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Chapter 3

SUMMER HOLDING AREAS OF THE GULF STURGEON WITHIN THE CONECUH/ESCAMBIA RIVER SYSTEM, ALABAMA AND FLORIDA

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ABSTRACT

The Gulf of Mexico sturgeon *Acipenser oxyrinchus desotoi* is an anadromous subspecies of the Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*. This federally threatened fish once inhabited Gulf coastal rivers from the Mississippi River to Tampa Bay, but is now rarely found

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south of the Suwannee River in Florida. The Conecuh/Escambia River system of Alabama and Florida contains more potential Gulf sturgeon spawning habitat than any other Florida Panhandle river, yet limited information is known about the sturgeons of this river. Radio transmitters were placed in 14 Gulf sturgeons collected from Escambia Bay during March through May of 2005. These radio-telemetered Gulf sturgeons were manually tracked via boat and radio receivers during April through November 2005 to collect summer holding area and movement data. Two, possibly three, summer holding areas were identified during this study, two in the Escambia River and one in the Delaney River.

INTRODUCTION

The Gulf of Mexico sturgeon *Acipenser oxyrinchus desotoi* (Vladykov, 1955) is a subspecies of the Atlantic sturgeon *A. o. oxyrinchus*. The Gulf sturgeon is an anadromous species that overwinters in the Gulf of Mexico and its associated estuaries, and then migrates into freshwater river systems of the Gulf Coast region for spawning during early spring (Huff, 1975). Gulf sturgeons remain within these rivers for summer refuge until they return to the feeding grounds of the Gulf of Mexico in autumn (Mason and Clugston, 1993).

The Gulf sturgeon historically inhabited coastal areas from the Mississippi River to Tampa Bay, but is now rarely found south of the Suwannee River in Florida (Foster and Clugston, 1997). Habitat destruction, overexploitation, and the blocking of spawning migration by dams and other anthropogenic river obstructions have all been major elements of the Gulf sturgeon's decline (Wooley and Crateau, 1985). Habitat destruction is primarily due to increased sediment loads within Gulf coastal plain rivers. Exploitation of the Gulf sturgeon increased in the 1860s, when it was discovered that smoked sturgeon meat could be used in place of smoked halibut (Smith, 1990). Another factor leading to increased harvesting of this fish was the discovery that its eggs could be used for high-quality caviar. To address the population decline of the Gulf sturgeon, it was federally listed as a threatened species in 1991; under the U.S. Endangered Species Act (USFWS, 1991). The U.S. Fish and Wildlife Service (USFWS) and the Gulf States Marine Fisheries Commission (GSMFC) formulated the Gulf Sturgeon Recovery and Management Plan in 1995 to identify priority action items needed to address numerous life history questions of this species (USFWS and GSMFC, 1995). Critical habitat was designated for the Gulf sturgeon in 2003 through a joint effort between the

USFWS and the National Marine Fisheries Service (USFWS and NMFS, 2003).

One very important element of the recovery plan established by the Gulf sturgeon Recovery/Management Task Team for the Southeast Region of the U.S. Fish and Wildlife Service (USFWS) is to locate and characterize critical habitat within each river that the Gulf sturgeon currently occupies (Hightower et al., 2002). Many studies recorded Gulf sturgeon congregations downstream of springs (Chapman and Carr, 1995; Foster and Clugston, 1997; Hightower et al., 2002). These areas may serve as thermal refuge from the surrounding higher temperatures within the rivers, and the deeper areas of river bottoms often associated with these springs may also serve as a refuge from surrounding river currents. Spawning habitats have been recorded within the Conecuh River, but only two areas have been suggested as summer holding areas within the Conecuh/Escambia River. One was suggested within the Conecuh River, near Brewton, Alabama, and the other was within the Escambia River, just below the Florida State Highway 184 Bridge (Quintette Bridge). Because the Conecuh/Escambia River has such large amounts of critical habitat, studying this river to obtain information about the location of additional summer holding areas and the Gulf sturgeon's use of habitat is an important part of implementing a successful recovery/management plan. This project is expected to aid the Conecuh-Sepulga Clean Water Partnership (CWP) in securing funds to work with the U.S. Fish and Wildlife Service to educate local landowners and farmers on proper land management techniques to help prevent further sedimentation of local rivers and streams. Locating the Gulf sturgeon's summer holding area locations within Conecuh/Escambia River will aid efforts to properly manage the designated critical habitat within this river. The objectives of this study were to track Gulf sturgeon movements and to identify summer holding areas within the Conecuh/Escambia River.

