Atlantic Sturgeon
and
Atlantic Sturgeon Critical Habitat
Consultation Framework
NOAA Fisheries Southeast Region

December 2023

Purpose and Scope

To inform the Southeast Region's (SERO) Endangered Species Act (ESA) Section 7 consultation activities of Atlantic sturgeon, this document consolidates, summarizes, and interprets the best available information obtained through the listing process, and subsequent research by state, federal, and university partners. This collection of information provides ESA Section 7 assistance, and identifies actions that can be taken early in the consultation process to promote species conservation and improve overall consultation efficiency for the action agency. This document synthesized lots of information and as such, it should be considered a job aid and used as general guidance only.

Five distinct population segments (DPS) of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) are federally protected under the ESA. This document focuses on the two DPSs most common in the Southeast and their critical habitat: the Carolina DPS and the South Atlantic DPS. Three DPSs occur primarily in the inside the jurisdiction of the Greater Atlantic Region Fisheries Regional Office (GARFO): the New York Bight DPS, the Chesapeake Bay DPS, and the Gulf of Maine DPS. Additional, critical habitat has been also been designated by GARFO for river systems within their jurisdiction. Unlike Gulf sturgeon, NOAA Fisheries has sole management authority over Atlantic sturgeon regardless of whether they are in the ocean or a river system.

Table 1. Atlantic Sturgeon ESA-related Documents

Listing Entity	ESA Status	Listing Rule/Designation Date
Carolina DPS	Endangered	77 FR 5914; February 6, 2012
South Atlantic DPS	Endangered	77 FR 5914; February 6, 2012
Critical Habitat for Carolina DPS	N/A	82 FR 39160; August 2017
Critical Habitat for South Atlantic DPS	N/A	82 FR 39160; August 2017
Atlantic Sturgeon Recovery Outline	N/A	March 2018

Species Life History

Species Description

- Weight: Up to 800 pounds
- Length: Up to 14 feet
- Age: Long-lived (60 years), late-maturing (5 years of age or older); age at maturity varies between sexes and region
- Anadromous: Spawn in freshwater, then migrate to feed and grow in estuarine/marine (brackish/salt) environments
- Diet: Generalist benthic suction feeders that eat amphipods, lancelets, polychaetes, gastropods, ghost shrimp, isopods, mollusks, and/or crustaceans
- Distinctive characteristics (Figure 1): A teleost (bony fish) with a heterocercal caudal fin (top lobe of tail fin larger than bottom lobe of tail fin) similar to that of sharks, and an elongated spindle-like body that is smooth-skinned, scale-less and armored with 5 lateral rows of bony plates called scutes. They have four barbels (sensory organs) that precede their wide, toothless, and ventral-facing (bottom-facing) mouths, as well as ampulla of Lorenzini.
- See Table 2 for life history, ecology, and habitat use of life stages.

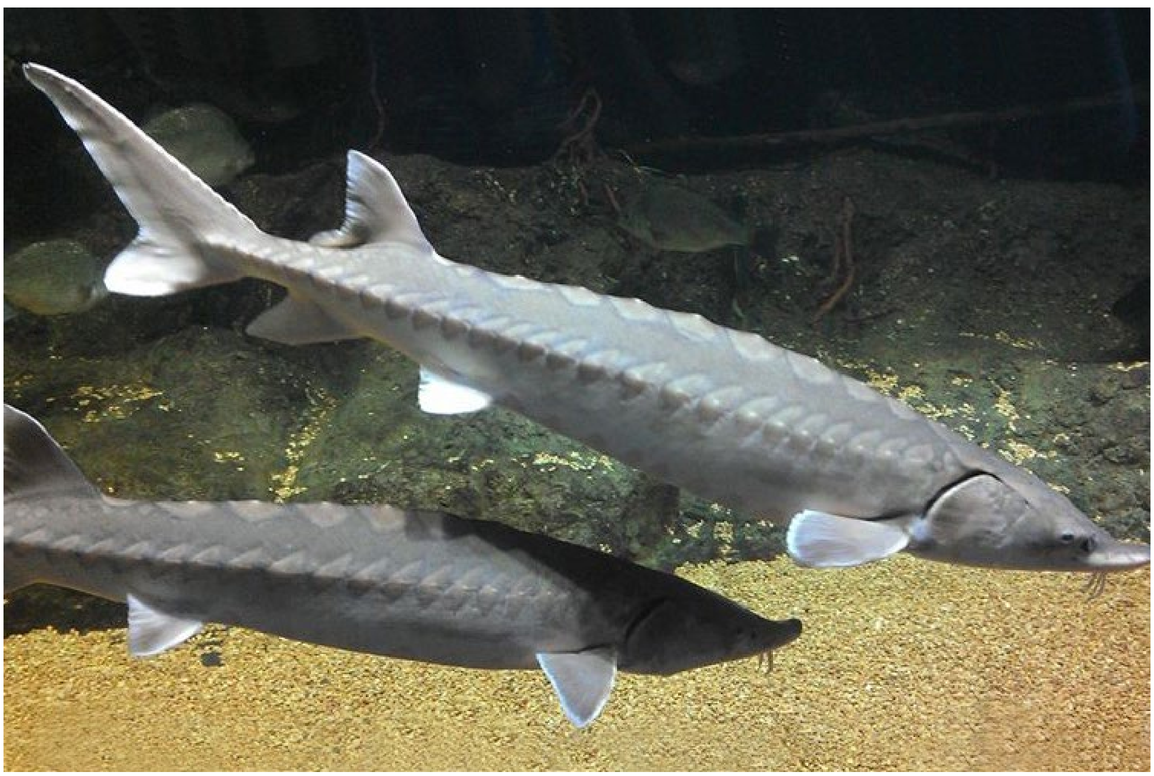


Figure 1. Atlantic sturgeon swimming. Credit: NOAA Fisheries

Table 2. General Size and Habitat Distribution by Life Stage

Life stage	Size	Habitat
Egg/Larvae/ Young of Year	Less than 30.0 cm TL	1. Freshwater riverine habitats
Juveniles	~30.0 – 80.0 cm TL	2. River systems, including the lower portion near river mouths and upper estuaries
Subadult	80.1 – 150.0 cm TL	3. May occupy all habitats (i.e. rivers, estuaries, bays, waters, and nearshore Atlantic)
Adults	> 150.0 cm TL	4. In rivers during spawning season(s) (varies by river); Spawning adults migrate up rivers to hard-bottom areas to spawn and then move back down river to holding areas. 5. Return to estuary/marine environments to feed following spawning; tend to move into nearshore Atlantic during the winter.

Range and Distribution

Atlantic sturgeon can be found in major estuaries and river systems from Canada to Florida. While still found generally throughout their historical range, Atlantic sturgeon spawning is known to occur in only 22 of 38 historical spawning rivers. Atlantic sturgeon are listed as five DPSs: the Gulf of Maine DPS (threatened), the New York Bight DPS (endangered), the Chesapeake Bay DPS (endangered), the Carolina DPS (endangered), and the South Atlantic DPS (endangered).

The Carolina DPS and the South Atlantic DPS, are under SERO's jurisdiction. The Carolina DPS includes all Atlantic sturgeon that are spawned in the watersheds (including all rivers and tributaries) ranging from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Figure 2) (77 FR 5914; February 6, 2012).

The South Atlantic DPS includes all Atlantic sturgeon that are spawned in the watersheds (including all rivers and tributaries) ranging from the Ashepoo, Combahee, and Edisto rivers in South Carolina, southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the South Atlantic DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Figure 3) (77 FR 5914; February 6, 2012).

Adult and subadult Atlantic sturgeon range widely throughout the marine environment (Figure 4). Atlantic sturgeon occurring the marine environment may be from any of the five DPSs. Biologists should be aware that because of this mixing, actions in the marine range of the species may affect Atlantic sturgeon from any DPS and more than one DPS.

