, Water-Resources Investigations Report 02-4162.

Keenlyne, K. D. 1997. Life history and status of the shovelnose sturgeon, *Scaphirhynchus platorynchus*. Environmental Biology of Fishes 48: 291-298.

Keevin, T.M., S.G. George, J.J. Hoover, B.R. Kuhajda, R.L. Mayden. 2007. Food habits of the endenagered Alabama sturgeon, *Scaphirhynchus suttkusi* Williams and Clemmer, 1991 (Acipenseridae). J. Appl. Ichthyol. 23: 500-505.

Kuhajda, B. R. 2002. Systematics, taxonomy, and conservation status of sturgeon in the subfamily Scaphirhynchinae (Actinopterygii, Acipenseridae). Ph.D. Dissertation, The University of Alabama, Tuscaloosa. 291 pp.

Kynard, B., E. Parker, D. Pugh, and T. Parker. 2005. Experimental studies of Pallid sturgeon dispersal and vertical swimming height during ontogeny. In: Evolution, Ecology and Management of Scaphirhynchus. St. Louis, MO, January 2005. Abstract.

Mayden, R.L., and B.R. Kuhajda. 1996. Systematics, taxonomy, and conservation status of the endangered Alabama sturgeon, *Scaphirhynchus suttkusi* Williams and Clemmer (Actinopterygii, Acipenseridea). Copeia 1996: 241-273.

Mettee, M.F., P.E. O'Neil, and J.M. Pierson. 1996. Fishes of Alabama and the Mobile Basin. Oxmoor House, Inc., Birmingham, Alabama. 820 pp.

Mettee, M.F., P.E. O'Neil, T.E. Shepard, and S.W. McGregor. 2005. A study of fish movements and fish passage at Claiborne and Millers Ferry Locks and Dams on the Alabama River, Alabama. Open-File Report 0507. 29 pp.

Mirarchi. R. E., J. T. Garner, M. F. Mettee, and P.O'Neil. 2004. Alabama Wildlife, Volume 2: Imperiled Aquatic Mollusks and Fishes. University of Alabama Press, Tuscaloosa, AL.

Moos, R.E. 1978. Movement and reproduction of shovelnose sturgeon (*Scaphirhynchus platorynchus)* in the Missouri River, South Dakota. Doctoral dissertation, University of South Dakota, Vermillion. 216 pp.

Pierson, J.M., W.M. Howell, R.A. Stiles, M.F. Mettee, P.E. O'Neil, R.D. Suttkus, and J.S. Ramsey. 1989. Fishes of the Cahaba River System in Alabama. Alabama Geol. Surv. Bull. 134:1-183.

Ramsey, J.S. 1976. Freshwater fishes. *In*: Boschung, H.T. (ed), Endangered and threatened plants and animals of Alabama, pp 53-65, Bull. Alabama Mus. Nat. Hist. No. 2.

Rider, S.J. and P. Hartfield. Conservation and collection efforts for the endangered Alabama sturgeon (*Scaphirhynchus suttkusi*). J. Appl. Ichthyol. 23: 489-493.

Shaffer, M. 1987. Minimum viable populations: coping with uncertainty. Pages 69-86; in: M. Soule (ed.), Viable Populations for Conservation. Cambridge Univ. Press.

Simons, A.M., R.M. Wood, L. Heath, B.R. Kuhajda, and R.L. Mayden. 2001. Conservation genetics of *Scaphirhynchus* species based on mitochondrial DNA sequences. Trans. Amer. Fish. Soc. vol. 130: 359-366.

Soule, M.E. (ed.). 1987. Viable Populations for Conservation. Cambridge Univ. Press. 189 pp.

Ramsey, J.S. 1976. Freshwater fishes. In: Endangered and threatened plants and animals of Alabama. H. Boschung (Ed.). Bull. Alabama Mus. Nat. Hist. 2, pp. 53-65.

Rider, S.J. 2004a. Alabama sturgeon (*Scaphirhynchus suttkusi*) broodfish collection, October 1, 2002 – September 30, 2003. Annual report to the U.S. Fish and Wildlife Service, Atlanta, Georgia. 5 pp.