STUDY AREA

Although the Conecuh/Escambia River is a single river body, this river shares two names. The river reach within the state of Alabama is referred to as the Conecuh River, and the reach of river located within Florida is named the Escambia River (Figure 1). The entire length of the Conecuh/Escambia River totals 362 km. Lakes Gantt and Point-A are two reservoirs that occur within the Conecuh/Escambia River system. Point-A Dam is the most downstream impediment of this river system, and the tailrace of this hydroelectric dam is

located at river kilometer (rkm) 222 from the mouth of the Escambia River. The study area encompasses 132 km of the Conecuh River, from Point-A Dam to the Florida state boundary, and all 90 km of the Escambia River, from the Alabama state boundary to Escambia Bay, near Pensacola, Florida. All 222 km of the study area is designated as Gulf sturgeon critical habitat, and 38.6 km of this river reach is identified as potential Gulf sturgeon spawning habitat (USFWS, 2002).

The Sepulga River flows into the Conecuh River about 55.5 km downstream of Point-A Dam. A 25 km reach of this major Conecuh River tributary, from Bull Slough Landing in Paul, Alabama, to the Conecuh and Sepulga Rivers confluence, was included within the study area. The entire lengths of the Delaney and White Rivers, which are two major tributaries of the lower Escambia River, were also included within the study area. The Delaney River is 6.5 km long, and enters the lower Escambia River at rkm 29.4. The White River begins at a split from the Escambia River near rkm 17, and flows for 14.4 km before returning to the Escambia River just upstream of rkm five of the Escambia River.

Current land use within the Conecuh/Escambia River watershed is predominantly undeveloped lands with agriculture and silviculture uses. Threats to this river include the introduction of sediment and other non-point source pollutants as a result of these land uses and the many unpaved road crossings within this watershed.

METHODS

Study population collection occurred from 28 March 2005 to 16 May 2005 at Lora Point of Escambia Bay and at the Escambia River mouth (Figure 2). Gill nets with dimensions of 45.7 m long and 2.4 to 3.1 m deep, with 7.7 to 10.1 cm bar mesh, were used during the collection. Lora Point is located 3.45 km southwest of the Escambia River mouth, and was established as a sampling site for this study after learning from a local commercial fisherman that this location is a historical Gulf sturgeon fishing location. The eight netting attempts at Lora Point consisted of six to eight gill nets set at water depths of two to three meters. Two netting attempts occurred at the Escambia River mouth (Figure 2), and consisted of four gill nets placed in water depths of three to five meters and oriented toward the shoreline along the fringes of the navigational channel. The soak time of each gill net was limited to 1.5 hours to avoid asphyxiation of captured sturgeon. Netting was attempted within the

Conecuh and Escambia Rivers, but failed due to floating debris and numerous snags created by hurricanes Ivan and Frances that had recently passed through the study area.

Captured Gulf sturgeons were placed within an on-board live well system. Individuals were measured for total length (TL) and fork length (FL) to the nearest 0.1 cm, and were weighed with a spring scale to the nearest 0.1 kg. Each Gulf sturgeon received an external T-bar Floy tag (Floy FD-67) placed in both pectoral fins, and a passive integrative transponder (PIT) tag (Biomark) was injected into the base of the dorsal fin. Sub-adult (immature, 90 to 125 cm FL) and adult (mature, >125 cm FL) Gulf sturgeons (Sulak and Randall, 2004) were selected to receive an Advanced Telemetry Systems, Inc. (ATS) Model F1850 internal radio transmitter. The ATS transmitters operated at 40 MHz, measured 70 x 17 mm, weighed 26 g, had a battery life of 633 days at a pulse rate of 40 pulses-per-minute, and were equipped with a flexible external antenna. Radio transmitters were implanted into the abdomen of the selected Gulf sturgeons using the surgical procedure described by Fox et al. (2000). Released individuals were observed for proper orientation within the water and the ability to swim away unassisted.

Semi-monthly manual radio telemetry tracking within the Conecuh/Escambia River began via boat on 27 April 2005; thirty days after the first Gulf sturgeon was radio-tagged. The initial-location radio telemetry searches lasted three days each, and were narrowed to two days each once the Gulf sturgeons' respective summer holding areas were located. Initial-location radio telemetry tracking was aborted and two-day specific summer holding area radio telemetry tracking began on 14 June 2005. The specific summer holding area radio tracking occurred on a twice monthly interval. Two ATS radio receivers, Models 2100 and 2000, were onboard during each search. The ATS Model 2100 was programmed to detect all of the Gulf sturgeons that were radio-tagged for the purpose of this study.

The ATS Model 2000 radio receiver was programmed to receive all radio tag signals of Gulf sturgeons tagged in the Yellow River (Figure 1) by the USFWS ($n = 10$) during the fall of 2004; in an attempt to document the migration of these individuals into the Conecuh/Escambia River. A 2.74 m whip antenna was attached to the bow of the tracking boat and was connected to the radio receivers by a t-splitter with two coaxial cables. The effective range of reception with this type antenna and transmitter was about 180 m. Once a radio-tagged Gulf sturgeon was detected, the 2.74 m whip antenna was removed from the radio receiver and replaced with a short-range antenna (Hightower et al., 2002).

