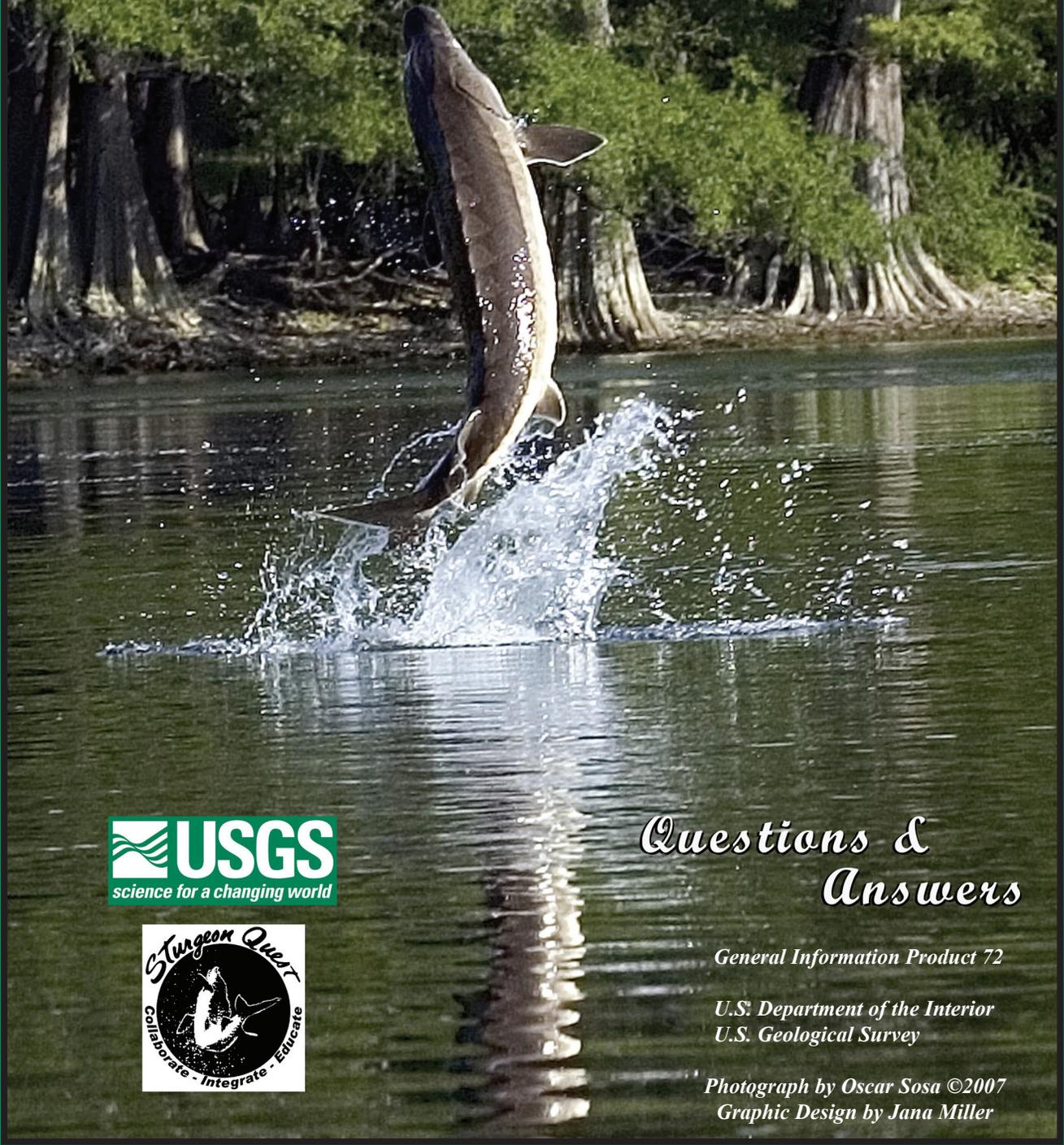


The Gulf Sturgeon In the Suwannee River



Questions & Answers

General Information Product 72

*U.S. Department of the Interior
U.S. Geological Survey*

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The Gulf Sturgeon in the Suwannee River: Life History Questions & Answers

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STURGEONS and PADDLEFISHES are modern descendants of an ancient group of freshwater fishes, the Chondrostei (a group of bony fishes with mostly cartilaginous skeletons). Sturgeons evolved during the Age of the Dinosaurs, and have prospered in the large rivers and lakes of North America, Europe and Asia for 200 million years. Together with alligators and crocodiles, they survived the mass extinction at the end of the Mesozoic Era, when the dinosaurs and many other groups of animals disappeared forever. They originated prior to the creation of the Atlantic Ocean, when the Northern Hemisphere supercontinent Pangea broke into North America and Eurasia. Most sturgeons are highly specialized to feed in the sediment on small invertebrate prey, a radical evolutionary departure from most of their fish-eating ancestors.