------. 2004b. Alabama sturgeon (*Scaphirhynchus suttkusi*) broodfish collection, October 1, 2003 – September 30, 2004. Annual report to the U.S. Fish and Wildlife Service, Atlanta, Georgia. 5 pp.

Rider S.J. and P. Hartfield. 2007. Conservation and collection efforts for the endangered Alabama sturgeon (*Scaphirhynchus suttkusi*). J. Appl. Ichthyol. 23: 489-493.

Rider, S.J. and J.R. Powell. 2009. *Scaphirhynchus suttkusi* – Alabama Sturgeon. In: The desperate dozen: southeastern freshwater fishes on the brink. B.R. Kuhajda, A.L. George, J.D. Williams. Southeast. Fishes Counc. Proc. 51: 11-12.

Rider, S.J., T.W. Ringenburg, T.R. Powell, J.R. Powell. 2009. Habitats and movements of an endangered Alabama sturgeon (*Scaphirhynchus suttkusi*). Presentation at the 139th Annual Meeting of the American Fisheries Society *Acipenseriformes in North America Symposium*, Nashville, TN.

Taylor, M.Y. 2004. Habitat use and tag retention of juvenile shovelnose sturgeon, a surrogate species for Alabama sturgeon. Masters Thesis. Auburn University, Auburn, Alabama.

Tucker, W.H., and L.A. Johnson. 1991. Alabama shovelnose sturgeon investigations. Study No. 2. ADCNR, Division of Game and Fish, Spanish Fort, AL. 6pp.

-------. 1992. Alabama shovelnose sturgeon investigations. Study No. 2. ADCNR, Division of Game and Fish, Spanish Fort, AL. 6pp.

-------. 1993. Alabama shovelnose sturgeon investigations. Study No. 2. ADCNR, Division of Game and Fish, Spanish Fort, AL. 4pp.

-------. 1994. Alabama shovelnose sturgeon investigations. Study No. 2. ADCNR, Division of Game and Fish, Spanish Fort, AL. 2pp.

U.S. Commission of Fish and Fisheries-USCFF. 1898. Report to the Commissioner for the year ending June 30, 1896. Part XXII. Government Printing Office, Washington, D.C. 493-533.

U.S. Fish and Wildlife Service (FWS). 2000. Recovery Plan for the Mobile River Basin Aquatic Ecosystem. Atlanta, Georgia. 128 pp.

---- Federal Register (65 FR 26438). 2000. Endangered and threatened wildlife and plants; final rule to list the Alabama sturgeon as endangered.

---- Federal Register (74 FR 26488). 2009. Endangered and threatened wildlife and plants; designation of critical habitat for Alabama sturgeon (*Scaphirhynchus suttkusi*).

Williams, J.D., and G.H. Clemmer. 1991. *Scaphirhynchus suttkusi*, a new sturgeon (Pisces: Acipenseridae) from the Mobile Basin of Alabama and Mississippi. Bulletin of the Alabama Museum of Natural History 10: 17-31.

Sedell, J.R., G.H. Reeves, F.R. Hauer, J.A. Stanford, and C.P. Hawkins. 1990. Role of refugia in recovery from disturbances: modern fragmented and disconnected river systems. Environmental Management 14:711-724.

Part III. Implementation Schedule

Recovery plans are intended to assist the Service and other stakeholders in planning and implementing actions to recover and/or protect endangered and threatened species. The following Implementation Schedule indicates task priorities; task numbers; task descriptions; task duration; potential stakeholders and responsible agencies; and estimated costs. It is a guide for planning and meeting the objectives discussed in Part II of this plan. The Implementation Schedule outlines recovery actions and their estimated costs for the 5 years of this recovery program. Downlisting and delisting dates cannot be estimated at this time. The cost estimates provided identify foreseeable expenditures that could be made to implement the specific recovery tasks during a 5-year period. **Actual expenditures by agencies and other partners is contingent upon appropriations and other budgetary constraints**.