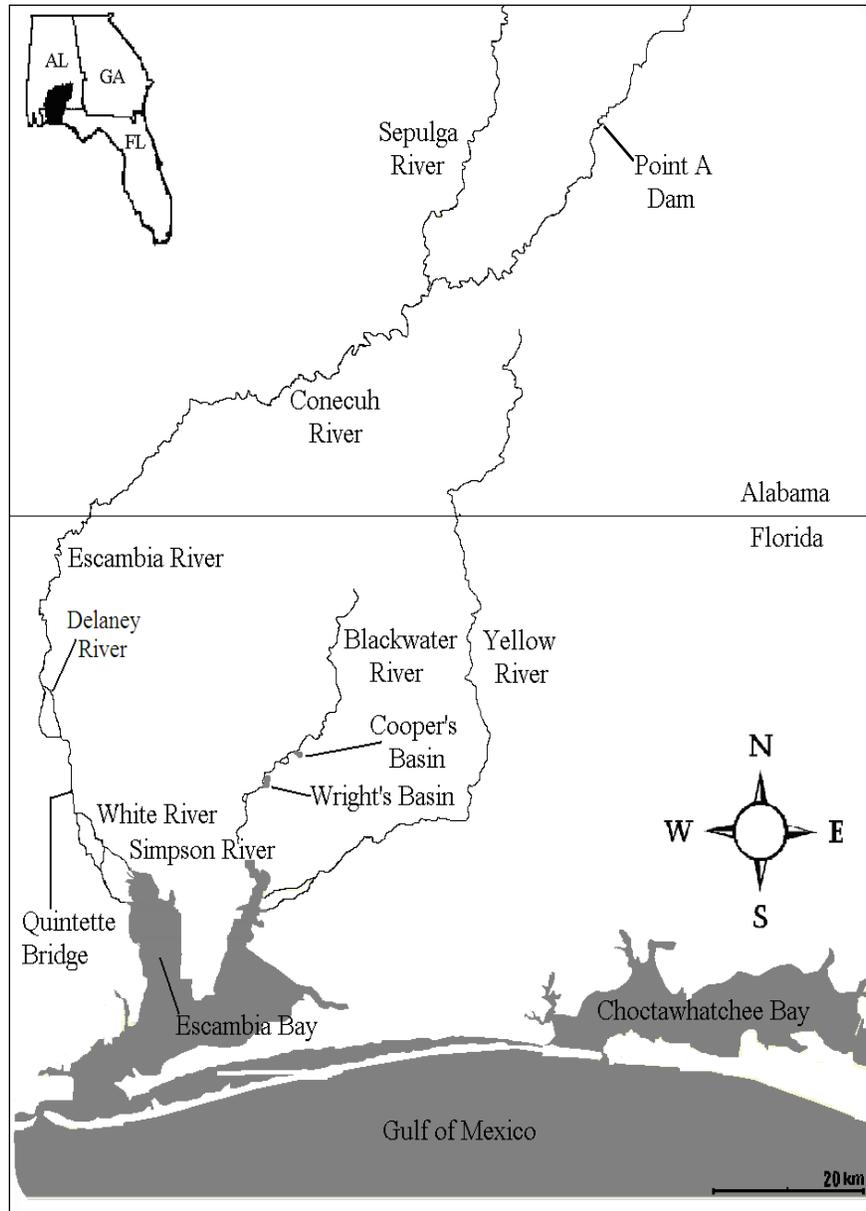


Figure 1. Map of the Conecuh/Escambia River system, from Point-A Dam in Andalusia, Alabama, to Escambia Bay in Pensacola, Florida.