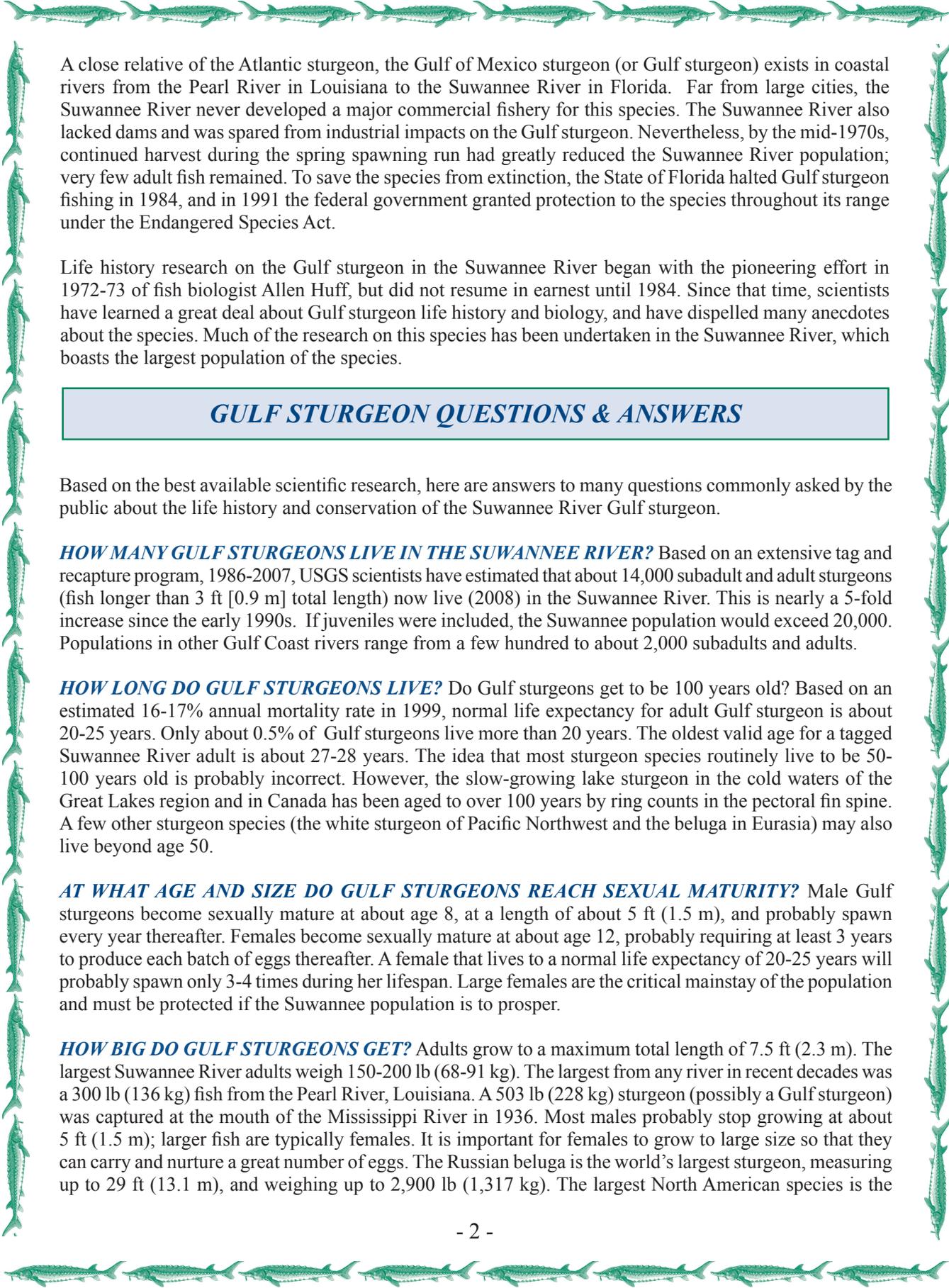
Populations of the world's 25 sturgeon species have been greatly diminished by overfishing, damming of rivers, and pollution over the last 150 years. But, before these devastating human impacts, sturgeons were enormously successful, existing in vast numbers, dominating most major river systems in the Northern Hemisphere. Sturgeons are the world's largest freshwater fishes. In Colonial America, coastal rivers were so heavily populated by



Gulf of Mexico Sturgeon
Acipenser oxyrinchus desotoi

large sturgeons that they were a hazard to navigation. With their large armored bodies, sturgeons are relatively immune to many predators, compared to smaller and more vulnerable bony fishes. Thus, unlike smaller fishes, sturgeons can exploit food resources on open unprotected sand habitats. They are also unique in having evolved a protrusible suction-feeding mouth, elegantly adapted to exploit tiny insect larvae, small crustaceans, worms, lancelets, lampshells, and other small prey that inhabit sand habitats. Finally, large body size and a low-speed lifestyle enable sturgeons to store and conserve enormous amounts of energy to fuel growth, reproduction and migration, and to live off their energy stores without feeding during the extreme conditions of either winter or summer, or in habitats where prey are scarce. Their unique abilities to exploit open unprotected habitats in big rivers and estuaries, feed on vast numbers of minute prey populating sand habitats, and exist on stored energy for many months, are the secrets of the success of sturgeons over millions of years. Since they forage for food by taste, touch and electrosensory organs, sturgeons have another particular advantage over most competing fishes. Unlike their competitors, sturgeons do not depend primarily on vision to find and ingest food, and can thus feed during both day and night.

Commercial net fishing during the spring spawning run decimated almost all North American sturgeon populations, beginning in the late 1800s. Sturgeons were harvested for both flesh and eggs. Large females were particularly targeted for caviar, effectively preventing re-population. By 1900-1920, only remnant populations remained in most rivers. Compounding the impact of rampant overfishing was extensive dam building during the early to mid-20th century. Dams fragmented sturgeon populations, and cut off access to upriver spawning grounds.



A close relative of the Atlantic sturgeon, the Gulf of Mexico sturgeon (or Gulf sturgeon) exists in coastal rivers from the Pearl River in Louisiana to the Suwannee River in Florida. Far from large cities, the Suwannee River never developed a major commercial fishery for this species. The Suwannee River also lacked dams and was spared from industrial impacts on the Gulf sturgeon. Nevertheless, by the mid-1970s, continued harvest during the spring spawning run had greatly reduced the Suwannee River population; very few adult fish remained. To save the species from extinction, the State of Florida halted Gulf sturgeon fishing in 1984, and in 1991 the federal government granted protection to the species throughout its range under the Endangered Species Act.

Life history research on the Gulf sturgeon in the Suwannee River began with the pioneering effort in 1972-73 of fish biologist Allen Huff, but did not resume in earnest until 1984. Since that time, scientists have learned a great deal about Gulf sturgeon life history and biology, and have dispelled many anecdotes about the species. Much of the research on this species has been undertaken in the Suwannee River, which boasts the largest population of the species.

