

Estuarine and Marine Habitat

Most subadult and adult Gulf sturgeon spend cool months (October or November through March or April) in estuarine areas, bays, or in the Gulf of Mexico (Odenkirk, 1989; Foster, 1993; Clugston *et al.*, 1995; and Fox *et al.*, 2002). Studies of subadult Gulf sturgeon (ages 4 to 7) in Choctawhatchee Bay found that 78 percent of tagged fish remained in the bay the entire winter, while 13 percent ventured into a connecting bay. Possibly the remaining 9 percent overwintered in the Gulf of Mexico (FWS, 1998). Adult Gulf sturgeon are more likely to overwinter in the Gulf of Mexico, with 45 percent of the tagged adults presumed to have left Choctawhatchee Bay and spent extended periods of time in the Gulf of Mexico (Fox and Hightower, 1998; and Fox *et al.*, 2002). In contrast, Gulf sturgeon from the Suwannee River subpopulation are known to migrate into the nearshore waters, where they remain for up to two months and then depart to unknown feeding locations in the open Gulf of Mexico (Carr *et al.*, 1996b; and Edwards *et al.*, in prep.).

Research in Choctawhatchee Bay indicates that subadult Gulf sturgeon show a preference for sandy shoreline habitats with water depths less than 3.5 m (11.5 ft) and salinity less than 6.3 parts per thousand (Parauka *et al.*, in press). Fox and Hightower (1998) found that adult Gulf sturgeon monitored in Choctawhatchee Bay use some of the same habitats as subadults. The majority of tagged fish have been located in areas lacking seagrass (Fox *et al.*, 2002; and Parauka *et al.*, in press).

Craft *et al.* (2001) found that Gulf sturgeon in Pensacola Bay appear to prefer shallow shoals 1.5 to 2.1 m (5 to 7 ft) and deep holes near passes. Unvegetated, fine to medium-grain sand habitats, such as sandbars, and intertidal and subtidal energy zones resulting in sediment sorting and a preponderance of sand support a variety of potential prey items including estuarine crustaceans, small bivalve mollusks and lancelets (Menzel, 1971; Abele and Kim, 1986; American Fisheries Society, 1989; and M. Brim, FWS, pers. comm. 2002).

Habitats used by Gulf sturgeon in the vicinity of the Mississippi Sound barrier islands tend to have a sand substrate and an average depth of 1.9 to 5.9 m (6.2 to 19.4 ft). Preliminary data from bottom samples taken in these barrier island areas show that all samples contain lancelets (*Branchiostoma*). Since lancelets are a documented prey of Gulf sturgeon, it is likely that Gulf sturgeon are feeding along the sand substrate at

barrier island passes (Ross *et al.*, 2001a). Gulf of Mexico nearshore (less than 1.6 km (1 mi)) unconsolidated, fine-medium grain sand habitats, including natural inlets and passes from the Gulf to estuaries, support crustaceans such as mole crabs, sand fleas, various amphipod species, and lancelets (Menzel, 1971; Abele and Kim, 1986; American Fisheries Society, 1989; and Brim, pers. comm. 2002).

Estuary and bay unvegetated habitats have a preponderance of sandy substrates that support burrowing crustaceans, such as ghost shrimp, small crabs, various polychaete worms, and small bivalve mollusks (Menzel, 1971; Abele and Kim, 1986; American Fisheries Society, 1989; and Brim, pers. comm. 2002). Gulf sturgeon are often located in these areas, and because their known prey items are present, it is assumed that Gulf sturgeon are foraging.

Migration

Migratory behavior of the Gulf sturgeon seems influenced by sex, reproductive status, water temperature, and possibly river flow. Carr *et al.* (1996b) reported that male Gulf sturgeon initiate migration to the river earlier in spring than females. Fox *et al.* (2000) found no significant difference in the timing of river entry due to sex, but reported that males migrate further upstream than females and that ripe (in reproductive condition) males and females enter the river earlier than nonripe fish (Fox *et al.*, 2000). Most adults and subadults begin moving from estuarine and marine waters into the coastal rivers in early spring (*i.e.*, March through May) when river water temperatures range from 16.0 to 23.0 °C (60.8 to 73.4 °C) (Huff, 1975; Carr, 1983; Wooley and Crateau, 1985; Odenkirk, 1989; Clugston *et al.*, 1995; Foster and Clugston, 1997; Fox and Hightower, 1998; Sulak and Clugston, 1999; and Fox *et al.*, 2000), while others may enter the rivers during summer months (Fox *et al.*, 2000). Some research supports the theory that spring migration coincides with the general period of spring high water (Chapman and Carr, 1995; Sulak and Clugston, 1999; and Ross *et al.*, 2001b), however, observations on the Choctawhatchee River have not found a clear relationship between the timing of river entrance and flow patterns (Fox *et al.*, 2002).

Downstream migration from fresh to saltwater begins in September (at about 23°C (73.4°F)) and continues through November (Huff, 1975; Wooley and Crateau, 1985; and Foster and Clugston, 1997). During the fall migration from fresh to saltwater, Gulf sturgeon may require a period of physiological

acclimation to changing salinity levels, referred to as osmoregulation or staging (Wooley and Crateau, 1985). This period may be short (Fox *et al.*, 2002) as sturgeon develop an active mechanism for osmoregulation and ionic balance by age one (Altinok *et al.*, 1997). On some river systems, timing of the fall migration appears to be associated with pulses of higher river discharge (Heise *et al.*, 1999a and b; Ross *et al.*, 2000 and 2001b; and Parauka *et al.*, in press).

Sturgeon ages 1 through 6 remain in the mouth of the Suwannee River over winter. In late January through early February, young-of-the-year Gulf sturgeon migrate down river for the first time (Sulak and Clugston, 1999). Huff (1975) noted that juvenile Gulf sturgeon in the Suwannee River most likely participated in pre- and post-spawning migrations, along with the adults.

Findeis (1997) described sturgeon (Acipenseridae) as exhibiting evolutionary traits adapted for benthic cruising. Tracking observations by Sulak and Clugston (1999), Fox *et al.* (2002), and Edwards *et al.* (in prep.) support that individual fish move over an area until they encounter suitable prey type and density, at which time they forage for extended periods of time. Individual fish often remained in localized areas (less than 1 km² (0.4 mi²)) for extended periods of time (greater than two weeks) and then moved rapidly to another area where localized movements occurred again (Fox *et al.*, 2002). It is unknown precisely how much benthic area is needed to sustain Gulf sturgeon health and growth, but because Gulf sturgeon have been known to travel long distances (greater than 161 km (100 mi)) during their winter feeding phase, significant resources must be necessary. These winter migrations are an important strategy for feeding and for occasional travel to non-natal rivers for possible spawning and resultant genetic interchange among subpopulations. Bays and portions of Gulf of Mexico waters adjacent to the lakes and bays near the mouths of the rivers where Gulf sturgeon occur are believed to be important for feeding and/or migrating (inter-river migrations that facilitate maintenance of the natural hierarchy of between river genetic variability).

When temperature drops occur that are associated with major cold fronts, researchers of the Escambia, Yellow, and Suwannee Rivers subpopulations have been unable to locate adult Gulf sturgeon within the bays (Craft *et al.*, 2001; and Edwards *et al.*, in prep.). They hypothesize that the drop in water temperatures associated with cold fronts disperses sturgeon to more distant foraging grounds. It is currently