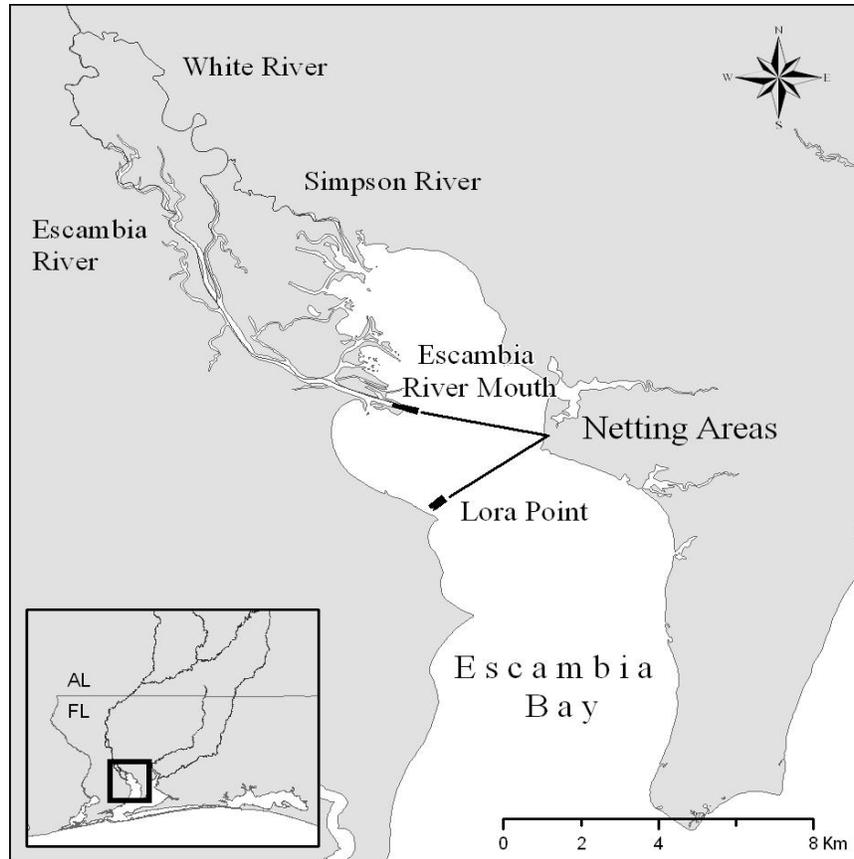


Figure 2. Map of the Escambia River and Escambia Bay Gulf sturgeon netting locations.

This method shortened the transmitter detection range, which allowed the position of the radio-tagged individual to be more precisely located. The latitude and longitude of each radio-tagged Gulf sturgeon telemetry relocation was recorded with either a Garmin GPS Map 76 or a Magellan Meridian Gold model handheld global positioning systems (GPS). Summer holding area lengths per Gulf sturgeon, which were determined by recording the most upstream and downstream radio detections of each individual within its chosen holding area, were recorded using the aforementioned GPS units. Flow volumes for the Escambia River were recorded from the U.S. Geological Survey (USGS) remote station # 02376033 near Molino, Florida. All tracking attempts ended on 2 December 2005.

RESULTS

Seven adult and five sub-adult Gulf sturgeons, ranging from 103 cm to 202 cm TL, were implanted with a radio transmitter during the netting attempts at Lora Point (Table 1). One of the adult individuals (Tag # 372) collected and radio-tagged at Lora Point was a gravid female. Two adult Gulf sturgeons (165 and 200 cm TL) collected at the Escambia River mouth received a radio transmitter implant (Table 1). One of these two adults, Tag # 912, was a gravid female.

Initial-Location Gulf Sturgeon Location Telemetry

Eleven of the fourteen Gulf sturgeons that were radio-tagged for this study were relocated via radio receivers within the study area (Table 1). Two of the fourteen radio-tagged individuals (Tag #s 330 and 372) were found in an area between Wright's and Cooper's Basins of the Blackwater River by USFWS biologists that were monitoring telemetry equipped fish in this river system. The location of these two Gulf sturgeons within the

Blackwater River was 55 km from where they were collected and tagged at Lora Point (Figure 1). One Gulf sturgeon that was radio-tagged during this study, Tag # 851, was never located during this study (Table 1). An adult Gulf sturgeon that was radio-tagged by the USFWS in the Yellow River during the fall of 2004, Tag # 761, was detected 13 times within the Escambia and Delaney Rivers (Table 1). The addition of this radio-tagged Yellow River Gulf sturgeon increased the study population to 12 individuals that supplied radio telemetry tracking data within the Conecuh/Escambia River study area.

There were 186 radio detections in the Conecuh/Escambia River during the monitoring period; with a mean of 15.5 radio detections per fish. The first radio-tagged Gulf sturgeon (Tag # 251) was located on 27 April 2005, and was 161 km upstream of its capture location at the Escambia River mouth on 28 March 2005. On 4 May 2005, this individual was telemetry relocated 37 km upstream of its 27 April 2005, location. The 4 May 2005, telemetry relocation of this Gulf sturgeon at rkm 198 of the Conecuh River, was the most upstream position that any of the radio-tagged Gulf sturgeons were found during this study. Craft et al. (2000) documented the occurrence of Gulf sturgeon spawning within the Conecuh River with the collection of eggs at five locations between rkm 161 and 170 of this river.