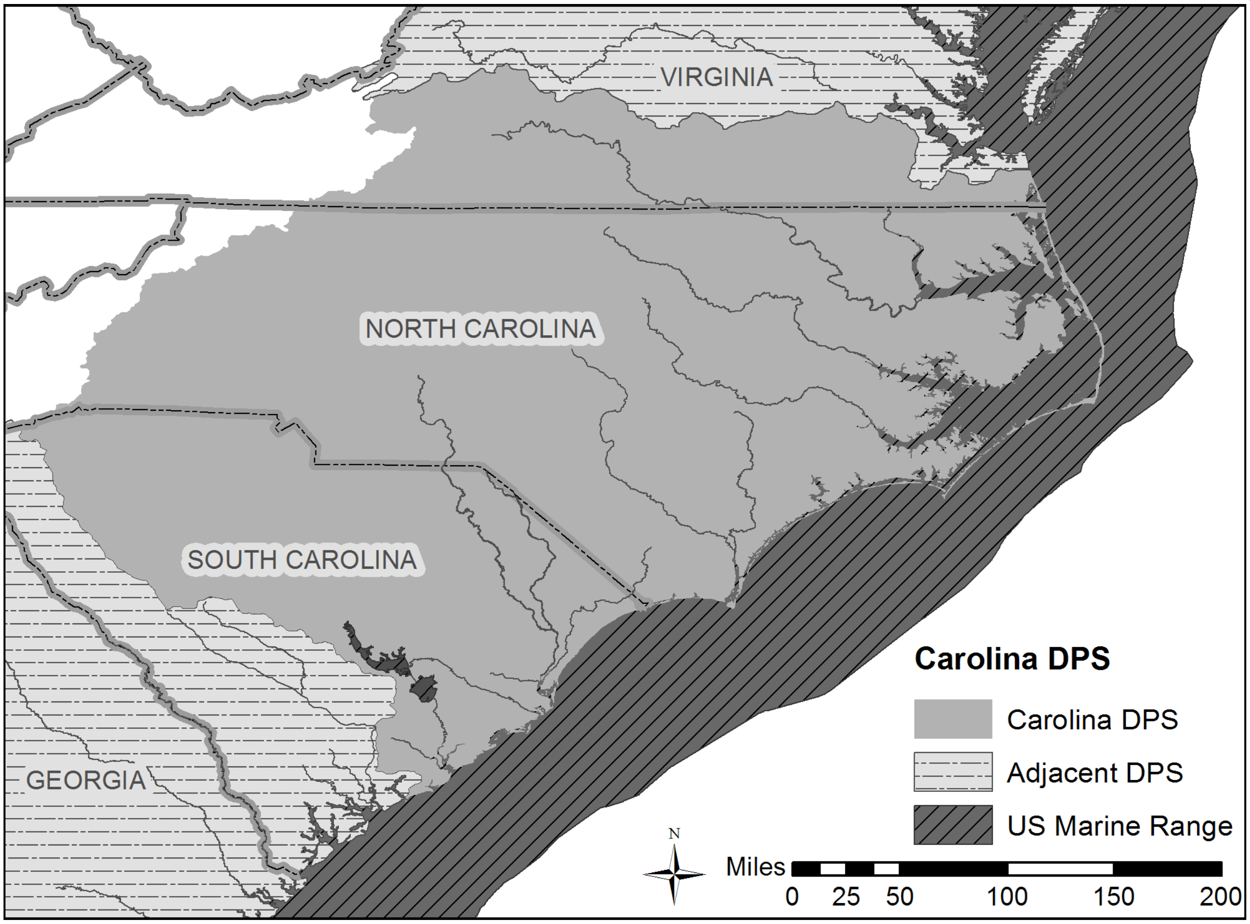


Figure 2. The riverine range of the Carolina DPS, including portions of the marine range.

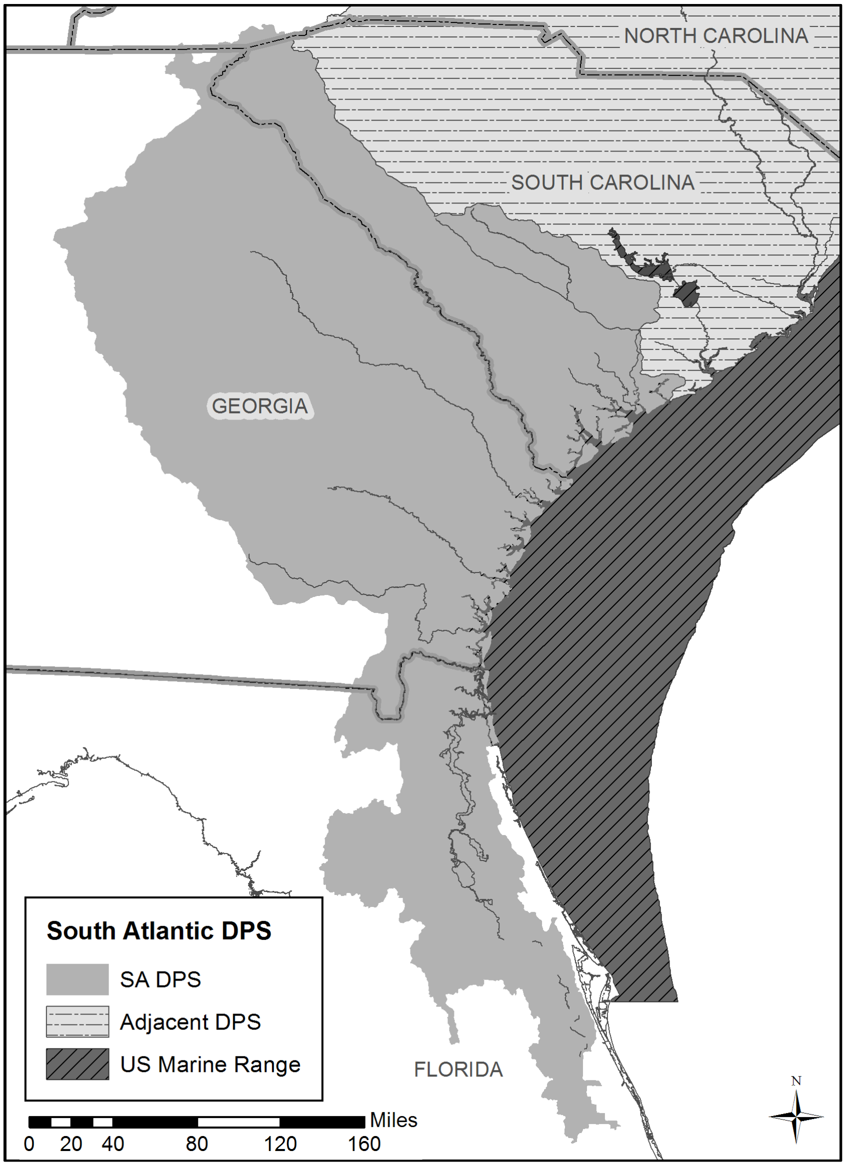


Figure 3. The riverine range of the South Atlantic DPS, including portions of the marine range.

