ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Action Agency: Federal Energy Regulatory Commission

Activity: Verdant's Roosevelt Island Tidal Energy Project, including the Seasonal Species Characterization-Netting Plan as required by Article 401 of the pilot project license issued by FERC
F/NER/2012/02251 **GARFO-2012-00027**

Date Issued: 9/26/12

Approved by: [signature] for John Bullard

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1.0 INTRODUCTION

The U.S. Federal Energy Regulatory Commission (FERC) issued a pilot license to Verdant for their Roosevelt Island Tidal Energy (RITE) project in the East River (FERC Project 12611) in January 2012 (see Figure 1 for map of project location). Article 401 of the license requires Verdant to carry out a Seasonal Species Characterization-Netting Plan. This Opinion considers the effects of the installation and operation of the RITE project and this trawl survey on listed species. This Opinion is based on information provided by FERC and Verdant in a 2011 Biological Assessment (BA), a May 2012 BA, and other available information as cited herein. A complete administrative record of this consultation will be kept on file at NMFS Northeast Regional Office.

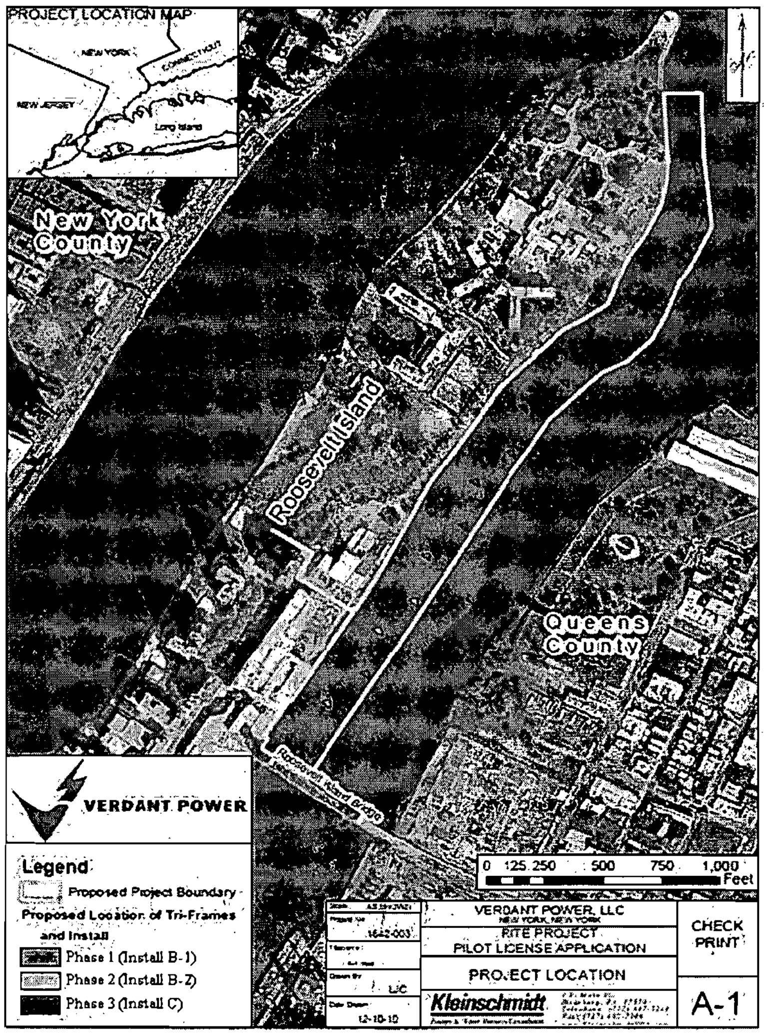

Figure 1. Map of Verdant RIT project and proposed trawl survey (source: FERC 2011)

2.0 CONSULTATION HISTORY

In December 2010, Verdant submitted to FERC a final application for a pilot license for the RITE project. FERC requested consultation with us on the effects of project operations in a letter dated January 13, 2011. The RITE project consists of a phased installation of an underwater tidal energy facility. At the time that FERC requested consultation with us, the Netting Plan had not been proposed; therefore, it was not considered in the 2011 consultation.

In a letter dated May 10, 2011, we provided our concurrence that the proposed operation of the RITE project was not likely to adversely affect shortnose sturgeon or any species of listed sea turtle and that any effects to Atlantic sturgeon (five Distinct Population Segments (DPS) were proposed for listing at the time) would be insignificant and discountable.

As provided in 50 CFR§402.16, reinitiation of consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In the event that the amount or extent of incidental take is exceeded, section 7 consultation must be reinitiated immediately.

The design and implementation of the RITE project has not changed since consultation was completed and we have no new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered. While a new species has been listed (five DPSs of Atlantic sturgeon), our 2011 consultation considered effects to those species as they were proposed at that time. However, the proposed action has been modified as there is now a trawl survey proposed that was not considered in the 2011 consultation.

FERC issued the pilot license to Verdant on January 23, 2012. Article 401 of the license requires Verdant to carry out a trawl survey to characterize the fish community present at the project site. Verdant discussed this requirement with us during the winter of 2012. We determined that interactions with Atlantic sturgeon were likely during the required trawl survey. Verdant prepared a draft BA that was submitted to FERC on May 7, 2012. In a letter dated May 31, 2012, FERC requested that we initiate formal consultation to consider effects of the required trawl survey. FERC and Verdant confirmed that the required study would not be undertaken until this consultation was complete. We replied to the request for consultation in a letter dated June 22, 2012; in this letter we confirmed that as all the information necessary for consultation has been received, consultation was initiated on May 31, 2012.

This Opinion, therefore, will consider not only the installation and operation of the RITE project (which was already considered in a 2011 informal consultation (see Appendix A), as well as the effects of the trawl survey, which was not considered in the May 2011 letter because the study had not been proposed at that time.

3.0 DESCRIPTION OF THE PROPOSED ACTION

3.1 Installation and Operation of the RITE Project

The RITE East Channel Pilot will consist of: (1) a field array of thirty 5-meter diameter axial flow Kinetic Hydropower System (KHPS) turbine-generator units mounted on ten tri-frame mounts, with a total capacity of 1 MW at 35 KW each; (2) underwater cables from each turbine to five shoreline switchgear vaults, that interconnect to a Control Room and interconnection points; and, (3) appurtenant facilities to ensure safe navigation and turbine operation. The project will be constructed in three phases: install B1, three Gen 5 turbines on a tri-frame; install B2, up to three additional tri-frames of three turbines; and, install C, up to six additional triframes (no more than 30 Gen 5 KHPS total).