Table 1. Characteristics of radio-tagged Conecuh/Escambia River Gulf sturgeons

| Date of capture | Capture location | Radio tag ID | Age class | Fork length (cm) | Total length (cm) | Weight (kg) | Number of radio tag detections |
|-----------------|----------------------|--------------|-----------|------------------|-------------------|-------------|--------------------------------|
| 09/03/04 | Yellow River | 761* | Adult | No Data | No Data | 49.5 | 13 |
| 03/28/05 | Escambia River Mouth | 251 | Adult | 147.3 | 165.1 | 32.8 | 20 |
| 03/28/05 | Escambia River Mouth | 912 | Adult | 189.2 | 200.0 | 61.7 | 17 |
| 03/29/05 | Lora Point | 562 | Adult | 162.6 | 170.2 | 36.6 | 5 |
| 03/29/05 | Lora Point | 191 | Sub-adult | 111.8 | 121.3 | 11.6 | 21 |
| 03/29/05 | Lora Point | 521 | Adult | 127.0 | 139.7 | 17.8 | 19 |
| 03/29/05 | Lora Point | 233 | Adult | 137.2 | 154.9 | 22.5 | 15 |
| 04/04/05 | Lora Point | 572 | Sub-adult | 111.1 | 127.0 | 11.2 | 18 |
| 04/04/05 | Lora Point | 851 | Adult | 178.4 | 189.2 | 54.5 | 0 |
| 04/13/05 | Lora Point | 291 | Adult | 182.3 | 201.9 | 59.0 | 16 |
| 04/14/05 | Lora Point | 372 | Adult | 158.8 | 190.5 | 51.9 | 1 |
| 04/27/05 | Lora Point | 592 | Sub-adult | 92.7 | 102.9 | 6.2 | 19 |
| 04/27/05 | Lora Point | 330 | Sub-adult | 108.0 | 120.0 | 19.1 | 1 |
| 05/04/05 | Lora Point | 101 | Adult | 146.1 | 162.6 | 32.0 | 15 |
| 05/16/05 | Lora Point | 641 | Sub-adult | 99.1 | 114.3 | 7.0 | 8 |

Note: asterisk refers to fish collected and radio-tagged by USFWS on Yellow River in 2004.

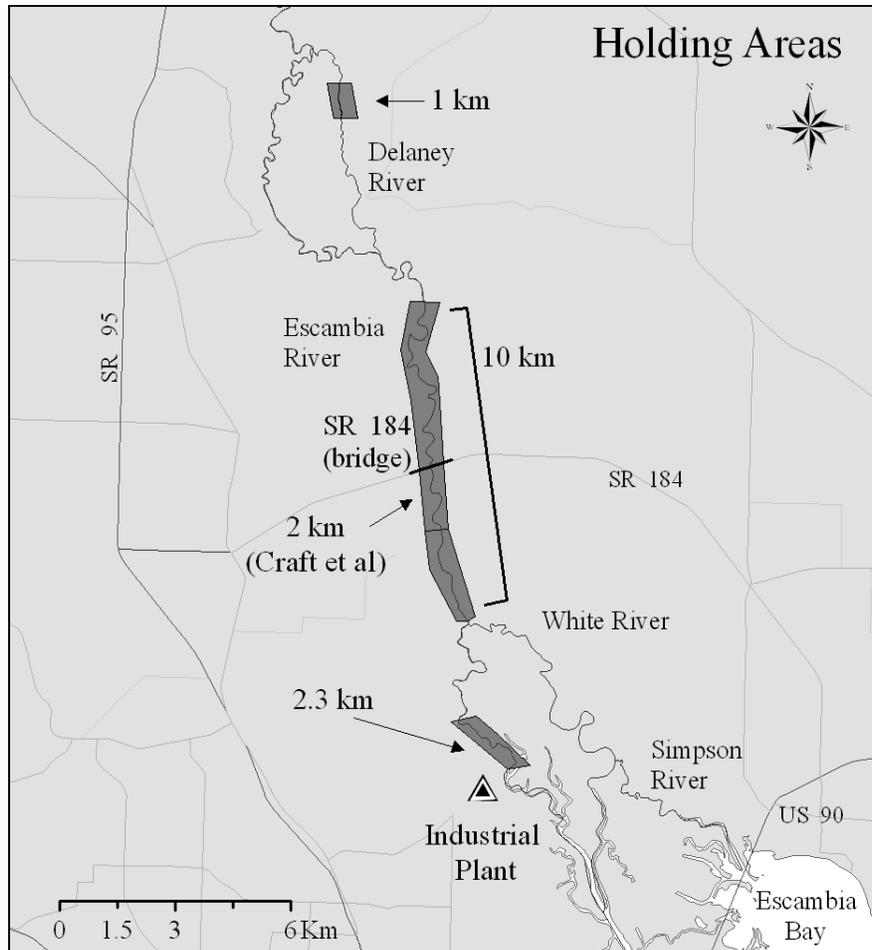


Figure 3. Map of the one, 2.3 and 10 kilometer Gulf sturgeon summer holding areas identified during this study within the Escambia River, Florida.