Recovery tasks are assigned numerical priorities to highlight the relative contribution they may make toward species recovery. Priorities in column one of the Implementation Schedule are assigned as follows:

> **Priority 1 -** An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.
>
> **Priority 2 –** An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.
>
> **Priority 3 –** All other actions necessary to meet the recovery objective.

While the ESA assigns a leadership role to the Service for the recovery of listed species, it also recognizes the importance of other Federal agencies, States, and other stakeholders in the recovery process. The "Responsible Agency" column of the Implementation Schedule identifies partners who can make significant contributions to specific recovery tasks. **The identification of agencies and other stakeholders within the Implementation Schedule does not constitute any additional legal responsibilities beyond existing authorities (e.g., ESA, CWA, etc.). Recovery plans do not obligate other stakeholders to undertake specific tasks and may not represent the views nor the official positions or approval of any agencies or stakeholder groups involved in developing the plan, other than the Service.**

Key to acronyms used in the Implementation Schedule

ADCNR	Alabama Department of Conservation and Natural Resources, Fisheries Section
ADEM	Alabama Department of Environmental Management
ASMC	Alabama Surface Mining Commission
AU	Auburn University
BI	Businesses and Industries
COE	U.S. Army Corps of Engineers
ES	Ecological Services Division of the FWS
FWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey/Water Resources Division
GSA	Geological Survey of Alabama
NGO	Non-governmental Organizations (The Nature Conservancy, World Wildlife Fund, National Fish and Wildlife Foundation, Alabama Rivers Alliance)
R4 FWS	Region 4, U.S. Fish and Wildlife Service, Atlanta, GA
RI	Research Institutions (e.g., USGS Cooperative Research Units, Universities)
TNC	The Nature Conservancy
UAIC	University of Alabama Ichthyological Collection

Other terms used:

O&M	Operations and maintenance
TBD	To be determined; contingent upon captured broodstock

Other partners and stakeholders may include businesses, industries, research institutes and universities, county and municipal governments, private landowners, conservation organizations, etc.

ALABAMA STURGEON IMPLEMENTATION SCHEDULE											
PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION	RESPONSIBLE PARTY		COST ESTIMATES ($K)					COMMENTS
				R4 FWS	Other	FY12	FY13	FY14	FY15	FY16	
1	1.1	Conduct annual collection efforts in the Alabama River	5 years	ES	ADCNR, FWS	100	100	100	100	100	Costs may be absorbed under existing programs
1	1.2	Identify opportunities to implement fish passage at Claiborne and Millers Ferry L&D's by manipulating flows and modifying lock operations.	continuous	ES	ADCNR, COE, GSA, APC, AU, TNC, FWS	100	100	100	100	100	Costs may be absorbed under existing programs
2	1.3	Develop an Alabama sturgeon population augmentation plan	continuous	ES	ADCNR, UAIC, FWS						
3	1.5	Develop a monitoring plan for hatchery reared Alabama sturgeon	continuous	ES	Appropriate agencies and research institutes						
1	2.1	Complete hatchery modifications for sturgeon culture	continuous	ES	Appropriate agencies and research institutes						Contingent upon 1.1
3	2.2	Revise propagation, culture, and fingerling protocols as necessary	continuous	ES	Appropriate agencies and research institutes						
3	2.3	Develop and implement a genetic conservation plan for Alabama Sturgeon broodstock	continuous	ES	ADCNR, UAIC						Costs TBD
1	2.4	Continue to collect and cryopreserve sperm from all captured males	continuous	ES	ADCNR, UAIC						Costs partially absorbed under 1.1