GULF STURGEON QUESTIONS & ANSWERS

Based on the best available scientific research, here are answers to many questions commonly asked by the public about the life history and conservation of the Suwannee River Gulf sturgeon.

HOW MANY GULF STURGEONS LIVE IN THE SUWANNEE RIVER? Based on an extensive tag and recapture program, 1986-2007, USGS scientists have estimated that about 14,000 subadult and adult sturgeons (fish longer than 3 ft [0.9 m] total length) now live (2008) in the Suwannee River. This is nearly a 5-fold increase since the early 1990s. If juveniles were included, the Suwannee population would exceed 20,000. Populations in other Gulf Coast rivers range from a few hundred to about 2,000 subadults and adults.

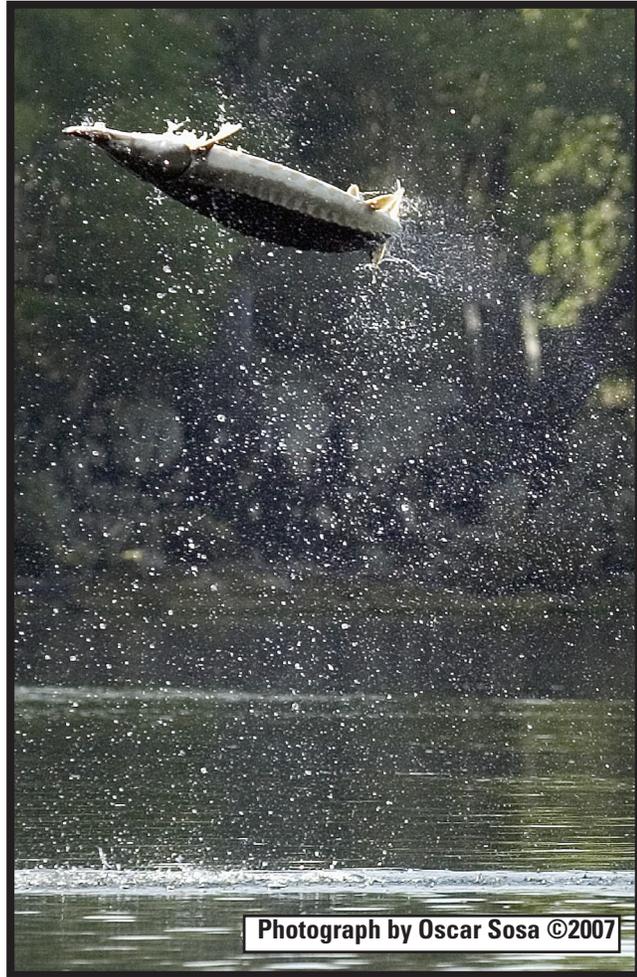
HOW LONG DO GULF STURGEONS LIVE? Do Gulf sturgeons get to be 100 years old? Based on an estimated 16-17% annual mortality rate in 1999, normal life expectancy for adult Gulf sturgeon is about 20-25 years. Only about 0.5% of Gulf sturgeons live more than 20 years. The oldest valid age for a tagged Suwannee River adult is about 27-28 years. The idea that most sturgeon species routinely live to be 50-100 years old is probably incorrect. However, the slow-growing lake sturgeon in the cold waters of the Great Lakes region and in Canada has been aged to over 100 years by ring counts in the pectoral fin spine. A few other sturgeon species (the white sturgeon of Pacific Northwest and the beluga in Eurasia) may also live beyond age 50.

AT WHAT AGE AND SIZE DO GULF STURGEONS REACH SEXUAL MATURITY? Male Gulf sturgeons become sexually mature at about age 8, at a length of about 5 ft (1.5 m), and probably spawn every year thereafter. Females become sexually mature at about age 12, probably requiring at least 3 years to produce each batch of eggs thereafter. A female that lives to a normal life expectancy of 20-25 years will probably spawn only 3-4 times during her lifespan. Large females are the critical mainstay of the population and must be protected if the Suwannee population is to prosper.

HOW BIG DO GULF STURGEONS GET? Adults grow to a maximum total length of 7.5 ft (2.3 m). The largest Suwannee River adults weigh 150-200 lb (68-91 kg). The largest from any river in recent decades was a 300 lb (136 kg) fish from the Pearl River, Louisiana. A 503 lb (228 kg) sturgeon (possibly a Gulf sturgeon) was captured at the mouth of the Mississippi River in 1936. Most males probably stop growing at about 5 ft (1.5 m); larger fish are typically females. It is important for females to grow to large size so that they can carry and nurture a great number of eggs. The Russian beluga is the world's largest sturgeon, measuring up to 29 ft (13.1 m), and weighing up to 2,900 lb (1,317 kg). The largest North American species is the

white sturgeon, which reaches a length of 18 ft (5.5 m) and a weight of 1,900 lb (863 kg).

WHY DO STURGEONS JUMP? Jumping behavior in many fishes probably evolved as a startle or escape response to predators. But the patterned aerobatics of Gulf sturgeon appear to serve another purpose. Gulf sturgeons rarely jump during spring or fall migrations, or during the spawning season. Jumping occurs most frequently in mid-summer in the river when sturgeons are fasting, so jumping at this time is not associated with feeding. The suggestion that sturgeons or other fish species jump to shed parasites is a false notion. Parasites anchor themselves firmly with suction disks, hooks, and anchors. They would not be so easily dislodged from a sturgeon (consider, for instance, the tenacity of a wood tick). The idea that jumping is simply a random behavior is countered by the fact that jumping occurs intensely at dawn and dusk, but much less frequently in between. However, jumping must be important. During a time of fasting and energy conservation, considerable energy must be expended to launch a 100 lb (45 kg) Gulf sturgeon six feet (1.8 m) into the air. When Gulf sturgeons jump, they typically flip sideways or upside-down, landing with a loud smacking report that can be heard for a great distance. Before and after a jump, Gulf sturgeons also produce a characteristic series of accompanying underwater sounds. It is highly probable that the overall sound pattern announces the location of the group to other sturgeons during summer holding in the river and winter foraging in the Gulf.