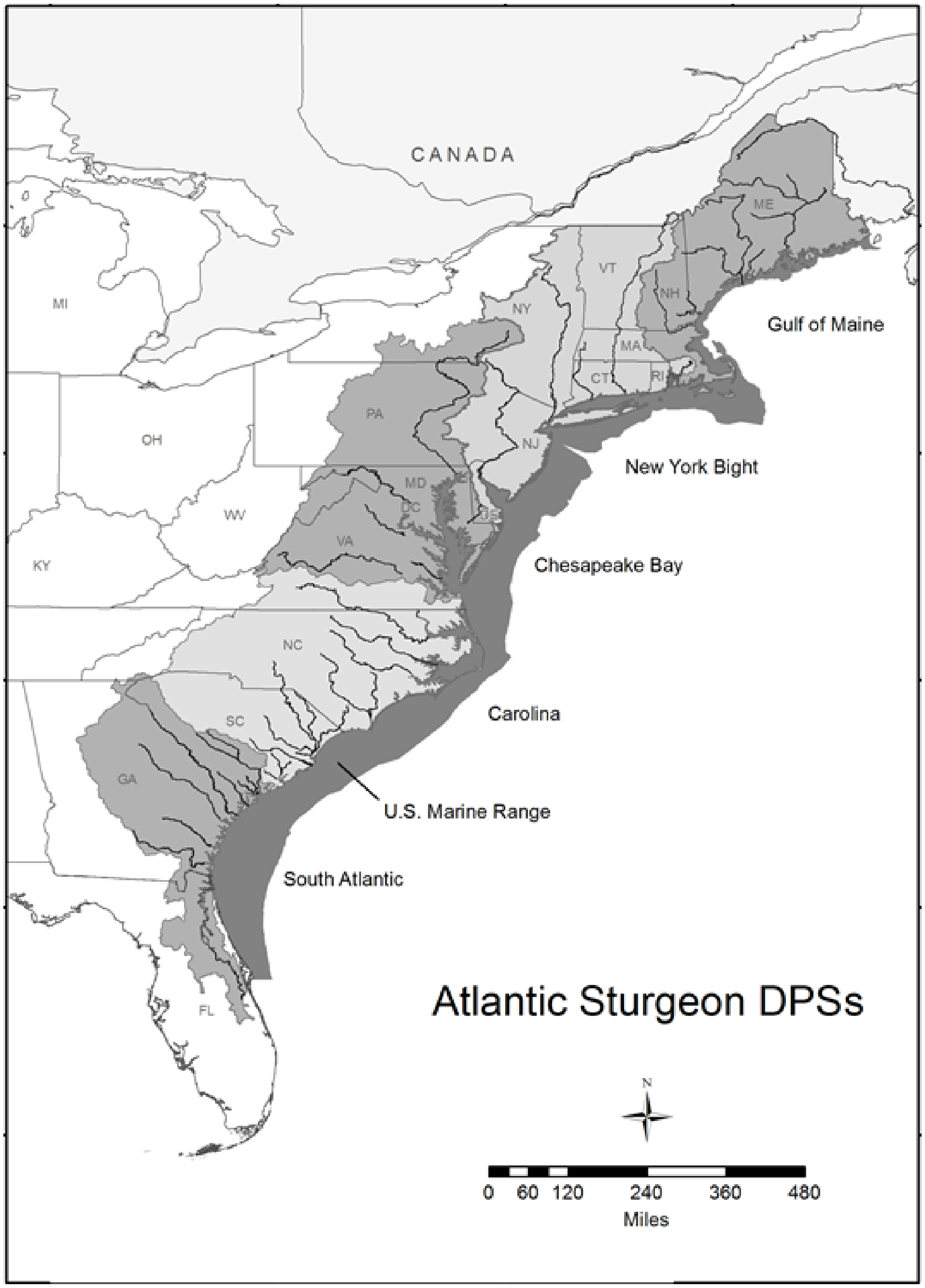


Figure 4. The riverine and marine ranges for all five DPSs.

Riverine vs. Marine Habitat Use

Riverine Habitat

Atlantic sturgeon use the upper reaches of rivers to spawn, at or near the fall line, over hard substrate consisting of rock, pebbles, gravel, cobble, limestone, or boulders (Gilbert 1989; Smith and Clugston 1997). Hard substrate is required so the highly adhesive eggs have a surface to stick to immediately following fertilization. Larval stage fish can use the interstitial spaces between rocks, pebbles, cobble, etc., to hide from predators during downstream movement and maturation (Gilbert 1989; Smith and Clugston 1997). Freshwater is required (i.e., 0.0–0.5 ppt) because salinity can kill Atlantic sturgeon during their first few weeks of life (Bain 1997; Cech Jr. and Doroshov 2005; Kynard and Horgan 2002).

As sturgeon mature, they move into lower river reaches and estuaries. Estuarine habitats are important for juveniles, serving as nursery areas by providing abundant foraging opportunities, as well as thermal and salinity refuges. During their first two years, juvenile Atlantic sturgeon remain in the estuaries of their natal rivers, which may include both fresh and brackish channel habitats below the head of tide (Hatin et al. 2007). Upon reaching age 2, juveniles become increasingly salt tolerant and some individuals will begin outmigrating to nearshore marine waters (Bain 1997; Dovel and Berggren 1983; Hatin et al. 2007).

Adults may be found in freshwater riverine habitats on the spawning grounds or while making migrations to and from the spawning grounds. They also use estuarine waters seasonally, principally in the spring through fall and will range widely in marine waters during the winter (Collins and Smith 1997; Dovel and Berggren 1983; Dunton et al. 2010; Erickson et al. 2011; Greene et al. 2009; Kazyak et al. 2021; Laney et al. 2007; Murawski et al. 1977; Savoy and Pacileo 2003; Smith 1985; Stein et al. 2004; Vladykov and Greeley 1963; Welsh et al. 2002; Wirgin and King 2011).

Marine Habitat

Individuals as young as age two may occur in the marine habitats. By five years of age, most juveniles are salt water tolerant becoming “subadults,” “late-stage juveniles,” or “marine migratory juveniles” and may be found in either riverine or marine habitats. Adults are also commonly found in marine waters. Offshore telemetry arrays indicate Atlantic sturgeon occur further offshore in the late fall and winter months than in the spring and summer (Arendt et al. 2017; Rothermel et al. 2020; Rulifson et al. 2020; Williams et al. 2019). Acoustic telemetry arrays off South Carolina/Georgia (Arendt et al. 2017) and Gray’s Reef National Marine Sanctuary (Williams et al. 2019) have detected tagged Atlantic sturgeon as far as 19 miles (31 kilometers) offshore, though approximately 80% of detections were recorded within 14 miles from shore (Arendt et al. 2017). Williams et al. (2019) reported detections occurring in waters 70 ft (21 meters) or shallower. Also, adults appear to aggregate in the ocean just offshore of large river systems (e.g., Savannah River) during the winter. This may make them more susceptible to adversely effects from dredging, relocation trawling, vessel strikes, etc.

Diet and Feeding

Atlantic sturgeon are omnivorous benthic (bottom) feeders. Diets of adult and subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, insects and fish such as sand lance (ASSRT 2007; Bigelow and Schroeder 1953; Collins et al. 2006; Guilbard et al. 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (ASSRT 2007; Bigelow and Schroeder 1953; Guilbard et al. 2007).

Growth and Reproduction

Atlantic sturgeon are generally referred to as having four size/developmental categories: eggs/larvae/young-of-year (YOY) ("early life stages" [ELS]) (Figure 5); juveniles, subadults (Figure 6), and adults (Figure 7).

Immediately after hatching, larvae enter the yolk sac larval stage and assume a demersal existence (Smith et al. 1980). Animals in this stage are fewer than 4 weeks old, with total lengths (TL) less than 30 millimeters (mm) (Van Eenennaam et al. 1996). Animals in this phase are in fresh water and are located far upstream very near the spawning beds. As the larvae develop, they commence downstream migration towards the estuaries. During the first half of their downstream migration, movement is limited to night. During the day, larvae use gravel, rocks, sticks, and other three-dimensional structure as refugia (Kynard and Horgan 2002). During the latter half of migration when larvae are more fully developed, movement occurs both day and night. As larvae grow and absorb the yolk sac, they enter the YOY phase (Figure 5). YOY are greater than 4 weeks old but less than 1 year, and generally occur in their natal river. These animals are generally located in freshwater downstream of the spawning beds, though they can be found in the estuaries.

Figure 5. Young-of-Year (YOY) Atlantic sturgeon CREDIT: South Carolina DNR

Following the YOY life phase, sturgeon develop into juveniles and subadults. The term "juveniles" generally refers to animals 1 year of age or older that reside in the natal estuary. Juveniles that have not yet outmigrated to marine habitats are commonly referred to as "river-resident juveniles" (RRJs). Upon reaching age 2, juveniles become increasingly salt tolerant and some individuals will begin their outmigration to nearshore marine waters (Bain 1997; Dovel and Berggren 1983; Hatin et al. 2007) (Figure 6). Juveniles that have outmigrated to marine habitats are commonly referred to as “marine migrant juveniles” (MMJs). Adults are sexually mature individuals of 1500+ mm TL (or 1300+ mm fork length) (Figure 7) and 5 years of age or older in the Southeast.

Figure 6. Subadult Atlantic Sturgeon CREDIT: NOAA Fisheries

Figure 7. Adult Atlantic Sturgeon CREDIT: South Carolina DNR

Atlantic sturgeon populations show clinal variation, and tend to grow faster, mature sooner, and die earlier in the Southeast compared to northern populations. Female Atlantic sturgeon likely spawn every 2 to 5 years (Bigelow et al. 1963; Stevenson and Secor 1999; Van Eenennaam et al. 1996); males spawn every 1 to 5 years (Caron et al. 2002; Collins et al. 2000b; Smith 1985). A more recent analysis of spawning intervals in the York River (Chesapeake Bay DPS) identified males returning once every 1.13 years and females returning once every 2.19 years (Hager et al. 2020). Hager et al. (2020) also reported three females returning to spawn in consecutive years, with one individual returning five out of six years.

Mature females produce from 400,000 to 8,000,000 eggs per year (Dadswell 2006; Smith et al. 1982; Van Eenennaam and Doroshov 1998). The average age at which 50% of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3 to 10 times longer than for other bony fish species examined (Boreman 1997).