The Verdant Gen 5 KHPS turbine consists of four major components: rotor with 3 fixed blades, nacelle, pylon and yaw mechanism; generator and drivetrain; and, the riverbed mounting system (3 KHPS turbines on one tri-frame mount). The RITE pilot project of 30 KHPS turbines would encompass a project boundary of approximately 21.6 acres, which includes 21.2 acres of underwater land lease, and 0.4 acres of shoreline right-of-way. The pilot will include 480V electrical cables from each of the 30 KHPS turbines. Cables will travel through the pylon assembly of each turbine in the tri-frame mount. For each tri-frame mount, the three turbine cables will be bundled together into a set, which will then be paired with another set and routed from the field, weighted along the riverbed, to five shoreline switchgear vaults. The individual turbine cable lengths from the turbine-generation to the respective vaults range from 233 to 322 feet, with an average of 282 feet. Construction is scheduled to occur in phases, beginning in the fourth-quarter of 2011 and being completed in 2014. The parameters of the turbines are as follows: 1.0m rotor hub diameter, 5.0m rotor tip diameter, 3 blades, approximately 40 revolutions per minute at full load.

The Verdant KHPS is designed to capture energy from the flow in both ebb and flood directions by yawing with the changing tide, using a passive weathervaning system with a downstream rotor. The turbines will have a fixed blade design.

3.2 Required Trawl Survey

Verdant is ordered by the FERC Pilot license to conduct RMEE-3 a Seasonal Species Characterization Netting Plan to characterize the composition of species of fish that have been seen in prior Verdant Hydroacoustics efforts in the East Channel of the East River and those that are likely to be monitored in the Seasonal Hydroacoustics (RMEE-1) and Seasonal DIDSON Monitoring (RMEE-2) plans as ordered in the FERC license (*See* www.the riteproject.com Volume 4 for details).

As part of the approved plan, the non-targeted netting would be conducted using a mid-water research trawl during or near slack tide in the near shore areas adjacent to the proposed project. The Verdant RITE project is being installed in four phases (A, B-1, B-2, and C) over the ten-year period that the pilot license is valid (through January 2022). In each of these four phases, there would be eight days of trawling; one day during late-May-June, one day during July-August and then one day every other week from September to December 15. Thus, the trawl survey will be carried out on eight days in each of four years that may or may not be consecutive. On each trawl day, three fifteen-minute tows will be carried out. Under the adaptive management provisions, at the conclusion of each netting event, the protocol and efficacy of the data collection is jointly evaluated and the study is either continued, modified, or concluded.

The trawling will be carried out with a trawl that is 25 feet wide by 20 feet deep (the channel depth is 33 feet) and has a length of 50 feet with 90-100 foot bridles and at least 200-ft long steel cable tow ropes. The net will include Mullet doors located on each side of the net opening to ensure the net is opened wide. The main portion of the net will consist of ½ inch 40 mm mesh going into 12 mm mesh, with a 1/8-inch 6 mm mesh cod-end collection bag. The start and end locations of each tow would be documented using a hand held global positioning system (GPS) unit, with the tows standardized by length. All netting will be done on slack tide during daylight only.

After each tow, the contents of the net would be inspected and all organisms sorted, identified, and counted; the representative catch would be documented photographically and any dead or injured fish would be frozen and archived for potential forensic examination. When possible, all live and unharmed fish would be released after processing. Verdant is required to report on the findings of the netting in a technical memo after each seasonal event and file comments and responses as part of its annual report. Verdant proposes to consult with the agencies immediately regarding necessary remedial measures if the netting identifies any adverse effects to fish populations in the East River (e.g., higher mortality rates than anticipated or other unanticipated impacts).

3.2 Action Area

The action area for Section 7 consultations is defined as all of the areas directly or indirectly affected by the Federal action, and not merely the immediate area involved in the action. We anticipate that the only effects on ESA-listed species and their habitat as a result of the survey are the direct effects of interaction between listed species and sampling gear that will be used for the survey, and the effects on other marine organisms (*i.e.*, prey) on or very near the bottom from the sampling gear. The trawl survey area consists of a portion of the East River. Therefore, for the purpose of this consultation, the action area for the proposed action is defined by the area in which the RITE project will be operated and sampling gear for the trawl survey will be deployed.

4.0 STATUS OF THE SPECIES

This section presents biological and ecological information relevant to formulating the Biological Opinion. Information on species' life history, its habitat and distribution, and other factors necessary for its survival are included to provide background for analyses in later sections of this Opinion.

Sea Turtles

Listed sea turtles occur seasonally in certain New York waters. The sea turtles in these waters are typically small juveniles with the most abundant being the federally threatened loggerhead (*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*), federally endangered green sea turtles (*Chelonia mydas*), and federally endangered leatherback sea turtles (*Dermochelys coriacea*).

There have been no documented captures of sea turtles in the East River and it is not likely to be a high use area for these species. Ruben and Morrealle (2000) review the available information on sea turtle use of the New York Bight. In this review, which includes information on the New York Harbor area, the authors report that there is an extremely low number of sightings or captures of sea turtles in the area. They also note that this is not due to a lack of sampling or monitoring studies but rather that it likely reflects the true rarity of these species in the area, particularly the upper Harbor. We have reviewed the available information on distribution of sea turtles in the New York Bight. Sea turtles are occasionally documented in western Long Island Sound and few individuals have been documented in New York Harbor. No sea turtles have been documented in the East River. Based on information summarized in Ruben and Morreale (1999)[1], in New York waters, sea turtles are most likely to be present in areas with sandy substrates, depths of 15-49 feet, current of less than 2 knots, and with high concentrations of sea turtle forage. The project area has depths of approximately 30 feet, making it consistent with the depths likely to be utilized by sea turtles in New York waters. However, the substrate consists of cobbles and bedrock with no sandy sediment. Additionally, current in the area is greater than 2 knots more than 73% of the time. Based on these factors and the lack of evidence of sea turtles in the East River, it is reasonable to conclude that the presence of sea turtles in the action area is extremely unlikely. As such, it is extremely unlikely that any sea turtles will be captured during the survey. No other effects to sea turtles are anticipated to result from the proposed action. As such, all effects to loggerhead, Kemp's ridley, green and leatherback sea turtles will be insignificant and discountable and these species will not be considered further in this Opinion.

Shortnose sturgeon

Shortnose sturgeon have been captured near the confluence of the East River and New York Harbor and at least two shortnose sturgeon tagged in the Hudson River have been recaptured in the Connecticut River. It is unknown whether these fish traveled through the East River and through Long Island Sound (the most direct route) or exited New York Harbor into the Atlantic Ocean and swam around southern Long Island and back into Long Island Sound. Shortnose sturgeon are primarily a riverine species. Limited information is available on the frequency of migrations away from the natal river. However, as evidenced by the movement between the Hudson and Connecticut Rivers referenced above and the documented movement of shortnose sturgeon from the Merrimack River, MA to the Kennebec River, ME as well as between the Kennebec and Penosbcot Rivers, ME, at least limited coastal movements occur. As juvenile shortnose sturgeon have limited tolerance to salinity these movements are only thought to be made by adults.

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[1] Ruben, H. and S. Morrealle. 1999. Biological Assessment for Sea Turtles in the New York Bight Complex. Unpublished Report - Submitted to NMFS by the US Army Corps of Engineers.

While the East River is not likely to be a high use area for shortnose sturgeon and there have been no documented captures of shortnose sturgeon in this waterbody, given the known distribution of shortnose sturgeon in nearby waters and the documented occurrences of shortnose sturgeon making coastal migrations from their natal rivers, the best available information indicates that occasional transient shortnose sturgeon may be present in the East River.