2	2.5	Evaluate information developed by other river sturgeon hatchery programs	continuous	ES							
2	3.1	Use existing Federal/State coordination and permit review processes to protect and maintain channel integrity and flow in the Alabama River and its tributaries	continuous	ES							
2	3.2	Identify, map, protect, and monitor stable riverine habitats in the Alabama River	3 years	ES	Appropriate agencies and research institutes	50	50	50			
2	3.3	Develop and implement State sand and gravel mining regulations that are protective of tributary channel integrity	continuous	ES	ASMC, ADEM						Costs may be absorbed under existing programs
2	3.4	Maintain and gage flows in the Alabama River and its tributaries	continuous	ES	COE, USGS						Costs may be absorbed under existing programs
2	3.5	Maintain water quality and existing water use classifications in the lower Alabama River	continuous	ES	ADEM						Costs absorbed under existing programs
2	3.6	Conduct sediment studies in the Alabama River	continuous	ES	Appropriate State agencies						Costs absorbed under existing programs
2	4.1	Determine seasonal habitat usage and movements of Alabama Sturgeon	continuous	ES	Appropriate agencies and research institutes						Contingent upon 1.1
3	4.2	Complete prey density studies in the lower Alabama River to identify important feeding areas	2 years	ES	Appropriate agencies and research institutes						TBD
3	4.3	Develop drift models for larval and post-larval life stages.	2 years	ES	Appropriate agencies and research						TBD

					institutes						
3	4.4	Conduct feeding and growth studies on broodstock and progeny when propagation is successful	2 years	ES	Appropriate agencies and research institutes						Contingent upon 1.1
3	4.5	Identify and delineate larval and juvenile sturgeon habitats	2 years	ES	Appropriate agencies and research institutes						Contingent upon 1.1
1	5.1	Coordinate and participate in workshops that encourage free exchange of information on the collection, propagation, reintroduction, and management of other sturgeon species.	annually	ES	ADCNR, COE, FWS						Costs absorbed under existing programs

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APPENDIX I. Nomenclature

Kingdom	Animalia -- Animal, animals, animaux
Phylum	Chordata -- chordates, cordado, cordés
Subphylum	Vertebrata -- vertebrado, vertebrates, vertébrés
Superclass	Osteichthyes -- bony fishes, osteíceto, peixe ósseo, poissons osseux
Class	Actinopterygii -- poisson épineux, poissons à nageoires rayonnées, ray-finned fishes, spiny rayed fishes
Subclass	Chondrostei -- paddlefishes, sturgeons
Order	Acipenseriformes -- paddlefishes, spoonfishes, sturgeons
Suborder	Acipenseroidei
Family	Acipenseridae -- sturgeons
Subfamily	Scaphirhynchinae
Genus	Scaphirhynchus Heckel, 1836 -- shovelnose sturgeons
Species	Scaphirhynchus suttkusi Williams and Clemmer, 1991 -- Alabama sturgeon

Type locality: Alabama River, just above the mouth of Little River, in Monroe County, Alabama.

Etymology. *suttkusi*. Patronymic for Dr. Royal D. Suttkus; contemporary American ichthyologist (Boschung and Mayden 2004).

NOMENCLATURE

TAXONOMY

Class: Osteichthyes
Order: Acipenseriformes
Family: Acipenseridae
Genus: Scaphirynchus
Species: suttkusi

Type Specimens

Specimens of *Scaphirynchus suttkusi* are deposited in the collections of the following institutions: Auburn University (AU); Tulane University (TU); University of Alabama Icthyological Collection (UAIC); Florida Museum of Natural History (UF); University of Michigan (UMMZ); and National Museum of Natural History, Smithsonian Institution (USNM).

Holotype - TU 135000, adult male, 552 mm standard length (SL), Alabama, Monroe County, overflow pool of Alabama River just above mouth of Little River at Dixie Landing, 18 March 1977, collected by W.E. Smith.