Separate putative spring- and fall-spawning runs have been identified using telemetry data and genetic samples collected from Atlantic sturgeon in the Edisto River (Farrae et al. 2017; White et al. 2021), Savannah River (Vine et al. 2019), Pee Dee River (Denison et al. 2023) and the Ogeechee River (White et al. 2021). Telemetry data from Atlantic sturgeon detected in the Altamaha River (including the Oconee and Ocmulgee rivers) indicates those individuals likely only spawn in the fall (Ingram and Peterson 2016). Researchers attempting to capture spawning Atlantic sturgeon in the Cape Fear River and Roanoke River in North Carolina have had conflicting success. Researchers working in the Cape Fear River have captured spawning adults and collected Atlantic sturgeon eggs during the spring, with little evidence thus far of fall spawning Atlantic sturgeon. Conversely, researchers in the Roanoke River have captured adults on putative spawning runs in the fall, but have found little evidence of a potential spring spawning run. Table 3 reports the estimated spawning period, when known, for Atlantic sturgeon by river.

Water temperature appears to be an important factor in triggering putative spawning migrations. Atlantic sturgeon making putative spawning runs in the Pee Dee River during the spring, initiated migrations each year at water temperatures between 8.8°C and 10.8°C (Denison et al. 2023). Conversely, Atlantic sturgeon making putative fall-spawning runs began migrations upriver when water temperatures were between 25°C and 30°C (Denison et al. 2023). In the Savannah River, Atlantic sturgeon making putative spring-spawning runs initiated migration at water temperatures between 16°C and 18°C (Vine et al. 2019). Those individuals completely exited the river when water temperatures had risen to between 20°C and 23°C (Denison et al. 2023). Atlantic sturgeon in Savannah River making putative spawning runs in fall, initiated migration at water temperatures from 24°C to 29°C (Vine et al. 2019). Regardless of river system, males tend to begin migrating at cooler temperatures (Dovel and Berggren 1983; Smith 1985; Smith et al. 1982) with females following a few weeks later (Collins et al. 2000a; Dovel and Berggren 1983; Smith 1985).

Table 3. Estimated Spawning Period by River

Spawning River	Likely Spring Spawning Window	Likely Fall Spawning Window	Reference
Chowan River	Unknown	Unknown	--
Roanoke River	Unknown	September - October	Smith et al. (2015) & M. Balazik-VCU, pers. comm. to A. Herndon-NMFS
Tar - Pamlico River	April	Unknown	Anecdotal Reports
Neuse River	April	September	Anecdotal Reports
Cape Fear River	Mid-March to Late-May	Unknown	F. Scharf-UNCW, pers. comm. to A. Herndon-NMFS
Northeast Cape Fear River	Mid-March to Late-April	Unknown	J. Facendola-NCDENR, pers comm. to A Herndon-NMFS
Pee Dee River	Late-January to Early-May	Mid-August to Mid-November	Denison et al. (2023); SCDNR (2021)
Waccamaw River	Unknown	Unknown	--
Black River	Unknown	Unknown	--
Santee River	Unknown	Unknown	--
Cooper River	March to April	Late-August to Mid-October	SCDNR (2023)
Edisto River	March to Mid-May	Late-August to Late-October	Collins et al. (2000b); Farrae et al. (2017); White et al. (2021)
Ashepoo River	Unknown	Unknown	--
Broad-Coosawatchie River	Unknown	Unknown	--
Combahee - Salkehatchie River	Unknown	Unknown	--
Savannah River	Late-February to Early-May	Mid-May to Late-October	Post et al. (2022); Vine et al. (2019)
Ogeechee River	Unknown	Unknown	--
Altamaha River	None Suspected	September-December	Ingram and Peterson (2016)
Satilla River	Unknown	Unknown	--
St. Marys River	Unknown	Unknown	--
St. Johns (FL)	None Suspected	None Suspected	--

Critical Habitat

NMFS designated 28 critical habitat units for all five DPSs, on August 17, 2017 (82 FR 39160). Only Atlantic sturgeon spawning rivers were designated critical habitat; critical habitat was not designated in the marine environment. Of those 28 critical habitat units, 14 were designated in Southeast; 7 for the Carolina DPS and 7 for the South Atlantic DPS (Table 4; Figure 8).

Table 4. Critical Habitat Units in the Southeast

Carolina DPS	
Critical Habitat Unit	**River(s) within Unit**
C1 – Roanoke River Unit	Roanoke River (NC)
C2 – Tar-Pamlico River Unit	Tar-Pamlico River (NC)
C3 – Neuse River Unit	Neuse River (NC)
C4 – Cape Fear River Unit	Cape Fear River; NE Cape Fear River (NC)
C5 – Pee Dee River Unit	Pee Dee River (NC/SC); Waccamaw River (SC); Bull Creek (SC)
C6 – Black River Unit	Black River (SC)
C7 – Santee River Unit	Santee River (SC); Rediversion Canal (SC); North Santee River (SC); South Santee River (SC); Tailrace Canal-W. Cooper River (SC); Cooper River (SC)
South Atlantic DPS	
SA1 – Edisto River Unit	Edisto River (SC); North Fork Edisto River (SC); South Fork Edisto River (SC); North Edisto River (SC); South Edisto River (SC)
SA2 – Combahee River Unit	Combahee River (SC); Salkehatchie River (SC)
SA3 – Savannah River Unit	Savannah River (SC/GA)
SA4 – Ogeechee River Unit	Ogeechee River (GA)
SA5 – Altamaha River Unit	Altamaha River (GA); Oconee River (GA); Ocmulgee River (GA)
SA6 – Satilla River Unit	Satilla River (GA)
SA7 – St. Marys River Unit	St. Marys River (GA)

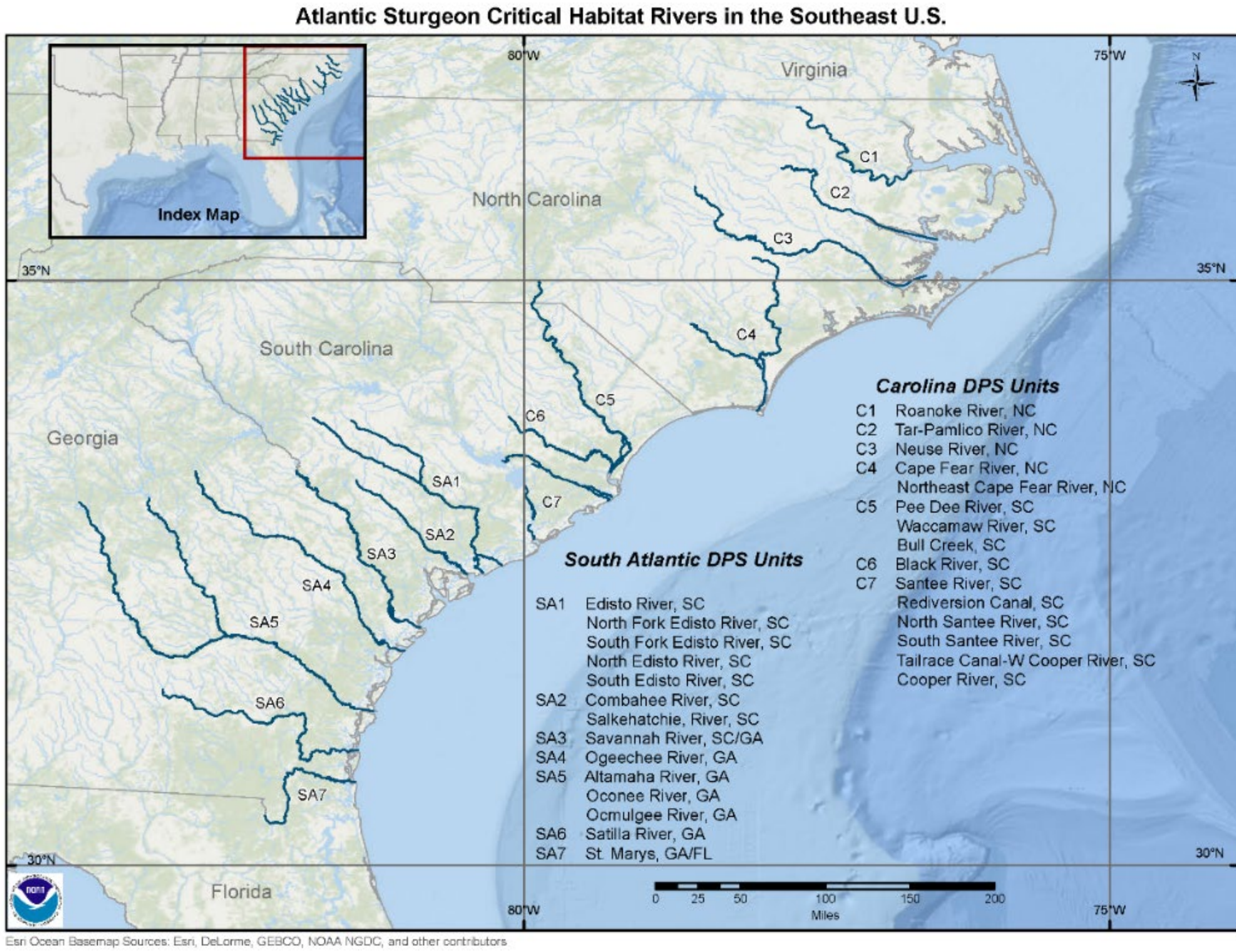


Figure 8. Map of Atlantic Sturgeon Critical Habitat

Within these critical habitat units, NMFS identified four physical and biological features (PBFs) we believe are necessary for conservation of Atlantic sturgeon from the Carolina and South Atlantic DPSs (Table 5).