Installation and Operation of the RITE project

As noted above, we previously considered effects of the installation and operation of the RITE project on shortnose sturgeon and determined all effects would be insignificant and discountable. These conclusions are documented in our May 2011 letter and summarized here.

Sediment in the project area consists of bedrock, boulders and cobbles. Installation of tri-frame mounts and electric cables may disturb substrate and could result in a temporary increase in turbidity. The tri-frame structure relies on shape and weight for its restraint on the bottom, but may be pinned with hand tools to the bedrock if necessary. Given that there are no soft sediments in the project area, any increase in turbidity is expected to be extremely small and localized and is not expected to affect the behavior of any shortnose sturgeon present in the action area. Additionally, as the units will be deployed on bedrock and cobble, with few benthic invertebrates present, there are not likely to be any effects to the benthic community that would affect the ability of shortnose sturgeon to forage in the project area. All effects of project installation will be insignificant and discountable.

The operation of the turbines will involve spinning blades. In the Biological Assessment (BA) prepared for this project, Verdant has conducted an analysis of the potential for listed species present in the East River to interact with the turbine blades (see KHPS-Fish Interaction Model, submitted to NMFS with the BA for a complete description of the model). The model developed by Verdant combines various parameters, including: water velocity distribution, channel geometry, physical and operation characteristics of the units, and specific fish characteristics (size, burst swimming speed, and swimming velocity in relationship to water velocity. The model does not make any assumptions about fish behavior; that is, it does not incorporate any likelihood that if a fish detects the presence of the turbines, that the fish would avoid an interaction. As adult shortnose sturgeon are highly mobile, it is likely that the model presents a very conservative estimate of the likelihood of interactions between an individual fish and the turbines. The model uses 9 parameters and was applied to calculate the strike probability for one turbine, Install A (2 turbines), Install B-1 (one tri-frame, 3 turbines), Install B-2 (4 tri-frames, 12 turbines) and Install C (10 tri-frames, 30 turbines). The turbines in the field are treated as if the fish had an equal opportunity to go through all 30 turbines; however, in reality, as the turbines are grouped together in 3s on a tri-frame, it would be more likely that a fish going through one turbine in a tri-frame would not pass through either one of the other two turbines. This also leads to the model presenting a very conservative estimate of the likelihood of interactions between an individual fish and the turbines.

Using the model, the probability of any individual shortnose sturgeon, if present in the East River, being struck by a turbine blade is 0.08%. The probability of a strike for Install B-1 (one tri-frame) is 0.23%, Install B-2 (4 tri-frames) is 0.91% and Install C (10 tri-frames) is 2.8%. This model predicts only the probability of an individual shortnose sturgeon, present in the East River, being struck by a turbine blade. Work done by Amaral et al. (2008)[2] tested the effects of leading edge turbine blades on fish strike survival and injury. For white sturgeon ranging in size from 100-150mm, blade strike survival at mean blade speeds of 10.6-12.2 m/s (comparable to the Verdant RITE outer edge blade speed of 10.5 m/s) was 100% for sturgeon stuck in the head and caudal region and 97.4% for those struck in the midsection.

The information available indicates that there is a very low probability of a shortnose sturgeon, if present in the East River, being struck by a turbine blade (up to 2.8% depending on the number of turbines present), and that even if struck, there is a very low probability of injury or mortality expected (0-2.6%, depending on where on the body the strike occurs). As explained above in the description of the model, the model is a very conservative estimate of the likelihood of blade strike given that it assumes that fish will demonstrate no avoidance behavior and that it assumes that a fish is exposed to all three turbines in a tri-frame when realistically exposure is likely to be limited to only one turbine per tri-frame and at least some avoidance behavior is expected.

As noted above, shortnose sturgeon are not resident in the East River. Information on movements outside of the natal river by this species is extremely limited. There are only two documented occurrences of shortnose sturgeon from the Hudson River being detected outside of the Hudson River. As explained above, the East River is a tidal strait with habitat that is not consistent with the types of habitat known to be used by shortnose sturgeon. No shortnose sturgeon have been documented in the East River. The rarity of shortnose sturgeon in the East River reduces the exposure that shortnose sturgeon would have to the turbines. Given the rarity of shortnose sturgeon in the action area and the low probability of a strike even if a shortnose sturgeon was present in the East River, it is extremely unlikely that there will be any interactions between the turbines and any shortnose sturgeon. As such, the effects of the operation of the Verdant RITE project on shortnose sturgeon are discountable.

Trawl Survey
Given the limited amount of trawling that will occur and the expected rarity of shortnose sturgeon in the East River, it is extremely unlikely that any shortnose sturgeon will be captured during the survey. No other effects to shortnose sturgeon are anticipated to result from the trawl survey.

Species That May be Adversely Affected by the Proposed Action

We have determined that the actions being considered in the Opinion may adversely affect the following listed species:

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[2] Amaral, S. et al. 2008. Effects of Leading Edge Turbine Blade Thickness on Fish Strike Survival and Injury. Proceedings of Hydrovision 2008. HCI Publications, St. Louis, Missouri.

Common name	**Scientific name**	**ESA Status**
Shortnose Sturgeon	Acipenser brevirostrum	Endangered
Gulf of Maine DPS of Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Threatened
New York Bight DPS of Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered
Chesapeake Bay DPS of Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered
South Atlantic DPS of Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered
Carolina DPS of Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered

4.1 Status of Atlantic Sturgeon

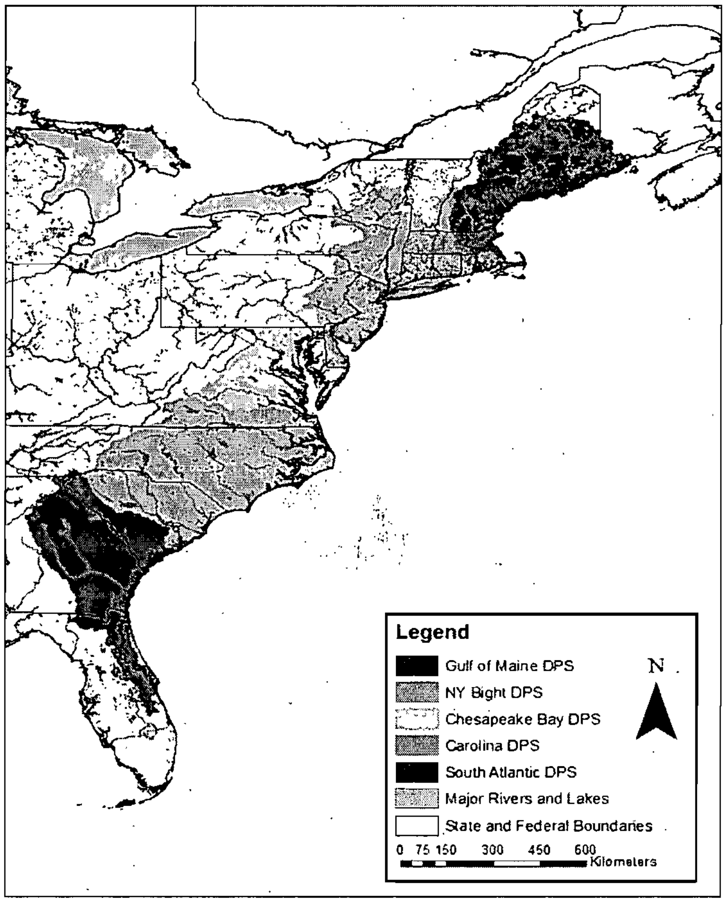
The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of which Atlantic sturgeon DPSs likely occur in the action area and provide information on the use of the action area by Atlantic sturgeon.