Paratypes - Alabama River drainage, Alabama: *Clark County*: AU 25919 (1) Alabama River about 4 mi SSE of Carlton, (RM 22.4), east bank on sand flat, 20 April 1984, J.S. Burke. *Dallas County*: UAIC 3634.01 (12), Junction of Alabama and Cahaba rivers, 21 March 1969, P. Hackney. *Elmore County*: USNM 200617 (1), Coosa River ca. 1 mi below Wetumpka, 27 November 1961, G. Best. *Monroe County*: TU 350001 (1) Overflow pool of Alabama River just above mouth of Little River at Dixie Landing, 5 April 1977, W.E. Smith; UF 84888 (1) Alabama River about 6 mi WSW of Caliborne (sic), (RM 58.5), 17 April 1985, J.S. Burke and T. Holman; UMMZ 218753 (1) Alabama River about 8 mi W of Fountain, 2 May 1985, J.S. Burke. *Perry County*: AU uncatalogued (1) Probably from Cahaba River, found preserved at Marion National Fish Hatchery before 1967; TU 64937 (1), Cahaba River near Marion National Fish Hatchery, ca 1 mi W Sprott, 30 April 1966; UAIC uncatalogued specimen (1), Cahaba River, ca. 13 mi below bridge at Suttle, March 1967, W. Tatum; UMMZ 218752 (1), Cahaba River near Cahaba, “about 1969", L. Walls. *Wilcox County*: AU 25917(1) Lake Claiborne, impounded Alabama River, about 3 mi ENE of Coy, (RM 109.8), west bank on Taft Bar, 2 May 1985, J.S. Burke and T. Holman; TU 50553 (1), Alabama River at Bear Creek, (RM 112.8), 2 March 1968, J. Grady; TU 52868 (1), Alabama River at Clifton Ferry Landing, (RM 137.3), 29 June 1968, R.D. Suttkus; UAIC 2180.01 (1), Alabama River, ca. 10 mi S Millers Ferry, February 1966, unknown commercial fisherman; UAIC 2616 (1), Alabama River at Millers Ferry, 4 June 1967, unnamed commercial fisherman; UAIC 2845.01 (1), Alabama River ca. 10 mi S Millers Ferry, 28 May 1966, unknown commercial fisherman. Tombigbee River drainage, Alabama: *Green/Sumpter County Line*: UAIC 401 (1), Tombigbee River SW of Eutaw near Epes, 13 November 1953, unknown fisherman (Williams and Clemmer, 1991). Williams, J.D., and G.H. Clemmer, 1991. Scaphirynchus suttkusi, a new sturgeon (Pisces: Acipenseridae) from the Mobile Basin of Alabama and Mississippi. Bulletin Alabama State Museum of Natural History, Number 10:17-31, 7 tables, 7 figures.

APPENDIX II. White Paper (Biggins 1994) entitled, “Federal Activities that May Affect the Alabama Sturgeon and Anticipated Section 7 Consultations on These Activities”.

Prepared: November 18, 1994.

This document was prepared jointly by the Fish and Wildlife Service and the U.S. Army Corps of Engineers in accordance with the September 1994 Memorandum of Understanding on Implementation of the Endangered Species Act.

Annual maintenance dredging by the Corps: Maintenance dredging by the U.S. Army Corps of Engineers (Corps) to maintain the navigation channel on the Alabama and lower Tombigbee Rivers annually removes 1.5 to 3.8 million cubic meters (2 to 5 million cubic yards) of unconsolidated aggregate (e.g., sand, mud, and silt). Dredge material from the Tombigbee River downstream of Coffeeville, Alabama, is disposed of at upland sites and within the banks of the river. On the Alabama River, fewer upland disposal areas have been established, and the majority of the dredge materials is placed within the shallow reaches of the river. Based on limited information on the Alabama Sturgeon and studies of the Shovelnose Sturgeon, it appears that these fish require currents over relatively stable substrates for feeding and spawning. They are generally not associated with those unconsolidated substrates that settle in slower current areas and must be removed annually to maintain navigation. Therefore, removal and disposal of unconsolidated materials is not perceived as a threat to the sturgeon or to its feeding or spawning habitat.

In the proposed rule, the U.S. Fish and Wildlife Service (Service) expressed concern that turbidity increases associated with the Corps' annual maintenance dredging could affect the sturgeon, and the Service still has some concern regarding this issue. However, based on the fact that (1) The Alabama and Tombigbee Rivers are currently characterized as turbid rivers; (2) channel maintenance activities produce only localized and temporary elevation of turbidity; (3) the extent to which turbidity impacts the Alabama Sturgeon is unknown; and (4) the Corps in cooperation with the Service has agreed to pursue research (within three years and based on the availability of funds) regarding the potential impacts of maintenance dredging activities, including turbidity, on the Shovelnose Sturgeon, the Service has concurred with the Corps' determination that based on current information their annual maintenance dredging program does not adversely affect the Alabama Sturgeon.