Table 5. Physical and Biological Features (PBF) of Atlantic Sturgeon Critical Habitat

Atlantic Sturgeon Critical Habitat PBFs and their Purpose/Function		
PBF		**Purpose/Role of PBF**
Hard Substrate (PBF 1)	Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0-0.5 parts per thousand range)	Necessary for settlement of fertilized eggs, refuge, growth, and development of early life stages
Salinity Gradient and Soft Substrate (PBF 2)	Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 parts per thousand and soft substrate (e.g., sand, mud) between the river mouth and spawning sites	Necessary for juvenile foraging and physiological development
Unobstructed Water of Appropriate Depth (PBF 3)	Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites	Necessary to support: • Unimpeded movement of adults to and from spawning sites; • Seasonal and physiologically-dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and • Staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (at least 1.2 meters) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river
Water Quality (PBF 4)	Water quality conditions, especially in the bottom meter of the water column, with the appropriate combination of temperature and oxygen values	Necessary to support: • Spawning; • Annual and inter-annual adult, subadult, larval, and juvenile survival; and • Larval, juvenile, and subadult growth, development, and recruitment. Appropriate temperature and oxygen values will vary interdependently, and depending on salinity in a particular habitat.

Section 7 Considerations for Atlantic Sturgeon

This section provides guidance to assist with ESA Section 7 consultations. It considered published scientific literature, as well as unpublished data provided by non-governmental, state, and federal agencies. The best available information indicates the Carolina and South Atlantic DPSs of Atlantic sturgeon occur in the mainstem of several rivers in North Carolina, South Carolina, Georgia, and northern Florida (see Table 3). The marine range of both DPSs extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Figure 4). Please refer to the SERO Section 7 Mapper for more detailed information regarding where to consult on Atlantic sturgeon in the Southeast Region.

Biologists should be aware that the potential adverse effects to Atlantic sturgeon from dredging in the Southeast have been considered in the South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States (2020 SARBO). Before consulting on dredging projects proposed by the U.S. Army Corps of Engineers, the Bureau of Ocean Energy Management, or the Environmental Protection Agency, first consider whether that action is covered by the 2020 SARBO.

No Effect Determination for the Species

When making a *no effect* determination, it is not necessary to mention the species in the consultation. Below are common reasons or activities that could conclude *no effect* for project effects to Atlantic sturgeon. When making an effect determination consider whether the species is likely to be present. Atlantic sturgeon appear to occur rarely in marine waters deeper than 50 m (164 ft). To date, SERO ESA Section 7 consultations do not consider Atlantic sturgeon present south of Cape Canaveral, Florida, in the marine environment or occurring in any river south of the St. John's River, Florida. Making a *no effect* determination for activities occurring outside the known range of Atlantic sturgeon would be appropriate.

Aside from an action occurring outside the range of the species, some projects may include activities with no route of effect on the species. The following are examples of routes of effect that typically have no effect on Atlantic sturgeon.

Turbidity – Mobile life stages of Atlantic sturgeon (i.e., life stages other than eggs/larvae) are able to swim through or avoid any potential turbidity without harm. Additionally, Atlantic sturgeon are naturally exposed to turbidity or sedimentation throughout its environment in areas of naturally lower water clarity. Therefore, we believe any potential exposure to turbidity will have no effect on the mobile life stages of Atlantic sturgeon. While no direct effect on mobile life stages Atlantic sturgeon is expected from turbidity, the biologist must still consider whether any indirect effects to Atlantic sturgeon will occur due to effects to its habitat from turbidity or if direct effects to eggs/larvae may occur. For example, would the sediment causing the turbidity have any effect on DO concentrations?

Entanglement in construction materials – There are no reports of Atlantic sturgeon becoming entangled in flexible materials in the water (e.g., turbidity curtains or in-water lines). However, it is possible that in-water construction materials could trap an Atlantic sturgeon. Therefore, if turbidity curtains and in-water equipment are placed in a manner that does not entrap species within the construction area or block access for them to navigate around the construction area, a no effect determination would be appropriate.

Noise – Pile installation by jetting, using an auger or drop punch to create a pilot hole, or installing pilings using a vibratory hammer will not result in physical injury (injury from exposure to peak pressure or cumulative sound exposure) or behavioral noise effects, because it will not create noise levels in excess of the respective thresholds for physical injury to or behavioral responses in Atlantic sturgeon. Therefore, we believe any potential exposure to the limited increase in noise from pile driving methods described above will have no effect on Atlantic sturgeon.

NOTE: Current research suggests that noise from vessels and dredging operations does not alter sturgeon swimming or migratory behavior. Therefore, analyses should not assume sturgeon will move away from vessels or dredging operations and additional mitigation measures should be in place to minimize potential adverse effects from these activities. More research is needed to better understand sturgeon hearing.

Injury from hand placement of materials – placement of riprap or anchors by hand will have no effect on Atlantic sturgeon.

Restriction of movement and access to foraging habitat – Seawalls, piles associated with single family docks, piles for ATONs, widely-spaced concrete bents supporting bridge, generally will have no effect on Atlantic sturgeon movement or ability to access foraging habitat. Atlantic sturgeon are mobile and can effectively swim around or by these types of structures to access foraging habitat with no added stress that could affect their well-being.

NOTE: A no effect determinations refers to the presence of the structures; the effects from installation may adversely affect the species and should be considered separately.

May Affect Determination (Not Likely to Adversely Affect [NLAA] or Likely to Adversely Affect [LAA]) for the Species

For proposed actions that may affect Atlantic sturgeon (Table 6), the biologist must carefully analyze the effects of the proposed action to confirm whether a *NLAA* or *LAA* determination is most applicable. An activity that is typically *NLAA* could be *LAA* for a different consultation if circumstances are significantly different (e.g., duration or magnitude of potential exposure, vulnerable life stage is present) or if project design criteria and best-management practices are not incorporated. The biologist may use this guidance, but must carefully analyze the effects of the proposed action to confirm whether *NLAA* or *LAA* is most applicable.

NLAA Determinations for the Species

Project effects that are considered insignificant (minor in scale and/or duration), extremely unlikely to occur, or wholly beneficial result in a *NLAA* determination. Common project effects that generally result in a *NLAA* determination for Atlantic sturgeon include: injury from installation of materials or construction equipment (extremely unlikely to occur or insignificant depending on situation), disturbance from non-hopper dredging or construction (insignificant–due to scale or duration), use of turbidity curtains (insignificant – due to scale and duration) and disturbance from temporary changes in water quality (insignificant). See Table 6 for a more thorough evaluation of activities, routes of effects, and best practices.

LAA Determination for the Species

Stressors that cause adverse effects to the species result in a *LAA* determination. Effects can include any form of "take," including harm, injury, or mortality. Examples of projects that may result in an *LAA* determination include operation of hydroelectric or diversion dams; dredging and associated relocation trawling; fisheries, fishing, and fisheries-related research activities. See Table 6 for a more thorough evaluation of activities, routes of effects, and best practices.

NOTE: In the Southeast, Atlantic sturgeon interact almost exclusively with state fisheries (commercial and recreational). North Carolina and Georgia both have Section 10(a)(1)(B) permits (Incidental Take Permits - "ITPs") authorizing the capture of Atlantic sturgeon in specific inshore fisheries; South Carolina has applied for an ITP. Hook-and-line fisheries occurring in federal waters of the Southeast are unlikely to incidentally capture Atlantic sturgeon.