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a subspecies of sturgeon distributed along the eastern coast of North America from Hamilton Inlet, Labrador, Canada to Cape Canaveral, Florida, USA (Scott and Scott, 1988; ASSRT, 2007; T. Savoy, CT DEP, pers. comm.). NMFS has delineated U.S. populations of Atlantic sturgeon into five DPSs (77 FR 5880 and 77 FR 5914). These are: the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (see Figure 2). The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King, 2011). However, genetic data as well as tracking and tagging data demonstrate sturgeon from each DPS and Canada occur throughout the full range of the subspecies. Therefore, sturgeon originating from any of the 5 DPSs can be affected by threats in the marine, estuarine and riverine environment that occur far from natal spawning rivers.

On February 6, 2012, we published notice in the *Federal Register* that we were listing the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs as endangered, and the Gulf of Maine DPS as threatened (77 FR 5880 and 77 FR 5914). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings.

As described below, individuals originating from the five listed DPSs may occur in the action area. Information general to all Atlantic sturgeon as well as information specific to each of the relevant DPSs, is provided below.

Figure 2. Map Depicting the Boundaries of the five Atlantic sturgeon DPSs



4.1.1 Atlantic sturgeon life history

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous[3] fish (Bigelow and Schroeder, 1953; Vladykov and Greeley 1963; Mangin, 1964; Pikitch *et al.*, 2005; Dadswell, 2006; ASSRT, 2007).

The life history of Atlantic sturgeon can be divided up into five general categories as described in the table below (adapted from ASSRT 2007).

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[3] Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQ's, available at http://www.nefsc.noaa.gov/faq/fishfaq1a.html, modified June 16, 2011)

Age Class	Size	Description
Egg		Fertilized or unfertilized
Larvae		Negative photo-taxic, nourished by yolk sac
Young of Year (YOY)	**0.3 grams <41 cm TL**	Fish that are > 3 months and < one year; capable of capturing and consuming live food
Sub-adults	**>41 cm and <150 cm TL**	Fish that are at least age 1 and are not sexually mature
Adults	**>150 cm TL**	Sexually mature fish

Table 1. Descriptions of Atlantic sturgeon life history stages.

They are a relatively large fish, even amongst sturgeon species (Pikitch *et al.*, 2005). Atlantic sturgeons are bottom feeders that suck food into a ventrally-located protruding mouth (Bigelow and Schroeder, 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder, 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007; Savoy, 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder, 1953; ASSRT, 2007; Guilbard *et al.*, 2007).

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e. length) than fully mature males; and (4) the length of Atlantic sturgeon caught since the mid-late 20th century have typically been less than 3 meters (m) (Smith *et al.*, 1982; Smith *et al.*, 1984; Smith, 1985; Scott and Scott, 1988; Young *et al.*, 1998; Collins *et al.*, 2000; Caron *et al.*, 2002; Dadswell, 2006; ASSRT, 2007; Kahnle *et al.*, 2007; DFO, 2011). The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 m (Vladykov and Greeley, 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.*, 1982; Van Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Dadswell, 2006). However, while females are prolific with egg production ranging from 400,000 to 4 million eggs per spawning year, females spawn at intervals of 2-5 years (Vladykov and Greeley, 1963; Smith *et al.*, 1982; Van Eenennaam *et al.*, 1996; Van Eenennaam and Doroshov, 1998; Stevenson and Secor, 1999; Dadswell, 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50 percent of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman, 1997). Males exhibit spawning periodicity of 1-5 years (Smith, 1985; Collins *et al.*, 2000; Caron *et al.*, 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (ASMFC, 2009). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; Caron *et al.*, 2002). Male sturgeon begin upstream spawning migrations when waters reach approximately 6° C (43° F) (Smith *et al.*, 1982; Dovel and Berggren, 1983; Smith, 1985; ASMFC, 2009), and remain on the spawning grounds throughout the spawning season (Bain, 1997). Females begin spawning migrations when temperatures are closer to 12° C to 13° C (54° to 55° F) (Dovel and Berggren, 1983; Smith, 1985; Collins *et al.*, 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain, 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 cm/s and depths are 3-27 m (Borodin, 1925; Dees, 1961; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; Shirey *et al.* 1999; Bain *et al.*, 2000; Collins *et al.*, 2000; Caron *et al.* 2002; Hatin *et al.* 2002; ASMFC, 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees, 1961; Scott and Crossman, 1973; Gilbert, 1989; Smith and Clugston, 1997; Bain *et al.* 2000; Collins *et al.*, 2000; Caron *et al.*, 2002; Hatin *et al.*, 2002; Mohler, 2003; ASMFC, 2009), and become adhesive shortly after fertilization (Murawski and Pacheco, 1977; Van den Avyle, 1983; Mohler, 2003). Incubation time for the eggs increases as water temperature decreases (Mohler, 2003). At temperatures of 20° and 18° C, hatching occurs approximately 94 and 140 hours, respectively, after egg deposition (ASSRT, 2007).

Larval Atlantic sturgeon (i.e. less than 4 weeks old, with total lengths (TL) less than 30 mm; Van Eenennaam *et al.* 1996) are assumed to undertake a demersal existence and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.*, 1980; Bain *et al.*, 2000; Kynard and Horgan, 2002; ASMFC, 2009). Studies suggest that age-0 (i.e., young-of-year), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley, 1999; Hatin *et al.*, 2007; McCord *et al.*, 2007; Munro *et al.*, 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.*, 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton, 1973; Dovel and Berggen, 1983; Waldman *et al.*, 1996; Dadswell, 2006; ASSRT, 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 m in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley, 1963; Murawski and Pacheco, 1977; Dovel and Berggren, 1983; Smith, 1985; Collins and Smith, 1997; Welsh *et al.*, 2002; Savoy and Pacileo, 2003; Stein *et al.*, 2004; USFWS, 2004; Laney *et al.*, 2007; Dunton *et al.*, 2010; Erickson *et al.*, 2011; Wirgin and King, 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 m during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 m in summer and fall (Erickson *et al.*, 2011). Shirey (Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009) found a similar movement pattern for juvenile Atlantic sturgeon based on recaptures of fish originally tagged in the Delaware River. After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras, North Carolina from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall. The majority of these tag returns were reported from relatively shallow near shore fisheries with few fish reported from waters in excess of 25 m (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in ASMFC, 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 m (Dovel and Berggren, 1983; Dadswell *et al.*, 1984; Johnson *et al.*, 1997; Rochard *et al.*, 1997; Kynard *et al.*, 2000; Eyler *et al.*, 2004; Stein *et al.*, 2004; Wehrell, 2005; Dadswell, 2006; ASSRT, 2007; Laney *et al.*, 2007). These sites may be used as foraging sites and/or thermal refuge.