It is assumed that this individual (Tag # 251) continued upstream to complete its spawning run within the Conecuh River spawning grounds, but was not detected within this more upriver reach due to a one week lapse between radio tracking attempts. Tag # 251 was next detected 155 km downstream of its previous location, within the Escambia River, on 14 June 2005, and remained within this river reach for the remainder of the summer.

No other radio-tagged Gulf sturgeons were detected within the Conecuh River reach during five telemetry tracking trips that occurred April through

June 2005. No radio-tagged Gulf sturgeons were detected in the four tracking surveys conducted in the Sepulga River during the April through June 2005 time period. Radio-tagged Gulf sturgeons were documented using the White River for migratory activity during the initial-location radio tracking of this study. This is the first documentation of Gulf sturgeons using the White River as a migratory thoroughfare.

Summer Holding Area Telemetry and Gulf Sturgeon Movement Patterns

There were a total of 179 summer holding area radio telemetry detections, with an average of 14.9 detections per fish, among the 12 radio-tagged Gulf sturgeons of this study. The Conecuh and White Rivers radio tag relocations ($n = 7$) were deleted because the individuals were transient at the time of detection. The mean length of the summer holding areas used by individual Gulf sturgeons equaled 3.61 km ($n = 12$, 95% CI: 2.01-5.21), which was calculated by averaging the most upstream and most downstream locations that individual radio-tagged Gulf sturgeons were detected.

The summer holding area radio tracking efforts of this study documented 10.3 km of new Gulf sturgeon summer holding area habitat within the Escambia River, and confirmed two kilometers of summer holding area habitat that Craft et al. (2001) documented within this river during their study (Figure 3). Craft et al. (2001) noted that their Escambia River summer holding reach began at the Florida State Route (SR) 184 bridge (rkm 21), and stretched downstream for two kilometers. Our study documented that the Gulf sturgeon summer holding area at this location actually begins near rkm 27, and reaches downstream for 10 km. This study located another potential summer holding area 4.3 km downstream of the larger 10 km long Escambia River summer habitat (Figure 3). One radio-tagged Gulf sturgeon (Tag # 641) was detected within this suggested summer holding area that began at rkm 10.4 of the Escambia River, and stretched upstream for 2.3 km.

The Yellow River Gulf sturgeon (Tag # 761) that entered the Escambia River during this study migrated to a reach of the Delaney River for its summer refuge. This radio-tagged individual was telemetry relocated in the Delaney River on eight separate occasions from 13 July through 19 October 2005, and occupied a summer holding area that began 4.3 km upstream of the Delaney-Escambia River confluence, and reached upstream for 1 km (Figure

3). No summer holding areas were observed in the Conecuh, Sepulga or White rivers.

DISCUSSION

No summer holding areas were noted within the Conecuh, Sepulga or White rivers during this study. A 10 km and a 2.3 km summer holding area were located and documented within the Escambia River, and another was found within the Delaney River. Although Tag # 641 was the only radio-tagged Gulf sturgeon documented using the 2.3 km-long summer holding area in the lower Escambia River, it is possible that other Gulf sturgeons were also holding within this same area. Due to the confirmation of Tag # 641 and the probability of other non-telemetered Gulf sturgeons using this river reach as summer holding habitat, it is recommended that this area be included within the overall amount of summer holding area habitat documented by this study. One radio-tagged adult Gulf sturgeon (Tag # 761) was detected on nine occasions, from 13 July through 19 October 2005, within the Delaney River. It is recommended that this one kilometer reach of the Delaney River also be added to the summer holding area habitat designations of the Conecuh/Escambia river system due to the documentation of Tag # 761 using this river reach as summer habitat, and because of the numerous observations of breaching Gulf sturgeons within this location during the tracking efforts. This is the first documentation of Gulf sturgeons using the Delaney River for summer holding habitat.

We received anecdotal information from fishermen and from personnel of an industrial facility that Gulf sturgeons were often observed breaching during the summer and early autumn in an area of the Conecuh River associated with the confluence of Murder Creek, near Brewton, Alabama (Figure 1). Investigations by the USFWS within this area during this study did not produce evidence of Gulf sturgeons residing within this river reach. However, Craft et al. (2001) observed several Gulf sturgeons at this site during the summer of 2001, and personnel of the USFWS and the Alabama Department of Conservation and Natural Resources (ADCNR) collected and tagged 39 Gulf sturgeons at this location in 2002 (USFWS, 2002). The USFWS and ADCNR netting efforts occurred during a low water event of the Conecuh River; within a depression of the river bottom located at the Murder Creek – Conecuh River confluence. This depression could serve as a congregational area for Gulf sturgeons using the Conecuh River as summer holding area

habitat during periods of low river flow. Our netting efforts at this location occurred during a prolonged high water event of the Conecuh River, and this may explain our lack of netting success due to the abundant availability of other Conecuh River areas that Gulf sturgeons could use as summer holding area habitat during prolonged high water events. Although none of the Gulf sturgeons radio-tagged for this study was detected using this Conecuh River reach as a summer holding area, the information gathered by various agencies suggests that this site may be used as a summer holding area contingent upon water flows. Further summer investigations at different water flow volumes are needed to better define the significance of this Conecuh River site.