Thus, as it is currently believed that the Corps' annual maintenance dredging program on the Alabama and lower Tombigbee Rivers is not likely to affect the Alabama Sturgeon, these channel maintenance activities will not need to be eliminated, modified in timing or duration, or altered to protect the Alabama Sturgeon. Therefore, no loss of revenue from diminished annual channel maintenance activities will be associated with the listing of the Alabama Sturgeon.

Maintenance dredging by the Corps to remove rock shelves: The Alabama and Tombigbee Rivers naturally move laterally, and to some extent, vertically. This natural river channel movement exposes rock shelves at the outer bends of the river. In order to provide for a reliable and safe navigation channel, these rock shelves must sometimes be removed, and similar channel alignment improvements of covered consolidated material are sometimes necessary on the inside bends. Although the removal of these obstructions to navigation are usually infrequent and restricted to isolated areas, this activity may adversely affect the Alabama Sturgeon. The Corps and the Service have discussed the potential impacts to the Alabama Sturgeon of removing these rock shelves, and both agencies agree that section 7 consultation will be required prior to the commencement of any rock shelf removal project within or adjacent to potential Alabama Sturgeon habitat. However, since both agencies agree that rock shelf removal projects are generally not emergency projects, there will be a sufficient period of time prior to the next dredging season for both agencies to consider the timing and habitat improvements which may be possible by the design and construction of the remaining shelf after excavation and by selective placement of the excavated material. Thus, the Service does not anticipate that these consultations will result in a jeopardy situation or result in delays in these maintenance dredging activities.

Use of training devices by the Corps: In the proposed rule, the Service cited studies by the Corps and others that the use of channel-training devices (e.g., training dikes, jetties, sills, and revetments) in several rivers in the eastern half of the United States reduced dredging requirements by over 50 percent. The Corps' own data stated that structures in the Alabama River were assumed to eliminate about 60 percent of dredging requirements at the specific location where such structures were designed and constructed in the last phase of training works on the Alabama River. The present system on the Alabama River consists of 67 channel training works at 16 locations. The Corps has subsequently stated that based on the Mobile District's criteria for the use of training works, these structures are already used to the maximum extent practicable. However, the Service understands that the Corps will continue to evaluate their use, will modify existing structures as necessary, and may construct additional training devices when justified. Although the Service believes that training devices could reduce impacts to the Alabama Sturgeon and encourages the Corps to consider their use in future planning, the Service does not believe that more training devices are required to avoid jeopardy to the Alabama Sturgeon.

Maintenance dredging for non-Federal activities: The Corps authorizes maintenance dredging for non-Federal navigation projects. Although these projects are usually on a much smaller scale that the Corps' annual maintenance dredging activities, they involve the removal of unconsolidated aggregate from navigable waters of the United States and include the discharge of some material back into the waterways. Thus, maintenance dredging by non-Federal entities comes under the Corps' authority pursuant to section 10 of the RHA (33 U.S.C. 403) and section 404 of the CWA (33 U.S.C. 1344). Maintenance dredging by non-Federal entities for navigation removes unconsolidated aggregate (e.g., sand, mud, and silt) that washes down from upstream portions of the river and from tributaries. Based on limited information on the Alabama Sturgeon and studies of the

Shovelnose Sturgeon, it appears that these fish require currents over relatively stable substrates for feeding and spawning. They are generally not associated with the unconsolidated substrates that settle in slower current areas. Therefore, removal of unconsolidated materials is not considered as a direct threat to the sturgeon or to its feeding or spawning habitat. Prior to the Corps' issuance of a section 404 permit for non-Federal maintenance dredging, the applicant must receive State water quality certification from the State of Alabama pursuant to section 401 of the CWA. As the Service does not believe that more restrictive water quality standards will be needed to protect the Alabama Sturgeon from this activity, the likelihood of an applicant receiving a State water quality certification will not be affected by the listing of the Alabama Sturgeon. Additionally, as addressed above under Annual maintenance dredging by the Corps, temporary increases in turbidity associated with maintenance dredging activities are nor currently believed to adversely affect the Alabama Sturgeon; and as dredge material from non-Federal maintenance dredging projects is traditionally disposed of at upland sites, potential impacts to the sturgeon are further reduced.