4.1.2 Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman, 1973; Taub, 1990; Kennebec River Resource Management Plan, 1993; Smith and Clugston, 1997; Dadswell, 2006; ASSRT, 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware, and at least 10,000 females for other spawning stocks (Secor and Waldman, 1999; Secor, 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 16 U.S. rivers are known to support spawning based on available evidence (i.e., presence of young-of-year or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT, 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only four rivers (Kennebec, Hudson, Delaware, James) are known to currently support spawning from Maine through Virginia where historical records support there used to be fifteen spawning rivers (ASSRT, 2007). Thus, there are substantial gaps in the range between Atlantic sturgeon spawning rivers amongst northern and mid-Atlantic states which could make recolonization of extirpated populations more difficult.

There are no current, published population abundance estimates for any spawning stock or for any of the five DPSs of Atlantic sturgeon. An annual mean estimate of 863 mature adults (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson, 2006). Using the data collected from the Hudson River and Altamaha River to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley, 1963; Smith, 1985; Van Eenennaam *et al.*, 1996; Stevenson and Secor, 1999; Collins *et al.* 2000; Caron *et al.*, 2002), the age structure of these populations is not well understood, and stage to stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (e.g., yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT, 2007).

4.1.3 Threats faced by Atlantic sturgeon throughout their range

Atlantic sturgeon are susceptible to over exploitation given their life history characteristics (e.g., late maturity, dependence on a wide-variety of habitats). Similar to other sturgeon species (Vladykov and Greeley, 1963; Pikitch *et al.*, 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19th and 20th centuries (Taub, 1990; Smith and Clugston, 1997; Secor and Waldman, 1999).

Based on the best available information, NMFS has concluded that unintended catch of Atlantic sturgeon in fisheries, vessel strikes, poor water quality, water availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all of the threats are not necessarily present in the same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from the Labrador, Canada to Cape Canaveral, FL, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, given that Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub, 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the Sturgeon FMP. Complementary regulations were implemented by NMFS in 1999 that prohibit fishing for, harvesting, possessing or retaining Atlantic sturgeon or its parts in or from the Exclusive Economic Zone in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO, 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the Gulf of Maine and the New York Bight DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO, 2010; Wirgin and King, 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian directed Atlantic sturgeon fisheries and of Canadian fish incidentally in U.S. commercial fisheries. At this time, there are no estimates of the number of individuals from any of the DPSs that are captured or killed in Canadian fisheries each year.

Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the Gulf of Maine DPS, with a smaller percentage from the New York Bight DPS.

Individuals from all 5 DPSs are caught as bycatch in fisheries operating in U.S. waters. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NMFS NEFSC 2011) in the Northeast Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NEFSC 2011). The analysis prepared by the NEFSC estimates that from 2006 through 2010 there were 2,250 to 3,862 encounters per year in observed gillnet and trawl fisheries, with an average of 3,118 encounters. Mortality rates in gillnet gear are approximately 20%. Mortality rates in otter trawl gear are believed to be lower at approximately 5%.

4.1.4 Genetic Composition of Atlantic sturgeon in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. We have considered the best available information to determine from which DPSs individuals in the action area are likely to have originated. We have mixed-stock analyses from samples taken in a variety of coastal sampling programs; however, to date, we have no mixed-stock or individual assignment data for Atlantic sturgeon in the East River.

Near the action area, we have mixed stock analysis from fish captured in the Hudson River, in central Long Island Sound and fish caught as bycatch in commercial fisheries operating along the Northeast Coast. The samples taken from central Long Island Sound are the closest geographically to the action area. Based on this, we expect that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 79%; South Atlantic 10%, Chesapeake Bay 7%, Gulf of Maine 4%; and Carolina 0.5%. These percentages are based on genetic sampling of individuals (n=275) captured within Long Island Sound between 2006 and 2010, and therefore, represent the best available information on the likely genetic makeup of individuals occurring in the action area. These assignments and the data from which they are derived are described in detail in Damon-Randall *et al.* (2012a). The genetic assignments have a plus/minus 5% confidence interval; however, for purposes of section 7 consultation we have selected the reported values above, which approximate the mid-point of the range, as a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area.

4.2 Gulf of Maine DPS of Atlantic sturgeon

The Gulf of Maine DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning still occurs in the Kennebec River, and it is possible that it still occurs in the Penobscot River as well. Spawning in the Androscoggin River was just recently confirmed by the Maine Department of Marine Resources when they captured a larval Atlantic sturgeon during the 2011 spawning season below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the Merrimack River at river kilometer (rkm) 49 blocked access to 58 percent of Atlantic sturgeon habitat in the river (Oakley, 2003; ASSRT, 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Keiffer and Kynard, 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in these rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS as well as likely throughout the entire range (ASSRT, 2007; Fernandes, *et al.*, 2010).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.*, 1981; ASMFC, 1998; NMFS and USFWS, 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) capture of 31 adult Atlantic sturgeon from June 15,1980, through July 26,1980, in a small commercial fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least 4 ripe males and 1 ripe female captured on July 26,1980; and, (3) capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, ME (NMFS and USFWS, 1998; ASMFC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Several threats play a role in shaping the current status of Gulf of Maine DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.*, 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.*, 1979). Following the 1880's, the sturgeon fishery was almost non-existent due to a collapse of the sturgeon stocks. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by-catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occurs. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the Gulf of Maine DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the Gulf of Maine DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region; however, as noted above, not all projects are monitored for interactions with fish. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects. We are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin and Saco Rivers, these dams are near the site of natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon are known to occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. While not expected to be killed or injured during passage at a dam, the extent that Atlantic sturgeon are affected by the existence of dams and their operations in the Gulf of Maine region is currently unknown. The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown; however, the documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. The range of Atlantic sturgeon in the Penobscot River is limited by the presence of the Veazie and Great Works Dams. Together these dams prevent Atlantic sturgeon from accessing approximately 29 km of habitat, including the presumed historical spawning habitat located downstream of Milford Falls, the site of the Milford Dam. While removal of the Veazie and Great Works Dams is anticipated to occur in the near future, the presence of these dams is currently preventing access to significant habitats within the Penobscot River. While Atlantic sturgeon are known to occur in the Penobscot River, it is unknown if spawning is currently occurring or whether the presence of the Veazie and Great Works Dams affects the likelihood of spawning occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. Like the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning occurring in this river.

Gulf of Maine DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA, 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no empirical abundance estimates for the Gulf of Maine DPS. The Atlantic sturgeon SRT (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers, 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

Summary of the Gulf of Maine DPS
Spawning for the Gulf of Maine DPS is known to occur in two rivers (Kennebec and Androscoggin) and possibly in a third. Spawning may be occurring in other rivers, such as the Sheepscot or Penobscot, but has not been confirmed. There are indications of increasing abundance of Atlantic sturgeon belonging to the Gulf of Maine DPS. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., the Saco, Presumpscot, and Charles rivers). These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8 percent (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, in draft).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

4.3 New York Bight DPS of Atlantic sturgeon
The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the

Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800's is unknown but, has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid 1970s (Kahnle *et al.*, 1998). A decline appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). Catch-per-unit-effort data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980's (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s and while the CPUE is generally higher in the 2000s as compared to the 1990s. Given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2007 being generally higher than those from 1990-1999, they are low compared to the late 1980s. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002). Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron, 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River; however, at this time we do not have information to quantify this threat or its impact to the population or the New York Bight DPS. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population.