Table 6. Threats, Routes of Effect, and Potential Impacts that May Affect Atlantic Sturgeon and Considerations for Effects Determinations

Threat	Route of Effects	Potential Impact to Species	Considerations
Dams	• Impede access to spawning, developmental, and foraging habitat; • Modify (diverting) free-flowing rivers to reservoirs, • Injure/kill fish on upstream and downstream migrations; • Alter water quality (e.g., flow, temperature, depth, nutrients, dissolved oxygen, salinity) in the remaining downstream portions of spawning and nursery habitat	• Reduced/blocked access to potential spawning, developmental, and foraging habitat • Reduced water quality/quantity in spawning, developmental, and foraging habitat downstream • Physical injury/death	• Is there a possibility for adding fish passage to the project area? • Can flows be managed to maintain water quality and quantity downstream? • Can technological improvements (e.g., turbine vents) be added to improve water quality from flows released?
Dredging & Relocation Trawling	• Direct physical injury to sturgeon (struck or taken by dredge or relocation trawler) • Increased risk of vessel strikes from larger ships using dredged channel • Direct removal/burial of prey species, • Turbidity/siltation effects • Contaminant resuspension • Noise/disturbance • Alteration of river hydrodynamics and physical habitat • Impede access to spawning, development, or foraging habitat if it occurs at a pinch point	• Loss of prey • Potential physical harm/injury from interaction with dredge or relocation trawling equipment • Potential reproductive/behavioral effects • Potential avoidance of developmental, and foraging habitat • Disturbance of potential prey; elimination of deep holes used for resting/refuge; and/or alteration rock spawning habitats. • Reduced/blocked access to potential spawning, developmental, and foraging habitat	• Can there be a construction window to reduce potential impacts? • Which dredging method is being used? • How deep is the dredging? • Does dredging change the sediment composition (e.g., from sand substrate to limestone)? • Will the dredging alter dissolved oxygen, temperature, or salinity? • Will dredging equipment and activities block migratory corridors or important foraging habitat?

Threat	Route of Effects	Potential Impact to Species	Considerations
Water Quality (e.g., dam releases, wastewater discharge, and dredging)	• Depressed DO • Changes in water temperature • Release of contaminants • Changes in salinity	• Restricts the extent suitable habitat can be used for life functions; extended exposure (greater than 24 hrs.) can cause injury/death. Sturgeon are more highly sensitive to low DO than other fish species. Of particular concern is the frequent occurrence of low DO coupled with high temperatures. • Potential physiological/ reproductive/behavioral effects	• Will the activity reduce water quality in a way to cause harm? • Will there be changes in temperature, DO, or salinity? • Is the project area a high-quality forage habitat? • Is the project area spawning habitat. • Do changes in water quality create a migratory barrier?
Water Withdrawals or Diversions, (e.g., dam releases, hydro power, and municipal use)	• Alteration of natural water flows in both the originating and receiving basins • Potential scouring or shoaling around the discharge • Diminished habitat quality • Restricted migratory or foraging access • Entrained or impinged sturgeon (particularly sturgeon eggs or larvae)	• Low DO, changes in temperature and salinity, resuspension or increase in contaminants • Increased flow velocity may cause scouring of habitat; decreased flow may increase shoaling, burying hardbottom habitat • Reduced flow diminishing habitat quality • Reduced flow restricting migratory or foraging access • Withdrawal velocities exceed swimming abilities of life stages present killing or pinning individuals on intake screens.	• Does water quantity affect water quality? • Are flows such that natural hydrology is not disrupted? • Does affected habitat provide a specific life history function (i.e., hard bottom spawning habitat)? • Will the flow velocity of water withdrawals exceed the swimming capacity of sturgeon life stages likely to be present?

Threat	Route of Effects	Potential Impact to Species	Considerations
State Fisheries, Fishing, Fisheries-related Research*	• Potential hooking, entanglement, and capture in commercial, recreational, or research fishing gear, (rod-and-reel gear, trawls, gillnets, seines) • Potential interactions with vessels	• Injury or mortality resulting from capture or poor handling • Post release mortality • Injury or mortality from vessel strikes – typically NLAA unless operation in very shallow water	• Safe handling and release procedures – Available for recreational and commercial gears • Fishery Observers – Collect data and report on size, sex (presence of claspers), catch location, release condition, etc. Observers are also trained to collect fin clips and deploy external tags. • Gear type, deployment duration, deployment frequency • Require posting of educational signage, anglers outreach, and fishing line disposal receptacles. • Construction conditions and noise abatement measures
In-Water Construction Projects (e.g., bridges docks, fishing piers, boat ramps, living reefs/shorelines, etc.)	• Impeded access to habitat, refuge, or migratory pathways • Noise • Vessel/gear interactions • Removal/burial of prey items • Water quality changes	• Potential physiological/behavioral effects • Potential physical injury and reduced/blocked access to potential spawning, developmental, and foraging habitat • Loss of prey • Restricts the extent suitable habitat can be used for life functions; extended exposure (greater than 24 hrs.) can cause injury/death • Of particular concern is the frequent occurrence of low DO coupled with high temperatures.	• What is the timing of the project? • What construction equipment and materials are being used? • What are the noise levels being produced by pile-driving? • Is the benthos being temporarily or permanently altered? • Is water quality or quantity being affected; temporarily or permanently? • Are migratory pathways being restricted or cut-off? • Is the project area a known high-use habitat? • What life-history stages may be present? • Are there potential vessel interaction? (Note: We are seeing some reports coming in lately of sturgeon being struck by vessels)
Beach Nourishment	• Short and/or long-term habitat alteration • Potential interference with migratory corridors	• Habitat avoidance or displacement from the action area • Avoidance or displacement from migratory corridors	• Type of equipment and duration of in-water construction • Project duration (temporary or long-term) • Project location/timing and habitat type

Threat	Route of Effects	Potential Impact to Species	Considerations
Habitat Restoration	• Potential interactions with construction equipment or vessels • Habitat alteration • Potential interference with migratory corridors	• Habitat avoidance or displacement from the action area – likely to be temporary • Avoidance or displacement from migratory corridors	• Type of habitat affected. Are there any beneficial effects? Creation or restoration of habitat or other positive water quality/habitat enhancements. • Type of equipment, time of year, and duration of in-water construction. • What is the average speed of support vessels and deployment frequency?
Outfalls, Water Releases, and Effluent Discharge	• Long term habitat alteration • Foraging energetics • Potential interference with migratory corridors	• Inability to use habitat or reduction in prey because water quality parameters are not suitable • Habitat degradation and avoidance or displacement from the action area • Inhibited ability to move in river systems due to changes in water quality • Potential physical injury and reduced/blocked access to potential spawning, developmental, and foraging habitat	• Project location, time of year, and habitat type • Project duration (temporary or long-term) • Reduction in habitat and prey availability
Vessel Traffic (Particularly large cargo vessels)	• Potential interactions with vessels	• Potential physical injury from interactions with vessels	• Will the project increase vessel traffic?

Section 7 Considerations for Atlantic Sturgeon Critical Habitat

During pre-consultation or technical assistance, an action agency may engage in scientific review or research to assess the impacts of their project on Atlantic sturgeon and their designated critical habitat. This section considers whether Atlantic sturgeon critical habitat may be affected by a proposed action. In making a determination, the biologist should determine: (1) if the action area is located within the boundary of any critical habitat unit, (2) whether any of the physical or biological features (PBFs) are present within the action area, and (3) whether the proposed action may affect one or more PBF, if present. Biologists should consider working with the action agency to mitigate for any critical habitat effects.

Note: Not all the PBFs need to be present in the action area for the action area to function as critical habitat.

No Effect Determination for the Critical Habitat

If an action occurs outside the boundary of Atlantic sturgeon critical habitat, then the proposed action will likely have no effect on critical habitat. However, even if a project is located outside the boundaries of critical habitat, once the action area is established to include all potential effects, impacts may cross the boundary of critical habitat and effects to critical habitat may need to be considered. A no effect determination is also appropriate if the action area occurs inside the boundary of Atlantic sturgeon critical habitat but none of the PBFs are present.

May Affect Determination (NLAA or LAA) for the Critical Habitat

Proposed actions that may affect Atlantic sturgeon critical habitat must be carefully assessed to determine the routes of effects. Based on the anticipated routes of effects, the biologist must choose whether a *NLAA* or *LAA* determination is most appropriate. Duration and magnitude of potential effects must be considered in addition to whether best practices are proposed.