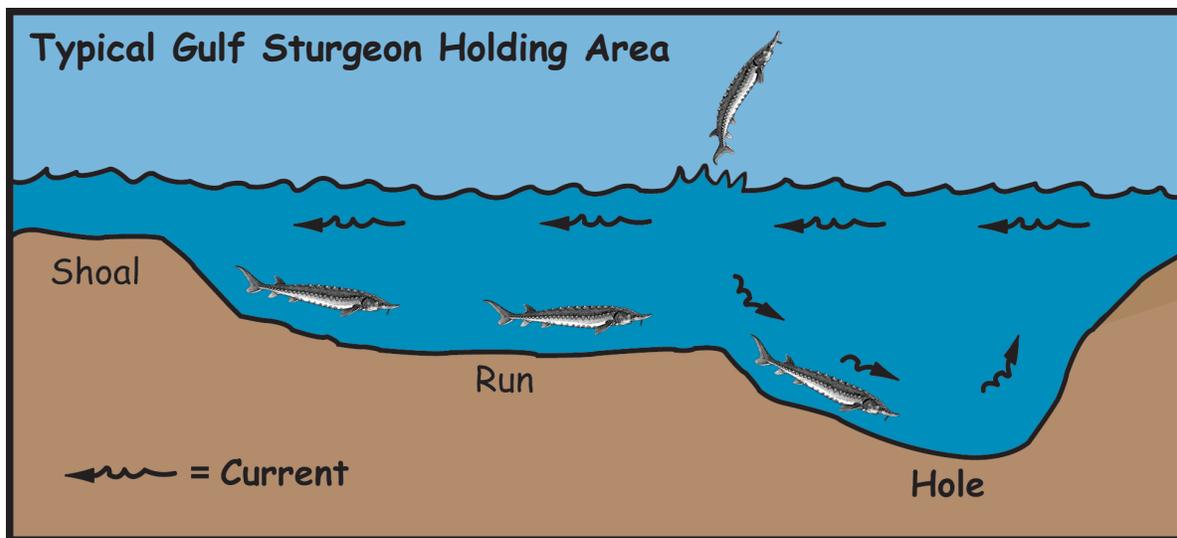
DO GULF STURGEONS ATTACK BOATS? No. Jumping is a natural behavior for Gulf sturgeons in summer holding areas, whether boats are present or not. Gulf sturgeons do not aim themselves at passing boats. Rather, just as roadside deer are hit by fast-moving cars, jumping sturgeons are sometimes struck by speeding boats. The impact of a fast-moving boat with a large airborne sturgeon can cause serious injury to boat passengers and the sturgeon alike. Indeed, boat strikes are a growing source of non-natural sturgeon mortality in the Suwannee River. The Florida Fish and Wildlife Conservation Commission has posted signs warning boaters to slow down to help reduce dangerous collisions. Sturgeon collisions can be minimized by proceeding slowly and close to the shoreline through known holding areas; sturgeons rarely jump in the shallows close to shore.

HOW MANY EGGS DOES A FEMALE GULF STURGEON PRODUCE? Each female produces between 200,000-500,000 eggs per spawning cycle. However, natural mortality from mishaps, predators, diseases, water quality, and all other causes will claim 99.999% of eggs, hatchlings and juveniles. So, only a very few eggs will eventually become adult sturgeons. This is natural. Each female only needs to produce two successful offspring during her life to maintain a stable population, replacing herself and one male. If many offspring survived to adulthood, any sturgeon river would rapidly become overpopulated.

IS IT TRUE THAT STURGEONS HAVE NO NATURAL PREDATORS? Although well armored with bony scutes, sturgeons are still vulnerable to many predators, and succumb to other sources of mortality as well. Their eggs are consumed by numerous other fishes and aquatic insect larvae. Hatchlings and young juveniles fall prey to a host of fish predators, probably including catfishes, bass, sunfishes, bowfin, gar, and small alligators. Fingerlings foraging in shallow water at night are probably targeted by barred owls. Juveniles could also be relatively easily captured by otters. Population statistics from the 22-year tag and recapture USGS database show that 12-17 subadults and adults out of every 100 die each year of natural causes, including old age. Adults bearing scars from shark and alligator bites demonstrate that even large sturgeons sometimes fall victim to predators.

WHAT DO GULF STURGEONS FEED ON WHILE IN THE RIVER? Except during their first year of life in the river, Gulf sturgeons normally do not feed while in freshwater. All feeding after the first year takes place in estuarine waters (juveniles) or in nearshore marine waters of the open Gulf of Mexico (subadults and adults) during winter. Gulf sturgeon feed intensively in winter, vacuuming up small benthic prey from soft, sandy marine substrates. Then, from March-April through October-November, they rarely feed, instead utilizing energy stored in their body fat and muscle. Individual fish can lose up to 30% of their body weight during the summer-fall fasting period. But, this weight loss is more than compensated for during the next round of winter feeding, when Gulf sturgeons can increase their body weight as much as 130%.

ARE NORTH FLORIDA SPRINGS IMPORTANT IN THE LIFE HISTORY OF THE GULF STURGEON? Gulf sturgeons do not normally inhabit freshwater springs, nor seek out springwater outflows as thermal refuges. Sturgeons require well-oxygenated water, but springwater is typically very low in oxygen, far too low for sturgeons to endure for very long. Sturgeons are also secretive fishes that prefer life in dark water. Their brown upper body color matches the dark river water, but is poor camouflage in clear springwater over the light gray substrate of spring heads and runs. Floridan Aquifer springs are not typical habitat for the Gulf sturgeons. Indeed, aside from the Suwannee River, most Gulf Coast sturgeon rivers have few springs.