Movement and Habitat Selection

Rogillio et al. (2007) reported that radio tagged sub adult and adult Gulf sturgeons were spatially separated in their summer habitat within the Bogue Chitto River, Louisiana. Our findings did not indicate any separation of summer habitat use between radio-tagged sub adult and adult Gulf sturgeons, and we also observed that the sites chosen by radio-tagged Gulf sturgeons for summer holding areas did not visually differ from surrounding areas of the river. However, this study's radio-tagged Gulf sturgeon population preferred to remain within their designated summer holding area. Only one of the 179 summer holding area radio detections (0.56%) occurred outside of the defined summer holding reach during the tracking efforts. This finding supports that of Zehfuss et al. (1999), who noted that 75% of their radio-telemetered Gulf sturgeon detections were within the chosen summer holding area of the Apalachicola River.

On 10 August 2005, this wandering radio-tagged individual (Tag # 233) was detected within the White River; one kilometer downstream of where this river splits from the Escambia River. The distance that this Gulf sturgeon was detected outside of the Escambia River summer holding area is consistent with the observations of Carr et al. (1996) in the Suwannee River. They noted that Gulf sturgeon movements were limited to two kilometers upstream or downstream of their selected summer holding area within the Suwannee River. Chapman and Carr (1995) also observed Gulf sturgeons remaining within one kilometer upstream or downstream of their summer holding areas in the Suwannee River. Tag # 233 was next detected back within its summer holding area near the SR-184 bridge on 7 September 2005, and was never again detected outside of the summer holding area bounds. Our observation agreed

with the Apalachicola River study of Zehfuss et al. (1999), where their Gulf sturgeons also returned to the summer holding area after venturing beyond the holding area boundaries.

Though these summer holding area data suggest that Gulf sturgeons rarely venture beyond the bounds of a chosen summer holding area, most of the data were obtained using radio-telemetry equipment with manual tracking techniques. This method limits availability of movement observations due to the lapse of time that can occur between manual tracking efforts. Another limiting factor is that Gulf sturgeons often display more nocturnal mobility, and all of our observations occurred during the day. We recommend that future studies of the spawning migration and summer holding areas of Conecuh/Escambia River Gulf sturgeons use either sonic or radio transmitters with remote data-logging receivers. The use of these technologies can permit continuous tracking of Gulf sturgeon movements, which will supply more detailed data of the desired behaviors.

The radio-tagged sub adult Gulf sturgeon (Tag # 641) that selected its summer holding area at rkm 10.4 of the Escambia River exhibited an interesting behavioral pattern. This individual was detected on 7 September 2005, holding near the barge canal of an industrial facility (Figure 3). The area was free of barges at the time of observation, and the Gulf sturgeon was located in 4.88 m of water. This Gulf sturgeon was observed the next day 1.77 km upstream from its 7 September 2005 location. Upon traveling downstream to the previous location of this individual, there were two large barges moored where this Gulf sturgeon was located the day before. The river at this location was about 37 m wide, and was just large enough for one barge to moor along one side of the river and still allow vessel traffic to navigate the river. It is suspected that the disturbance from the barges' movement in such a narrow channel may have prompted this Gulf sturgeon to leave its location. This individual was never again observed in its original location at the industrial facility, and remained in a 1.19 km stretch of river ($n = 5$ observations), 0.7 km upstream of the facility. Although this observation only involved one fish, further study of sudden disturbances triggering an avoidance behavior of Gulf sturgeons within summer holding habitats may help further the understanding of summer refugia selection and behavior.

Periods of high flow were common on the Escambia River during the summer of 2005. The observed mean daily flow during the study period was nearly twice as high as the 20-year mean flow record for the USGS gauge # 02376033 near Molino, Florida (Figure 4). This study observed that prolonged periods of elevated flow volumes within the Escambia River during the Gulf

sturgeon summer holding months did not appear to affect radio-tagged Gulf sturgeons' fidelity toward their selected summer holding area or their migratory behavior. This observation was consistent with those of Wooley and Crateau (1985) and Zehfuss (2000) in the Apalachicola River, Foster and Clugston (1997) in the Suwannee River, and Hightower et al. (2002) in the Choctawhatchee River.