NLAA Determinations for the Critical Habitat

There are a few instances of specific effects from proposed projects resulting in *NLAA* effect determinations for Atlantic sturgeon critical habitat. These may include effects that alter the PBFs but do not necessarily remove them, or effect their ability to fulfill their ecological function. For example, a project temporarily disturbs the hard bottom substrate necessary for spawning, but the impacts occur during a time of year when no spawning activity is expected and the habitat would regain its functionality completely before the next spawn season. For a more thorough evaluation of project activities that may affect critical habitat, see Table 7.

LAA Determinations for the Critical Habitat

If the proposed action occurs within the boundary of an Atlantic sturgeon critical habitat unit and it will adversely affect (e.g. long-term or permanently) one or more of the PBFs, then the biologist must make a LAA determination. Whether adverse effects to Atlantic sturgeon critical habitat result in a Destruction or Adverse Modification (DAM) determination depends on how much critical habitat remains after the completion of the proposed action and the overall functionality of that critical habitat unit after the proposed action is completed. For a more thorough evaluation of project activities that may affect critical habitat, see Table 7.

Table 7. Potential Threats That May Affect Atlantic Sturgeon Critical Habitat

Threat	PBF Affected	Potential Impact to PBF	Considerations
Dams	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3) • Water Quality (PBF 4)	• PBF 1 – Increased flows may scour hard substrate making laying eggs impossible • PBF 2 - Increased flows may scour soft substrate removing foraging habitat • PBF 3 – Dams create a physical barrier; altered flow regimes may create conditions too shallow for migration/spawning • PBF 4 – Flow alterations may affect water temperature and/or DO concentrations	• Can flows be moderated to avoid scouring? • Can flows be controlled to ensure sufficient water remains for spawning/migration • Can flows be managed such that water temperature and/or DO concentrations are not significantly affected? • Is the benthos being temporarily or permanently altered? • Will any actions outside critical habitat units have "downstream effects" that will ultimately cross into critical habitat?
Dredging	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3) • Water Quality (PBF 4)	• PBF 1 – Dredging could remove hard substrate; turbidity/sedimentation created by dredging could cover hard substrate suitable for spawning. • PBF 2 – Dredging could remove soft substrate removing foraging habitat. • PBF 3 – Dredging equipment could create an obstruction migration/movement • PBF 4 – Dredging may affect water temperature and/or DO concentrations	• Can there be a construction window to reduce potential impacts? • Which dredging method is being used? • How deep is the dredging? • Does dredging change the sediment composition (e.g., from sand substrate to limestone)? • Will the dredging alter dissolved oxygen, temperature, or salinity? • Will dredging equipment and activities block migratory corridors or important foraging habitat? • Is the benthos being temporarily or permanently altered? • Will any actions outside critical habitat units have "downstream effects" that will ultimately cross into critical habitat?

Threat	PBF Affected	Potential Impact to PBF	Considerations
Water Withdrawals or Water Diversions (e.g., municipal use)	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3) • Water Quality (PBF 4)	• PBF 1 – Water withdrawals/diversions may make hard substrate inaccessible • PBF 2 – Water withdrawals/diversions may make soft substrate inaccessible • PBF 3 – Water withdrawals/diversions may create an obstruction to migration/movement • PBF 4 – Water withdrawals/diversions may alter water temperature or DO concentrations	• Can withdrawals be managed to ensure sufficient water is available for spawning/movement? • Can withdrawals be conducted during times of year when spp. less likely to need to the habitat?
In-Water Construction Projects (e.g., bridges docks, boat ramps, living reefs/shorelines, etc.)	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3)	• PBF 1 – Potential removal of hard substrate. • PBF 2 – Removal or restricted access to soft substrate removing foraging habitat/opportunities • PBF 3 – In-water structures could create an obstruction migration/movement	• Can the project be completed without affecting hard substrate? • What is the timing of the project? • What construction equipment and materials are being used? • Is the benthos being temporarily or permanently altered? • Is water quality or quantity being affected; temporarily or permanently? • Are migratory pathways being restricted or cut-off? • What life-history stages may be present? • Will any actions outside critical habitat units have "downstream effects" that will ultimately cross into critical habitat?
Beach Nourishment	• Unobstructed Water of Appropriate Depth (PBF 3)	• PBF 3 – Beach nourishing equipment could create an obstruction migration/movement	• What is the timing of the project? • What construction equipment and materials are being used? • Are migratory pathways being restricted or cut-off? • What life-history stages may be present?

Threat	PBF Affected	Potential Impact to PBF	Considerations
Habitat Restoration	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3) • Water Quality (PBF 4)	• PBF 1 – Burial of hard substrate; sedimentation of hard substrate from nearby activities • PBF 2 – Burial of soft substrate • PBF 3 – Potential creation of physical barriers; filling riverine habitat that may create conditions too shallow for migration/spawning • PBF 4 – Material placement may temporarily affect DO concentrations	• Is hard substrate present? • Will any actions outside critical habitat units have “downstream effects” that will ultimately cross into critical habitat? • Will soft substrate be permanently converted or hard substrate? • Type of habitat affected. Are there any beneficial effects? Creation or restoration of habitat or other positive water quality/habitat enhancements. • Type of equipment, time of year, and duration of in-water construction.
Outfalls and Effluent Discharge	• Hard Substrate (PBF 1) • Salinity Gradient and Soft Substrate (PBF 2) • Unobstructed Water of Appropriate Depth (PBF 3) • Water Quality (PBF 4)	• PBF 1 – Sediment in discharges may bury hard substrate; discharges may make water quality parameters unsuitable for spawning • PBF 2 – Discharges scour soft substrate • PBF 3 – Very warm or very cold discharges may create a thermal barrier to migration/movement • PBF 4 – Very warm discharges will affect water temperature and DO concentrations	• Is hard substrate present? • Will any actions outside critical habitat units have “downstream effects” that will ultimately cross into critical habitat? • Project location, time of year, and habitat type • Project duration (temporary or long-term) • Will any actions outside critical habitat units have “downstream effects” that will ultimately cross into critical habitat?

Conservation Considerations and Recovery Integration

Minimization of Effects and Conservation Measures

Regardless of consultation type (i.e., formal or informal), a constructive dialog between SERO PRD and the action agency can shape the proposed action to minimize negative effects on conservation and recovery of the species. For example, the biologist can seek ways to incorporate mitigation measures and best practices, recommend different equipment, materials, or methods, or require monitoring and construction moratoriums to ensure the proposed action is carried out in the most careful and least impactful manner possible. Such minimization measures are required, as part of any non-jeopardy formal consultation (i.e., a LAA determination) under the Incidental Take Statement. In those instances, "Terms and Conditions" designed to monitor and minimize the impact of any such take on the species will be developed.

Best Practices for Reducing and Avoiding Effects to Atlantic Sturgeon

Consider the following when including Atlantic sturgeon in the consultation:

- Report sightings to the Sturgeon Reporting Hotline at NOAA.Sturg911@noaa.gov, or by telephone: 844-788-7491 (1-844-STURG-911). The applicant's agent will report during construction; the applicant will report post-construction
- Daylight-only operations
- Limit vessel operation speeds and/or the quantity of vessels operating in a given area
- Require the use of the SERO Protected Species Construction Conditions
- Ensuring projects prevent debris from entering the environment

Construction Windows

- Projects should consider the life stages of Atlantic sturgeon that may be present depending on the time of year when the action will occur and where it occurs. For example, adults/eggs/larvae/YOY may be found in the upstream freshwater reaches of rivers during spawning periods (see Table 2). Juveniles/subadults/adults are likely to be found year round in the lower reaches/estuaries. Adults/subadults are likely to be found in the marine environment during the winter.
- Consider whether cofferdams can be installed during times of year when Atlantic sturgeon will be absent. Then, once installed, work occurring inside the cofferdams can be conduct at any time regardless of species presence in the action area.

Observers

- NMFS-approved protected species observers are required on hopper-dredging vessels and during relocation trawling. These observers are sometimes tasked with measuring, tagging, and/or collecting genetic samples (i.e., fin clips). Additionally, construction crews are required to watch for evidence of listed-species and cease work if sighted.

Relocation Trawling

- Closed-net relocation trawling uses a capture-relocation technique and is generally targeted at an active hopper-dredging site; this action causes non-lethal take.