DO GULF STURGEONS DEPEND ON SPRINGWATER AREAS AS THERMAL REFUGES IN SUMMER? Gulf sturgeons in the Suwannee River reside in a small number of holding areas between May and October. Holding areas are characterized by a 20-40 ft (6-12 m) deep scour hole, above a 0.5-2.0 mi (0.8-3.2 km) long, 8-12 ft (2.4-3.7 m) mid-depth straight run, above a 2-6 ft (0.6-1.8 m) deep shoal. The deep waters of such 'hole-run-shoal' areas have low velocity bottom currents, providing energetic refuge from the main river current. This is very important during the summer fasting period when energy must be



conserved for at least six months. Water temperature is unimportant in determining the location of summer holding areas. The Suwannee is very well mixed; springs have slight influence on local water temperature. Temperature in one place varies much more due to day-time warming and night-time cooling than due to local springwater influences. Each holding area is the summer home of several hundred sturgeons of all sizes. Major holding areas occur above Jacks Sandbar, below Manatee Springs, between Fanning Springs and Usher Landing, below Old Town Trestle, near Sun Spring, near Rock Bluff, below the conjunction of the Santa Fe and Suwannee rivers, and near Anderson Springs. There are also a number of less important holding areas. Holding areas are readily recognized in mid-summer as areas where sturgeons are frequently observed jumping. Some holding areas occur near major springs, others do not – but with over 200 springs along the river, it is not surprising that some holding areas lie near named springs. Geologically, spring outflows may have contributed to the formation of holding areas in the riverbed by gradually eroding out deep scour holes that sturgeons use as energetic refuges.

WHY DO GULF STURGEONS COME INTO THE SUWANNEE RIVER; AREN'T THEY REALLY MARINE FISH? AND, WHY DO THEY STAY IN THE RIVER IF THEY DO NOT FEED THERE?

Gulf sturgeons are called anadromous fishes, from the Greek, meaning fishes that travel back and forth between freshwater and saltwater. However, like their ancient Chondrosteian ancestors, Gulf sturgeons are fundamentally freshwater fishes. They visit marine waters to exploit the rich supply of benthic invertebrate prey found on sandy bottom. However, they must return to freshwater rivers to spawn since the eggs and early hatchlings cannot tolerate saltwater. Also, a great deal of energy would be required to remain in the ocean year-round to continually pump salt out of the blood and body tissues. Feeding in the open Gulf of Mexico is confined to winter when sharks and other large predators have migrated south or into deeper waters. In the summer, the Suwannee River and other Gulf Coast rivers are safe havens from sharks. More importantly, these rivers provide comfortable freshwater refuges from the physiological stress of saltwater.

DOES RIVER FLOW OR WATER LEVEL AFFECT RE-POPULATION OF THE GULF STURGEON?

Although it has generally been thought that low flow in spring negatively impacts sturgeon reproduction, there is no evidence for this in the Gulf sturgeon. Instead, the success of Young-of-the-Year (YOY) is correlated with river flow in fall and early winter. This is the time of year when YOY migrate downriver to feed in the estuary. Strong river flow during this season probably extends the area of low salinity water at the river mouth, greatly expanding the estuarine feeding area of small juveniles, which cannot tolerate high salinity. However, exceptionally low water during any season probably impacts all sturgeon life history stages. Low water promotes growth of the filamentous green alga *Vaucheria*, clogging the Suwannee River bottom feeding habitat of YOY with ropes and mats of algae, and probably depleting dissolved oxygen at night.

ARE GULF STURGEONS REALLY COLD-WATER FISHES LIVING ON THE EXTREME EDGE OF THEIR TEMPERATURE TOLERANCE?

No, this is not true, nor must Gulf sturgeons seek out cool springwater to survive summer temperatures. Gulf sturgeons have adapted to their southern habitat over

tens to hundreds of thousands of years. They are well adapted to the 50-90 °F (10-32 °C) annual temperature range that they regularly experience, including high mid-summer water temperatures. The Suwannee River is atypical among Gulf sturgeon rivers, being cooled by the influx of Floridan aquifer ground water from hundreds of springs and seeps. Summer water temperatures rarely exceed 79-82 °F (26-28 °C), a range easily tolerated by Gulf sturgeons. In contrast, some other Gulf Coast rivers heat up to 86-90 °F (30-32 °C) for several months, but Gulf sturgeons still move actively even at these elevated temperatures. Some of the world's other sturgeon species are adapted to even warmer water. For example, the Chinese sturgeon ranges into tropical waters in the South China Sea.

WHY DO GULF STURGEONS CEASE TO FEED IN THE SUMMER? Actually, feeding ceases in early spring, immediately when Gulf sturgeon first enter freshwater, while river water temperatures are near their coldest 50-63 °F (10-17 °C) of the year. The likely reason that feeding stops is that larval insect prey in the Suwannee River are tiny and very sparsely distributed. Essentially, it is not worth the energy cost to actively forage for scarce invertebrate food in the river, particularly since foraging requires expending energy to swim against the strong river current. Intense feeding on abundant prey in marine waters provides all the energy needed for the whole year.

EXCEPT WHEN THEY JUMP, WHY ARE STURGEON SO RARELY SEEN OR CAUGHT IN THE SUWANNEE RIVER?

Much of Gulf sturgeon behavior, including spawning and the fall migration to the Gulf, takes place at the bottom of the river, in dark

tannic water, and often at night. Fingerlings are cryptic and nocturnal, rarely venturing into shallow water in the daytime, or into the clear waters of spring outflows. Since larger sturgeons typically do not feed in the river, they are rarely caught on fishing gear. Every so often, however, a sturgeon that cannot resist sucking down a fat worm dangling just within reach is caught by a surprised angler.