Summary of the New York Bight DPS
Atlantic sturgeon originating from the New York Bight DPS spawn in the Hudson and Delaware rivers. While genetic testing can differentiate between individuals originating from the Hudson or Delaware river the available information suggests that the straying rate is high between these rivers. There are no indications of increasing abundance for the New York Bight DPS (ASSRT, 2009; 2010). Some of the impact from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke

Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware River. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004 to 2008, and at least 13 of these fish were large adults. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. NMFS has determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

4.4 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS includes the following: all anadromous Atlantic sturgeons that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, VA. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT, 2007). Based on the review by Oakley (2003), 100 percent of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e. dams) are located upriver of where spawning is expected to have historically occurred (ASSRT, 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well (Musick *et al.*, 1994; ASSRT, 2007; Greene, 2009). However, conclusive evidence of current spawning is only available for the James River. Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat prior to entering the marine system as subadults (Vladykov and Greeley, 1963; ASSRT, 2007; Wirgin *et al.*, 2007; Grunwald *et al.*, 2008).

Age to maturity for Chesapeake Bay DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is 5 to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.*, 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.*, 1998). Therefore, age at maturity for Atlantic sturgeon of the Chesapeake Bay DPS likely falls within these values.

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder, 1928; Vladykov and Greeley, 1963; ASMFC, 1998; Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor, 2002; Bushnoe *et al.*, 2005; ASSRT, 2007; Balazik *et al.*, 2010). Habitat disturbance caused by in-river work such as dredging for navigational purposes is thought to have reduced available spawning habitat in the James River (Holton and Walsh, 1995; Bushnoe *et al.*, 2005; ASSRT, 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the Chesapeake Bay DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface to volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.*, 2004; ASMFC, 1998; ASSRT, 2007; EPA, 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor, 2005; 2010). At this time we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT, 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005 through 2007. Several of these were mature individuals. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the New York Bight DPS.

In the marine and coastal range of the Chesapeake Bay DPS from Canada to Florida, fisheries bycatch in federally and state managed fisheries pose a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population

(Stein *et al.*, 2004; ASMFC, 2007; ASSRT, 2007).

Summary of the Chesapeake Bay DPS
Spawning for the Chesapeake Bay DPS is known to occur in only the James River. Spawning may be occurring in other rivers, such as the York, but has not been confirmed. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the Chesapeake Bay DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). We do not currently have enough information about any life stage to establish a trend for this DPS.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries and vessel strikes remain significant threats to the Chesapeake Bay DPS of Atlantic sturgeon. Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007). The Chesapeake Bay DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

4.5 Carolina DPS of Atlantic sturgeon
The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) 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. Sturgeon are commonly captured 40 miles offshore (D. Fox, DSU, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein et al. 2004, ASMFC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 2). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the Carolina DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	Spawning Population	Data
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Table 2. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the Carolina DPS occurs within the Mid-Atlantic Coastal Plain ecoregion (TNC 2002a), which includes bottomland hardwood forests, swamps, and some of the world's most active coastal dunes, sounds, and estuaries. Natural fires, floods, and storms are so dominant in this region that the landscape changes very quickly. Rivers routinely change their courses and emerge from their banks. The primary threats to biological diversity in the Mid-Atlantic Coastal Plain, as listed by TNC are: global climate change and rising sea level; altered surface hydrology and landform alteration (e.g., flood-control and hydroelectric dams, inter-basin transfers of water, drainage ditches, breached levees, artificial levees, dredged inlets and river channels, beach renourishment, and spoil deposition banks and piles); a regionally receding water table, probably resulting from both over-use and inadequate recharge; fire suppression; land fragmentation, mainly by highway development; land-use conversion (e.g., from forests to timber plantations, farms, golf courses, housing developments, and resorts); the invasion of exotic plants and animals; air and water pollution, mainly from agricultural activities including concentrated animal feed operations; and over-harvesting and poaching of species. Many of the Carolina DPS' spawning rivers, located in the Mid-Coastal Plain, originate in areas of marl. Waters draining calcareous, impervious surface materials such as marl are: (1) likely to be alkaline; (2) dominated by surface run-off; (3) have little groundwater connection; and, (4) are seasonally ephemeral.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time-frame. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with a potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, is estimated to be less than 3 percent of what they were historically (ASSRT 2007).

Threats

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen (DO)) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. Twenty interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by North Carolina Department of Environmental and Natural Resources or other resource agencies. Since the 1993 legislation requiring certificates for transfers, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd pending certification. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Atlantic sturgeon are more sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5 percent of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0 and 51 percent, with the greatest mortality occurring in sturgeon caught by sink gillnets. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets, therefore fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.)

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the Carolina DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the Carolina DPS have remained relatively constant at greatly reduced levels (approximately 3 percent of historical population sizes) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. A long life-span also allows multiple opportunities to contribute to future generations, it also results increases the timeframe over which exposure to the multitude of threats facing the Carolina DPS can occur.

The viability of the Carolina DPS depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon sturgeon populations. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

Summary of the Status of the Carolina DPS of Atlantic Sturgeon

In summary, the Carolina DPS is estimated to number less than 3 percent of its historic population size. There are estimated to be less than 300 spawning adults per year (total of both sexes) in each of the major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) from

Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of over 60 percent of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and DO) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations has contributied to the status of the Carolina DPS.

4.6 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin 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.

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (Table 3). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the spawning population in the St. Marys River, as well as any historical spawning population present in the St. Johns, is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. Both the St. Marys and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the South Atlantic DPS for specific life functions, such as spawning, nursery habitat, and foraging. However, fish from the South Atlantic DPS likely use other river systems than those listed here for their specific life functions.

River/Estuary	**Spawning Population**	**Data**
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)
Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Extirpated	
St. Johns River, FL	Extirpated	

Table 3. Major rivers, tributaries, and sounds within the range of the South Atlantic DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

The riverine spawning habitat of the South Atlantic DPS occurs within the South Atlantic Coastal Plain ecoregion (TNC 2002b), which includes fall-line sandhills, rolling longleaf pine uplands, wet pine flatwoods, isolated depression wetlands, small streams, large river systems, and estuaries. The primary threats to biological diversity in the South Atlantic Coastal Plain listed by TNC are intensive silvicultural practices, including conversion of natural forests to highly managed pine monocultures and the clear-cutting of bottomland hardwood forests. Changes in water quality and quantity, caused by hydrologic alterations (impoundments, groundwater withdrawal, and ditching), and point and nonpoint pollution, are threatening the aquatic systems. Development is a growing threat, especially in coastal areas. Agricultural conversion, fire regime alteration, and the introduction of nonnative species are additional threats to the ecoregion's diversity. The South Atlantic DPS' spawning rivers, located in the South Atlantic Coastal Plain, are primarily of two types: brownwater (with headwaters north of the Fall Line, silt-laden) and blackwater (with headwaters in the coastal plain, stained by tannic acids).

Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least two river systems within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, is estimated to be less than 1 percent of what they were historically (ASSRT 2007).

Threats

The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e, being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Dredging is a present threat to the South Atlantic DPS and is contributing to their status by modifying the quality and availability of Atlantic sturgeon habitat. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns Rivers. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Low DO is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day mgd of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

A viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the South Atlantic DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the South Atlantic DPS have remained relatively constant at greatly reduced levels (approximately 6 percent of historical population sizes in the Altamaha River, and 1 percent of historical population sizes in the remainder of the DPS) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry, 1971; Shaffer, 1981; Soulé, 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. While a long life-span also allows multiple opportunities to contribute to future generations, it also results increases the timeframe over which exposure to the multitude of threats facing the South Atlantic DPS can occur.

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon

The South Atlantic DPS is estimated to number fewer than 6 percent of its historical population size, with all river populations except the Altamaha estimated to be less than 1 percent of historical abundance. There are an estimated 343 spawning adults per year in the Altamaha and less than 300 spawning adults per year (total of both sexes) in each of the other major river systems occupied by the DPS in which spawning still occurs, whose freshwater range occurs in the watersheds (including all rivers and tributaries) of the ACE Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the South Atlantic DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the South Atlantic DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality are also contributing to the status of the South Atlantic DPS through reductions in DO, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current impact to the South Atlantic DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may utilize multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the South Atlantic DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch is currently not being addressed through existing mechanisms. Further, access to habitat and water quality continues to be a problem even with NMFS' authority under the Federal Power Act to recommend fish passsage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Current regulatory regimes do not require a permit for water withdrawals under 100,000 gpd in Georgia and there are no restrictions on interbasin water transfers in South Carolina. Data required to evaluate water allocation issues are either very weak, in terms of determining the precise amounts of water currently being used, or non-existent, in terms of our knowledge of water supplies available for use under historical hydrologic conditions in the region. Existing water allocation issues will likely be compounded by population growth, drought, and potentially climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the South Atlantic DPS.

5.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR§402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area.

5.1 Federal Actions that have Undergone Formal or Early Section 7 Consultation

We have not conducted any formal section 7 consultations for actions in the action area. As described in Section 2.0, we previously consulted with FERC on effects of the proposed installation and operation of the Verdant RITE project on listed species and determined that the project was not likely to adversely affect shortnose sturgeon, any DPS of Atlantic sturgeon, or any species of listed sea turtle.

5.2 Non-federally regulated fisheries

Atlantic sturgeon may be vulnerable to capture, injury and mortality in fisheries occurring in state waters. The action area includes portions of New York state waters; however, commercial and recreational fishing in the East River occurs at very low levels and no fishing activity is known to take place in the action area.

5.3 Other Activities

5.3.1 Maritime Industry

Private and commercial vessels, operating in the action area of this consultation also have the potential to interact with Atlantic sturgeon. It is important to note that minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to effects such as entanglement. Listed species may also be affected by fuel oil spills resulting from vessel accidents. Fuel oil spills could affect animals through the food chain. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger oil spills may result from severe accidents, although these events would be rare and involve small areas. No direct adverse effects on Atlantic sturgeon resulting from fishing vessel fuel spills have been documented.

5.3.2 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific Federal, state, local, or private action, may affect Atlantic sturgeon in the action area. The East River has been heavily polluted in the past, with sources of pollution ranging historically from untreated sewage discharges to unregulated fill and industrial pollution. The waters of the East River are currently cleaner than they have been in at least a century; however, legacy pollutants remain and may continue to affect Atlantic sturgeon and their prey.

5.4 Reducing Threats to Atlantic sturgeon

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. In the near future, NMFS will be convening a recovery team and will be drafting a recovery plan which will outline recovery goals and criteria and steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway, involving NMFS and other Federal, State and academic partners, to obtain more information on the distribution and abundance of Atlantic sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by the DPSs and ways to minimize these threats, including bycatch and water quality, and to develop population estimates for each DPS. Fishing gear research is underway to design fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA Section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change and information on past and predicted future effects of global climate change throughout the range of the listed species considered here. Additionally, we present the available information on predicted effects of climate change in the action area and how Atlantic sturgeon may be affected by those predicted environmental changes over the life of the proposed action. Climate change is relevant to the Status of the Species, Environmental Baseline and Cumulative Effects sections of this Opinion; rather than include partial discussion in several sections of this Opinion, we are synthesizing this information into one discussion. Effects of the proposed action that are relevant to climate change are included in the Effects of the Action section below (section 7.0 below).

6.1 Background Information on predicted climate change

The global mean temperature has risen 0.76ºC (1.36°F) over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (IPCC 2007a). Precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b); these trends have been most apparent over the past few decades.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000). The Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation. The Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 3°-5°C (5°-9°F) on average in the next 100 years which is more than the projected global increase (NAST 2000). A warming of about 0.2°C (0.4°F) per decade is projected for the next two decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene *et al.* 2008).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene *et al.* 2008, IPCC 2006). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2006). The NAO impacts climate variability throughout the northern hemisphere (IPCC 2006). Data from the 1960s through the present show that the NAO index has increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2006). This warming extends over 1000m (0.62 miles) deep and is deeper than anywhere in the world oceans and is particularly evident under the Gulf Stream/ North Atlantic Current system (IPCC 2006). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene *et al.* 2008; IPCC 2006). There is evidence that the NADW has already freshened significantly (IPCC 2006). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene *et al.* 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the East River, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Additional information on potential effects of climate change specific to the action area is discussed below. Warming is very likely to continue in the U.S. over the next 25 to 50 years regardless of reduction in GHGs, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 25 to 50 years, and it is possible that rate of change will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Expected consequences could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants other than heat currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development may experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2°C (0.4°F) per decade; and 3) a rise in sea level (NAST 2000). A warmer and drier climate will reduce stream flows and increase water temperature resulting in a decrease of DO and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing. Sea level is expected to continue rising: during the 20th century global sea level has increased 15 to 20 cm (6-8 inches).

6.2 Species Specific Information on Climate Change

Atlantic sturgeon

Global climate change may affect all DPSs of Atlantic sturgeon in the future; however, effects of increased water temperature and decreased water availability are most likely to effect the South Atlantic and Carolina DPSs. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile Atlantic sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, Atlantic sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the saltwedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the saltwedge. It is unlikely that shifts in the location of the saltwedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with DO and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers. Atlantic sturgeon prefer water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all Atlantic sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. All of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

6.3 Effects of Climate Change in the Action Area

Information on how climate change will impact the action area is extremely limited. Available information on climate change related effects in New York largely focuses on effects that rising water levels may have on the human environment.