Best Practices for Reducing and Avoiding Effects to the Critical Habitat

Consider the following ways to reduce adverse affects to Atlantic sturgeon critical habitat:

To the greatest extent practicable:

- Avoid removal or burial of hard substrate/cobble/gravel
- Use existing project footprints
- Conduct the project during time of year when relevant life stages are not present in the project area
- Ensure flows in the river remain sufficient to support the life stages potentially in the project area
- Ensure dredging does not remove soft substrate down to bedrock
- Ensure water discharge from projects do not have very low DO concentrations and are not significantly warmer than ambient water temperatures

Conservation Activities and Recommendations

It is also important to work with action agencies to promote proactive efforts to help conserve and recover the species. This will help the agency comply with its Section 7(a)(1) obligations, fill data gaps, improve the environmental baseline of species, and recover species so they no longer need the protections of the ESA. Regardless of consultation type (i.e., informal or formal consultation), conservation activities discussed early in the consultation process may be included as part of the proposed action. During formal consultation (i.e., a LAA determination), these may also be implemented through non-binding "Conservation Recommendations."

Cooperative engagement between SERO and action agencies provides an opportunity to establish or strengthen partnerships and provide federal agencies the opportunity to proactively implement measures beneficial to ESA species and critical habitat. Biologists should give thought to possible conservation recommendations based on the project type, location, and action agency or applicant performing the activity and consider whether action agencies could incorporate any of those recommendations into the project. Where applicable and practicable, staff should seek the cooperation and assistance of action agencies and applicants in helping with public outreach concerning the plight of the species. This may include, but is not limited to, helping communicate the importance of minimizing human impacts to habitats used by Atlantic sturgeon (and other protected species) (e.g., educational signage).

The Atlantic Sturgeon Recovery Outline was published in 2017. The outline described a preliminary recovery strategy identifying near-term and longer-term actions to pursue; Table 8 describes those actions.

Table 8. Recovery Actions Described in the 2017 Atlantic sturgeon Recovery Outline

Near-Term Actions Task Description
Improve understanding of population dynamics, population distribution, abundance, trends, and structure through research, monitoring, and modeling.
Continue researching fish passage designs that allow Atlantic sturgeon access to historical spawning grounds currently blocked by dams.
Continue research and monitoring of human-caused sources of injury or mortality such as fisheries bycatch and vessel strikes with the goal of minimizing those impacts.
Develop standardized methods to create reliable abundance indices.
Long-Term Actions Task Description
Work with dam owners/operators to implement fish passage once designs that successfully pass fish are identified.
Implement region-wide initiatives to improve water quality in sturgeon spawning rivers, with specific focus on eliminating or minimizing human-caused anoxic zones.
Implement regional initiatives to improve access to historical habitats and ensure water withdrawals have minimal impact on Atlantic sturgeon.

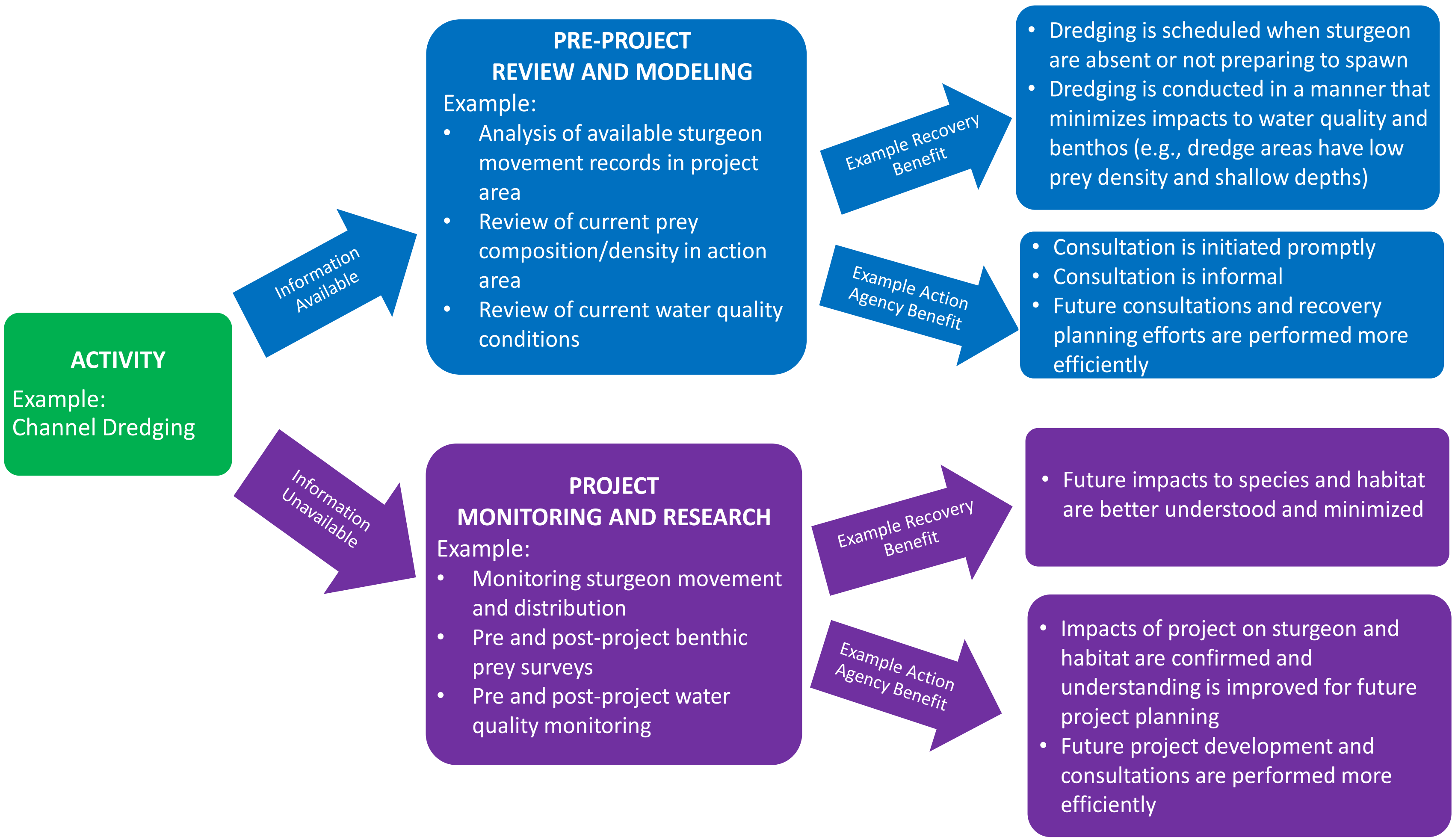
Filling Data Needs

Due to the rarity of most listed species and limited resources available for their study, data gaps often exist regarding both individual and population level effects from federal actions. Closing these data gaps is a major recovery priority and can result in more timely and accurate consultations in the future. Our understanding of the probability and magnitude of stressors in a federal action can influence the project implementation timeline in several ways including prompt determination of informal vs. formal consultation requirements; identification of environmental windows to avoid/minimize adverse effects; or development of effective best management practices. Through integrating recovery actions into their proposed action, action agencies can contribute to closing these data gaps and to the recovery of listed species, while minimizing their adverse effects and improving consultation quality and efficiency for their current proposed action and future actions.

The likelihood an activity will cause injury or harm to an individual Atlantic sturgeon (“take”) can be estimated as the product of the following: probability of an activity occurring in an area where sturgeon are present; duration of exposure of individuals to the activity; magnitude of the exposure; and probability of the activity impacting the individual. When all of this information is available, effects can be quickly assessed. However, there are often data gaps that can delay our consultation response while we gather the best available information to support our determination of whether protected species could be affected by a particular project. Even with the best available information, there are often data gaps that lead to formal consultation, as we must err on the side of species conservation. While acting conservatively toward the species is appropriate and necessary for conservation, conducting a formal consultation may be an unnecessary time commitment if take does not occur. Alternatively, data gaps may create blind spots to potential effects, resulting in an action taking a listed species even if an informal consultation was conducted. Such an outcome could delay a project until formal consultation is reinitiated and completed.

Monitoring and research studies (e.g., incorporating acoustic telemetry into proposed actions) that are implemented in advance of or during larger projects can accomplish multiple consultation and recovery objectives—species avoidance, refinement of work windows, reduced planning time, implementation of recovery actions, etc. Demographic information (e.g., abundance, mortality rate) may also be necessary to evaluate population consequences of larger projects in the context of population status and recovery. In this regard, resolving gaps in species demographic information can improve the accuracy of jeopardy analyses and our overall understanding of recovery. The same principles described above apply to improve consultation efficiency and recovery in multiple project types. Figure 9 provides a conceptual example of how research could simultaneously benefit federal action agencies and listed species.

Figure 9. Example of Research Benefiting Federal Action Agencies and Species Conservation



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