DO STURGEONS FORM SCHOOLS? Unlike many other fishes, Gulf sturgeons do not school. Behaving more like herd animals, they congregate loosely during the winter feeding period and during the summer fasting period. They may also move in loosely-organized pods during the spring and fall migrations, probably maintaining contact by sound, and/or by smell. However, tag recapture data show that individual males and females may form a bonded pair that stays together for years, perhaps for life.

ARE GULF STURGEONS FOUND IN THE SMALLER TRIBUTARIES OF THE SUWANNEE RIVER?

Almost all sturgeon species live primarily in large rivers. They generally do not go into small streams and tributaries, or do so only briefly for spawning. Although abundant in the main stem of the lower and middle



Suwannee River, Gulf sturgeon are rarely found in the Santa Fe and Alapaha rivers, and venture only a short distance up the Withlacoochee River (the largest tributary of the Suwannee). In the Suwannee River proper, adults are seldom found above Suwannee State Park, except during the spawning season. The YOY extend farther upriver to at least White Springs, with occasional sightings above Big Shoals.

WHERE DO GULF STURGEONS SPAWN? Like most sturgeon species, Gulf sturgeons require gravel substrate for spawning. The sticky eggs must be deposited directly on clean gravel. After hatching, larvae hide under the gravel for the first few days of life. Spawning grounds must have high velocity flow, well-oxygenated water, and a particular chemistry measured as pH and dissolved calcium. Water chemistry must be just right for eggs to become adhesive and for sperm to function normally. Gravel substrate is rare in the Suwannee River. Sand bottom predominates in the lower river, giving way to expanses of bare rock in the upper river. Gravel substrate, predictably high-velocity flow, and favorable water chemistry (very slightly acidic with abundant dissolved calcium) co-occur only along a 15-mile (24 km) stretch of the upper Suwannee. There are just four known (by egg collections) spawning grounds in the Suwannee mainstem, all located between Anderson Springs and Devil's Neckbone. All are very small, typically less than the size of a football field. The most important spawning ground is near Nobles Ferry (Gibson Park). Another spawning ground lies in the lower part of the Withlacoochee River above Suwannee State Park.

DON'T STURGEONS BROADCAST THEIR EGGS INDISCRIMINATELY OVER LARGE AREAS? No. It is misleading to consider the Gulf sturgeon as a broadcast spawner, implying that eggs are released indiscriminately in open water to drift in the current and land where they may. Instead, eggs are deposited directly onto gravel substrate – not released into the water column - and only on specific gravel bed areas selected by spawning females. Eggs that fail to stick will get swept downstream, get coated with sand, and probably fail to hatch.



A 3-inch long, 2-month old Suwannee River Gulf sturgeon fingerling.

WHERE DO HATCHLINGS AND FINGERLINGS LIVE? After hatching, the tiny, helpless larvae hide in gravel on the spawning ground, living off energy stored in the yolk sac. Four to five days later, after the mouth and fins develop, they emerge and begin to feed voraciously on insect larvae, repeatedly swimming up into open water. The YOY fingerlings disperse widely in the whole river from White Springs down to Long Reach, just upstream of the town of Suwannee, but avoid the saline rivermouth. They forage individually and apparently do not aggregate, except perhaps immediately before downriver migration in January-February. Fingerlings are rarely captured, and then only one at a time. The nearly jet-black fingerling may hide among black vegetative matter (leaves and sticks) that accumulate in swales on the river bottom. Depending on a meager diet of gnat larvae, fingerlings are typically very slender. After reaching the estuary in mid-winter, they fatten quickly in the brackish oasis of abundant food.

WHY DO LARGE MALES NETTED IN SPRING AND FALL HAVE RED ABRADED SNOUTS? ARE THEY DAMAGED FROM CAPTURE IN NETS? When scientists capture sturgeons in large mesh nets made of loose multi-filament twine (instead of monofilament), fish are rarely injured in any way. During spawning, which takes place at night, several males may compete for one female. Spawning males repeatedly rub their snouts vigorously against the flanks of the female. Their snouts become red, raw, and sometimes bloody from rubbing the bony scutes and sandpaper-like skin of the female. The abdomen of the female also becomes pink or red from the same rubbing behavior. Since a few fish may spawn in fall, red snouts and flanks may also be observed then.



HOW HAVE STURGEON POPULATIONS BEEN ABLE TO REBOUND AFTER BEING FISHED TO THE BRINK OF EXTINCTION?

Sturgeons are very unusual genetically. All sturgeon species have multiple sets of chromosomes (a condition known as polyploidy), with as many as 500 chromosomes in some species. The Gulf sturgeon has about 120 chromosomes (compared to 48 for many marine fishes, and 46 in humans). Polyploidy in sturgeons may confer unusual genetic plasticity and potential ecological adaptability, enabling rapid accommodation to changing conditions. Sturgeons display a remarkable ability to re-populate from a very small number of adults, without detrimental effects. They seem able to avoid the anticipated adverse effects of inbreeding within a very small population. A small portion of any sturgeon population always behaves differently than the majority, evidence of behavioral and ecological adaptability.

WHAT EVENTS TRIGGER THE FALL EMIGRATION TO THE GULF?

Adult sturgeons migrate downriver in October-November as water temperature drops to 20°C. But a distinct, as yet unknown, migration cue precedes the thermal cue. Adults begin to produce a thick, copious slime beginning in mid-September while the river is still very warm. Day-length (photoperiod) may be the initial pre-migratory cue, or an intrinsic biological clock may trigger the migratory urge. Such an intrinsic clock may result from growing physiological hunger toward the end of summer fasting. In some years, fall migration may be cued early by high river flow from a late tropical storm. Adults may remain in the river mouth for a few days or weeks prior to entering saltwater, gradually adjusting to salinity. They enter Suwannee Sound mid-salinity waters and adjacent nearshore waters, and feed there until the first major winter front prompts emigration into the open Gulf of Mexico in December-January. Thereafter, individuals disperse widely along the coast, remaining in waters less than 20 ft (6 m) deep. Tagged Suwannee River Gulf sturgeons have been recovered as far south as Tampa Bay and as far north as the Apalachicola River.