Spring inflows were often closely associated with congregating Gulf sturgeons in the Suwannee and Choctawhatchee Rivers (Chapman and Carr, 1995; Carr et al., 1996; Foster and Clugston, 1997; Hightower et al., 2002). This was not the case in the Escambia and Delaney River summer holding areas. There were only two documented springs in the Escambia River, yet the Florida reach of the Choctawhatchee River had seven springs within or near its main channel, and the Suwannee River had over 200 springs located within or near its main stem (Katz et al., 2003; Spechler and Schiffer, 1995). The nearest spring inflow to an Escambia River summer holding area was located 13.2 km upstream of the summer habitat located near the SR-184 bridge. Foster and Clugston (1997) pointed out that Gulf sturgeons in the Suwannee River could have been observed congregating near spring inflows simply because of the numerous springs located within this river's drainage, which our findings support.

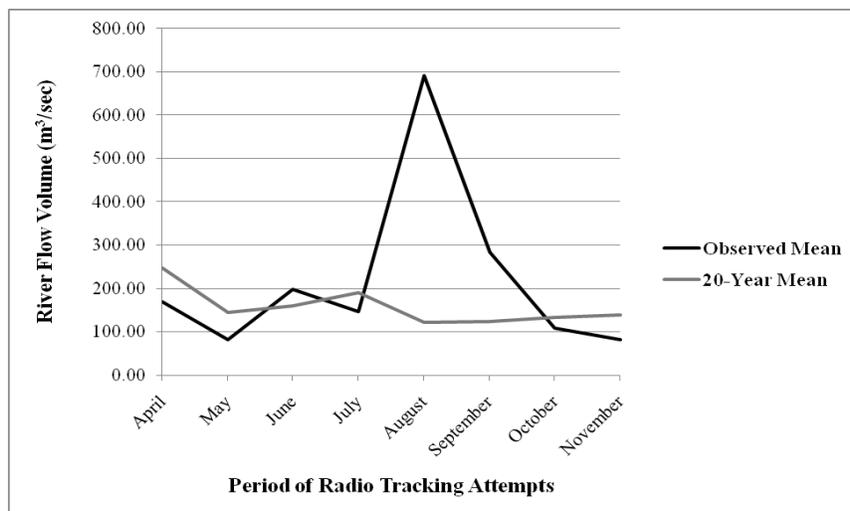


Figure 4. Mean Escambia River flow volumes observed April through November 2005 compared with 20-year mean flow volumes at the U.S. Geological Survey remote station # 02376033, near Molino, Florida, during radio tracking attempts.

Several Escambia River Gulf sturgeons were telemetry detected within scour holes and on the leeward side of ledges along the river's bottom. This behavior was well documented by Sulak and Clugston (1999) in the Suwannee River. Moser and Ross (1995) also observed this behavior in Atlantic sturgeons within the Lower Cape Fear River, North Carolina. It was originally suggested that these holes might serve as a form of temperature refuge, but Gulf sturgeons most likely use these depressed areas to escape strong river currents; thereby conserving energy during their long period of fasting (Sulak and Clugston, 1999).

CONCLUSION

The overall goal of this study was to locate and document Gulf sturgeon summer holding area habitats within the Conecuh/Escambia River Basin. This study confirmed the two-kilometer summer holding area documented by Craft et al (2001), and expanded the overall amount of suitable Gulf sturgeon summer holding area to 12.3 km within the Escambia River. A one kilometer long summer holding area was located and documented within the Delaney River. This study also tracked and documented a mature Gulf sturgeon traveling far upstream into the spawning habitat of the Conecuh River. The White River was documented for the first time as a thoroughfare for migrating Gulf sturgeons. Summer holding area movements of Gulf sturgeons within the Escambia River were consistent with the findings of other researchers, and we observed Gulf sturgeons migrating into and out of the river at water temperatures similar to those previously documented throughout the Gulf sturgeon's range. Unlike observations within the Choctawhatchee and Suwannee Rivers, the Escambia River Gulf sturgeons did not prefer locations downstream of spring inflows. Many Gulf sturgeons in the study population used scour holes and the leeward side of ledges, which may explain why they did not appear to be influenced to move downstream by the abnormally high flows of the river during the study period.

Documentation and protection of Gulf sturgeon summer holding areas are essential for the Gulf sturgeon's successful recovery. Measures must be taken to insure that water quality in the Conecuh/Escambia River system is maintained at standards that can support a healthy aquatic community. Environmental disturbances that may pose a threat to disrupting Gulf sturgeon summer holding areas within the Conecuh/Escambia River system also need to be documented and rectified. Further investigations using sonic or radio

transmitters and passive receivers are needed to determine whether additional Gulf sturgeon summer holding habitat is present within this riverine system.

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