Changes in river flow patterns: A series of dams now control water flows in much of the Mobile River system. Changes in the natural flow patterns have probably had both direct and indirect effects on the Alabama Sturgeon and its habitat. In the proposed rule, it was stated that The Service expects that continuous minimum flows of approximately 3,000 [cfs] will be required [to sustain the Alabama Sturgeon] below both Robert F. Henry and Millers Ferry Locks and Dams on the lower Alabama River and that * * *minimum flows below Claiborne Lock and Dam are already maintained at approximately 5,000 cfs to provide for cooling water intake of downstream industry. Although the Service concedes that little information on the flow needs of the sturgeon is available, a minimum figures of 90 cms (3,000 cfs) was arrived at by Service and other biologists familiar with the Alabama River and its fish populations. The Service now has evidence of the continued existence of the Alabama Sturgeon in the free-flowing portion of the Alabama River downstream of Claiborne Lock and Dam and that the APC, through an agreement with the Corps, attempts to maintain (for the purposes of navigation) a minimum average daily flow of approximately 149 cms (4,640 cfs) over any seven consecutive day period and a minimum average daily flow of approximately 81 cms (2,667 cfs) over any three consecutive day period downstream of Claiborne Lock and Dam. Further, the average daily flows over the last decade downstream of Claiborne Lock and Dam have ranged from 114 to 6,912 cms (3,800 to 244,000 cfs). Therefore, the Service believes that the minimum average daily flows, as agreed to by the Corps and the APC, coupled with historic and Federal Energy Regulatory Commission ordered flow patterns, are likely adequate to sustain the Alabama Sturgeon in this river reach.

The Service's opinion on flow requirements for river segments upstream of Claiborne Lock and Dam, as stated in the proposed rule, has changed somewhat. The Service's position remains that the best biological judgement at this time is that a minimum average daily flow of approximately 90 cms (3,000 cfs) from the Robert F. Henry and Millers Ferry Locks and Dams would be required to maintain a population of the Alabama Sturgeon upstream of Claiborne Lock and Dam. However, the continued existence of the sturgeon upstream of Claiborne Lock and Dam has not been substantiated in nearly a

decade, although anecdotal evidence exists. Therefore, based on our current knowledge of the Alabama Sturgeon and its distribution, no changes in water releases from these structures or from structures located in the headwaters of the Alabama River system (e.g., Coosa and Tallapoosa Rivers) are being suggested for the benefit of the sturgeon nor are they anticipated by the Service as a result of this listing. Thus, without changes in flow releases from power-generating dams, there should be no loss of electrical power revenue resulting from listing the Alabama Sturgeon.

State water quality standards: Although it is possible that some point-source discharges negatively impact the Alabama Sturgeon, there is no evidence to support the conclusion that the State's water quality standards must be changed if the fish is listed. As discussed in the proposed rule, the potential exists for point discharges to impact the Alabama Sturgeon, and it is noted that there is an increasing demand for discharge permits in the Mobile River system. However, there are two factors that work to minimize any impacts to this fish from point-source discharges: (1) As the Alabama Sturgeon inhabits larger channel areas, the effects of any point discharge into its habitat would likely be minimized by dilution and (2) the State of Alabama, with assistance from and oversight by the EPA, sets water quality standards that are presumably protective of aquatic life. It is the Service's position, as stated in the proposed rule, that as long as current fish and wildlife standards under the CWA are used to issue discharge permits and the conditions of the permits are enforced, there is no need to modify the State's water quality standards to protect the Alabama Sturgeon. A violation of State water quality standards would be a violation of the CWA, and listing the Alabama Sturgeon could potentially increase noncompliance penalties. However, the listing, based on current information, would not increase the need for changes in State water quality standards.