DO GULF STURGEONS HOME TO THE RIVER WHERE THEY HATCHED?

Like anadromous salmon, sturgeons are thought to home strongly to their natal river, the river where they hatched from eggs. Telemetry and genetic studies confirm general homing behavior. However, there is some straying and exchange among Gulf Coast river populations. Exchanges between the Suwannee and Apalachicola rivers (and vice-versa), and the Ochlockonee and Suwannee Rivers have been documented by tag returns and acoustic telemetry. Exchanges between other Gulf sturgeon rivers also occur. Routine straying from the Suwannee River population may be important in maintaining the populations of the Apalachicola and Ochlockonee rivers, where spawning is restricted or impossible due to dams blocking access to natural spawning grounds upriver.

HOW DO WE KNOW THAT THE GULF STURGEON POPULATION IS INCREASING NATURALLY?

Fishery biologists captured and tagged an average of 600 Gulf sturgeons each year in the Suwannee River from 1986-1999, and a average of 350 in 2006-2007. Statistical analyses of recapture data show that the population has increased 5-fold under State of Florida (1984) and Federal (1992) protection. It now contains a healthy mix of size-classes, evidence of repeated spawning success. The percentage of sexually mature adults has also increased from 10 % to 40 % of the population. Finally, the annual mortality rate for subadults and adults has declined from 16-17 % to 12%. Thus, more fish are surviving to sexual maturity.

WOULD RELEASING HATCHERY-REARED STURGEONS HELP THE SPECIES RE-POPULATE THE SUWANNEE RIVER?

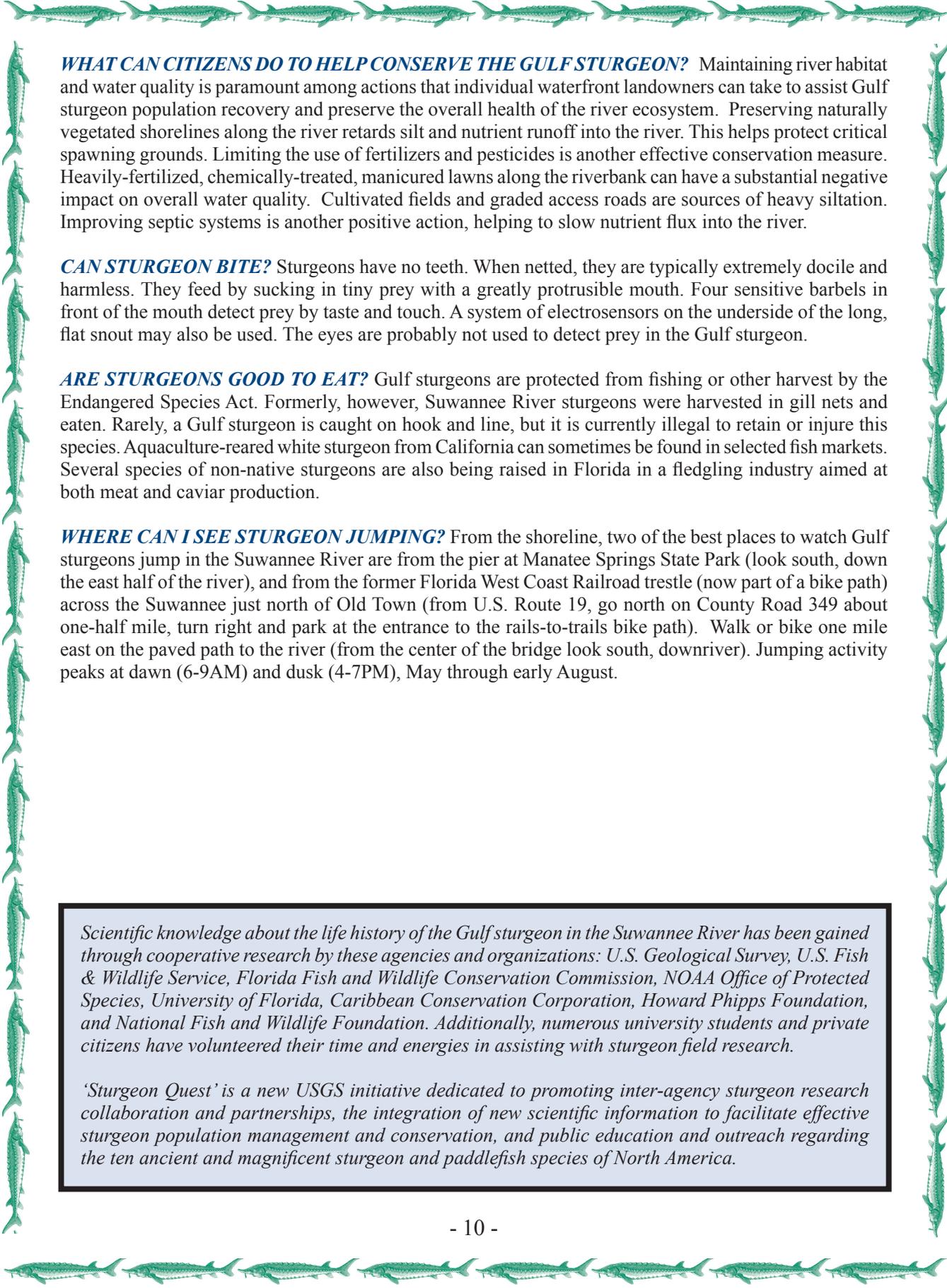
Stocking hatchery-raised fingerling to supplement wild fish populations has been a favored tool of fisheries managers for 100 years. However, scientific evidence suggests that hatchery programs for restocking a wild population are risky measures that should be used only when the population is verging upon extinction. The Suwannee River has a large, healthy, naturally-reproducing Gulf sturgeon population that does not need supplemental stocking. To harvest eggs for artificial spawning, adult females are removed from the wild and normally sacrificed (most hatchery programs, although some egg harvest methods allow the female to live for return to the river). This means loss of 200,000-500,000 eggs per female to the wild in that year. Even with 99.999% mortality to offspring over time, a single wild spawning event

could naturally add 20-50 adults per female to the ultimate population. The sacrifice of a female also means the potential loss of up to 2-3 more spawns, the entire productivity of her lifetime, a probable 40-150 adults that otherwise could naturally have been added to the population. Release of hatchery fish presents serious risks, such as decreasing genetic diversity within the population, domestication of the wild population by gene replacement from artificial selection, potential competition for food with wild YOY sturgeon by large numbers of hatchery fingerlings, and potential introduction of resistant strains of pathogens into the wild. In an already stable and naturally increasing population, releasing hatchery fish confers few benefits and typically entails the loss of wild adult females (the key to natural repopulation), on top of great risks to the genetic integrity of the wild population.



DOES SCIENTIFIC NETTING AND TAGGING KILL GULF STURGEONS? When properly-constructed research nets are continuously tended, and captured sturgeons are immediately removed, tagged, and released, mortalities from scientific sampling are very rare. USGS scientists have netted over 3,250 Gulf sturgeons in the past ten years, without a single mortality.

WHAT ARE THE MAIN THREATS TO THE GULF STURGEON? The main threats to Gulf sturgeons in the Suwannee River are low water and habitat degradation. During extended droughts, water levels drop dramatically and clear springwater dominates the river, allowing sunlight to penetrate to the river bottom. Nutrients (nitrogen and phosphorus) from septic tanks, agricultural fertilizer, and farm animal waste become concentrated due to low water flow. Together, these conditions result in massive blooms of the alga *Vaucheria* that carpets the river bottom. Fingerling sturgeons probably have difficulty finding open sand bottom to feed. At night, algal consumption of dissolved oxygen may result in levels too low for survival of sturgeons and other fishes. Masses of dying algae stimulate bacterial growth, further depleting oxygen. Excess nutrients also impact the primary feeding grounds of juveniles in the Suwannee estuary. Here, two marine algae species, sea lettuce and drift algae, can completely cover the bottom and smother the benthic prey of young sturgeons. Another threat is habitat degradation, particularly to sensitive spawning grounds. Silt from graded roads and shoreline development can cover and ruin the few beds of clean gravel required for sturgeon eggs. Release of chlorinated or otherwise treated water into the river might change local water chemistry, making it unfavorable to sturgeon eggs and sperm. A minor but increasing threat is boat strikes, with large adult sturgeons seeming to be the most vulnerable to death from collisions. Boat strikes have increased annually as more speed boats, ski-boats, and jet skis use the river. Most strikes occur in summer holding areas where sturgeons congregate.



WHAT CAN CITIZENS DO TO HELP CONSERVE THE GULF STURGEON? Maintaining river habitat and water quality is paramount among actions that individual waterfront landowners can take to assist Gulf sturgeon population recovery and preserve the overall health of the river ecosystem. Preserving naturally vegetated shorelines along the river retards silt and nutrient runoff into the river. This helps protect critical spawning grounds. Limiting the use of fertilizers and pesticides is another effective conservation measure. Heavily-fertilized, chemically-treated, manicured lawns along the riverbank can have a substantial negative impact on overall water quality. Cultivated fields and graded access roads are sources of heavy siltation. Improving septic systems is another positive action, helping to slow nutrient flux into the river.

CAN STURGEON BITE? Sturgeons have no teeth. When netted, they are typically extremely docile and harmless. They feed by sucking in tiny prey with a greatly protrusible mouth. Four sensitive barbels in front of the mouth detect prey by taste and touch. A system of electrosensors on the underside of the long, flat snout may also be used. The eyes are probably not used to detect prey in the Gulf sturgeon.

ARE STURGEONS GOOD TO EAT? Gulf sturgeons are protected from fishing or other harvest by the Endangered Species Act. Formerly, however, Suwannee River sturgeons were harvested in gill nets and eaten. Rarely, a Gulf sturgeon is caught on hook and line, but it is currently illegal to retain or injure this species. Aquaculture-reared white sturgeon from California can sometimes be found in selected fish markets. Several species of non-native sturgeons are also being raised in Florida in a fledgling industry aimed at both meat and caviar production.

WHERE CAN I SEE STURGEON JUMPING? From the shoreline, two of the best places to watch Gulf sturgeons jump in the Suwannee River are from the pier at Manatee Springs State Park (look south, down the east half of the river), and from the former Florida West Coast Railroad trestle (now part of a bike path) across the Suwannee just north of Old Town (from U.S. Route 19, go north on County Road 349 about one-half mile, turn right and park at the entrance to the rails-to-trails bike path). Walk or bike one mile east on the paved path to the river (from the center of the bridge look south, downriver). Jumping activity peaks at dawn (6-9AM) and dusk (4-7PM), May through early August.

Scientific knowledge about the life history of the Gulf sturgeon in the Suwannee River has been gained through cooperative research by these agencies and organizations: U.S. Geological Survey, U.S. Fish & Wildlife Service, Florida Fish and Wildlife Conservation Commission, NOAA Office of Protected Species, University of Florida, Caribbean Conservation Corporation, Howard Phipps Foundation, and National Fish and Wildlife Foundation. Additionally, numerous university students and private citizens have volunteered their time and energies in assisting with sturgeon field research.

'Sturgeon Quest' is a new USGS initiative dedicated to promoting inter-agency sturgeon research collaboration and partnerships, the integration of new scientific information to facilitate effective sturgeon population management and conservation, and public education and outreach regarding the ten ancient and magnificent sturgeon and paddlefish species of North America.



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