Coalbed methane: The extraction of coalbed methane can necessitate the release of produced water into the environment, and this discharge was mentioned as a potential threat to the Alabama Sturgeon in the proposed rule. The Corps authorizes produced-water discharge structures pursuant to section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) if the outfall structure is placed into navigable waters of the United States. The Corps typically authorizes these structures with a Letter of Permission. Letters of Permission are a type of permit issued through an abbreviated processing procedure that includes coordination with Federal (including the Service) and State fish and wildlife agencies, as required by the Fish and Wildlife Coordination Act, and a public interest evaluation, but without publishing an individual public notice. Letters of Permission may be used in those cases subject to section 10 when, in the opinion of the District Engineer, the proposed work would be minor, would not have significant individual or cumulative impacts on environmental values, and should encounter no appreciable opposition. Additionally, prior to discharge, the applicant must receive a permit from the State of Alabama under NPDES guidelines. As the Alabama Sturgeon exists far downstream of these permit activities, the Service does not believe that any modification to existing discharge structure authorization procedures is needed to protect the Alabama Sturgeon. The potential coalbed methane wells are far upstream of known Alabama Sturgeon habitat and any discharge must meet State water quality standards (the Service has stated that the water quality standards will not have to be modified in order to

protect the Alabama Sturgeon). Therefore, the Service does not anticipate any direct or indirect impacts to the Alabama Sturgeon from properly permitted produced-water discharges.

Gravel mining: In-stream gravel mining involves work in navigable waters of the United States and includes the discharge of the noncommercial dredge material back into the waterway. Thus, in-stream gravel mining comes under the Corps' authority, pursuant to section 10 of the RHA (33 U.S.C. 403) and section 404 of the CWA (33 U.S.C. 1344). The Service believes that the Alabama Sturgeon likely uses relatively stable substrate for breeding and feeding habitat. Thus, mining of this stable substrate could threaten the species. However, the Service believes the mining of unconsolidated material or relatively stable material that is covered by several inches of fine sediment would not be likely to jeopardize the species' continued existence.

Prior to the issuance of a permit by the Corps for in-stream gravel mining, the applicant must receive State water quality certification from the State of Alabama pursuant to section 401 of the CWA. As the Service does not believe that more restrictive water quality standards will be needed to protect the Alabama Sturgeon from this activity, the likelihood of an applicant's receiving State water quality certification will not be affected by the listing of the Alabama Sturgeon. However, as in-stream gravel mining generally produces higher turbidity levels than are produced by maintenance dredging, the Service believes that increases in turbidity within Alabama Sturgeon habitat from in-stream gravel mining activities could be considered a ``may adversely affect situation that the Corps would need to address through section 7 consultation with the Service. However, the Service does not anticipate that turbidity produced from gravel-mining of unconsolidated substrates would likely jeopardize the continued existence of the Alabama Sturgeon.

Other regulatory activities of the Corps: The Corps authorizes other non-Federal activities (e.g., pipelines, piers, wharfs, and small boat channels) within waters of the United States within the historic range of the Alabama Sturgeon. These non-Federal activities are regulated through the Corps' regulatory program and evaluated on a case by case basis. Although these activities are on a much smaller scale than most other activities authorized by the Corps, these actions are more numerous and therefore could present a greater number of opportunities for the Service to consider impacts to the sturgeon. Thus, concern has been expressed that if the Alabama Sturgeon is listed permit applicants will be burdened by time delays and by requirements to conduct sturgeon surveys. The Service recognizes that some of the non-Federal activities authorized by the Corps (e.g., bridge pier placement and pipeline crossings) in the Alabama River system could be delayed by a requirement to conduct endangered species surveys (Alabama Sturgeon plus other listed species). However, it has been the experience of the Service that most of these non-Federal activities do not require a survey and further are not delayed because of endangered species issues.