There are no predictions of water temperature increases for the East River; however, predictions for the Hudson River is available. Air temperatures in the Hudson Valley have risen approximately 0.5°C (0.9°F) since 1970. In the 2000s, the mean Hudson river water temperature, as measured at the Poughkeepsie Water Treatment Facility, was approximately 2°C (3.6°F) higher than averages recorded in the 1960s (Pisces 2008). However, while it is possible to examine past water temperature data and observe a warming trend, there are not currently any predictions on potential future increases in water temperature in the action area specifically or the Hudson River generally. The Pisces report (2008) also states that temperatures within the Hudson River may be becoming more extreme. For example, in 2005, water temperature on certain dates was close to the maximum ever recorded and also on other dates reached the lowest temperatures recorded over a 53-year period. Other conditions that may be related to climate change that have been reported in the Hudson Valley are warmer winter temperatures, earlier melt-out and more severe flooding. An average increase in precipitation of about 5% is expected; however, information on the effects of an increase in precipitation on conditions in the action area is not available.

Sea surface temperatures have fluctuated around a mean for much of the past century, as measured by continuous 100+ year records at Woods Hole (Mass.), and Boothbay Harbor (Maine) and shorter records from Boston Harbor and other bays. Periods of higher than average temperatures (in the 1950s) and cooler periods (1960s) have been associated with changes in the North Atlantic Oscillation (NAO), which affects current patterns. Over the past 30 years however, records indicate that ocean temperatures in the Northeast have been increasing; for example, Boothbay Harbor's temperature has increased by about 1°C since 1970. While we are not able to find predictive models for New York and New Jersey, given the geographic proximity of these waters to the Northeast, we assume that predictions would be similar. The model projections are for an increase of somewhere between 3-4°C by 2100 and a pH drop of 0.3-0.4

units by 2100 (Frumhoff *et al.* 2007). Assuming that these predictions also apply to the action area, one could anticipate similar conditions in the action area over that same time period.

6.4 Effects of Climate Change in the Action Area to Atlantic sturgeon

As there is significant uncertainty in the rate and timing of change as well as the effect of any changes that may be experienced in the action area due to climate change, it is difficult to predict the impact of these changes on Atlantic sturgeon. The proposed action will take place over the next ten years.

In the action area, it is possible that changing seasonal temperature regimes could result in changes in the timing of seasonal migrations through the area as sturgeon move through the East River. There could be shifts in the timing of spawning; presumably, if water temperatures warm earlier in the spring, and water temperature is a primary spawning cue, spawning migrations and spawning events could occur earlier in the year. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature or river flow alone will affect the seasonal movements of sturgeon through the action area.

Any forage species that are temperature dependent may also shift in distribution as water temperatures warm. However, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

Limited information on the thermal tolerances of Atlantic sturgeon is available. Atlantic sturgeon have been observed in water temperatures above 30°C in the south (see Damon-Randall *et al.* 2010); in the wild, shortnose sturgeon are typically found in waters less than 28°C. In the laboratory, juvenile Atlantic sturgeon showed negative behavioral and bioenergetics responses (related to food consumption and metabolism) after prolonged exposure to temperatures greater than 28°C (82.4°F) (Niklitschek 2001). Tolerance to temperatures is thought to increase with age and body size (Ziegweid *et al.* 2008 and Jenkins *et al.* 1993), however, no information on the lethal thermal maximum or stressful temperatures for subadult or adult Atlantic sturgeon is available. Shortnose sturgeon, have been documented in the lab to experience mortality at temperatures of 33.7°C (92.66°F) or greater and are thought to experience stress at temperatures above 28°C. For purposes of considering thermal tolerances, we consider Atlantic sturgeon to be a reasonable surrogate for shortnose sturgeon given similar geographic distribution and known biological similarities.

Normal surface water temperatures in the action area can be as high as 24-27°C at some times and in some areas during the summer months; temperatures in deeper waters and near the bottom are cooler. A predicted increase in water temperature of 3-4°C within 100 years is expected to result in temperatures approaching the preferred temperature of Atlantic sturgeon (28°C) on more days and/or in larger areas. This could result in shifts in the distribution of sturgeon out of certain areas during the warmer months. Information from southern river systems suggests that during peak summer heat, sturgeon are most likely to be found in deep water areas where temperatures are coolest. Thus, we could expect that over time, sturgeon would shift out of shallow habitats on the warmest days. This could result in reduced foraging opportunities if sturgeon were foraging in shallow waters.

As described above, over the long term, global climate change may affect Atlantic sturgeon by affecting the location of the salt wedge, distribution of prey, water temperature and water quality. However, there is significant uncertainty, due to a lack of scientific data, on the degree to which these effects may be experienced and the degree to which Atlantic sturgeon will be able to successfully adapt to any such changes. Any activities occurring within and outside the action area that contribute to global climate change are also expected to affect Atlantic sturgeon in the action area. While we can make some predictions on the likely effects of climate change on these species, without modeling and additional scientific data these predictions remain speculative. Additionally, these predictions do not take into account the adaptive capacity of these species which may allow them to deal with change better than predicted.

7.0 EFFECTS OF THE ACTION

The required trawling is a component of the pilot license issued by FERC to Verdant. Effects of the installation and operation of the hydrokinetic project on listed species have already been considered (see Section 2.0). Therefore, this section of the Opinion will consider effects of the trawling study on Atlantic sturgeon. Atlantic sturgeon could be affected by the proposed action in a number of ways. This includes: (1) capture in sampling gear; (2) interactions with the research vessels; (3) effects to prey; and (4) effects to habitat. The analysis will be organized along these topics.

7.1 Summary of information on distribution of Atlantic sturgeon in the action area

Subadult and adult Atlantic sturgeon may be present in the action area year-round. In the marine environment, Atlantic sturgeon are most often captured in depths less than 50 meters. Some information suggests that captures in otter trawl gear is most likely to occur in waters with depths less than 30 m (ASMFC 2007). No studies targeting Atlantic sturgeon have been carried out in the East River. Tagged Atlantic sturgeon have been detected on hydroacoustic receivers placed in the action area. These individuals were documented in June and October (2011). Dunton (Dunton et al. 2011) tagged 66 Atlantic sturgeon off the south coast of Long Island in May 2011. During the summer of 2011, two of these individuals swam into the East River, through the action area. While this information confirms that Atlantic sturgeon occur in the East River, we currently have no estimates of the number of Atlantic sturgeon that are likely to occur in the action area generally or during any particular time of year. As described above, we expect that Atlantic sturgeon in the action are will originate from the NYB (79%), South Atlantic (10%), Chesapeake Bay (7%), Gulf of Maine (4%), and Carolina (0.5%) DPSs. .

7.2 Effects of Installation and Operation of the RITE Project

7.2.1 Effects of RITE Installation on Atlantic Sturgeon

Sediment in the project area consists of bedrock, boulders and cobbles. Installation of tri-frame mounts and electric cables may disturb substrate and could result in a temporary increase in turbidity. The tri-frame structure relies on shape and weight for its restraint on the bottom, but may be pinned with hand tools to the bedrock if necessary. Given that there are no soft sediments in the project area, any increase in turbidity is expected to be extremely small and localized and is not expected to affect the behavior of any sturgeon present in the action area. Additionally, as the units will be deployed on bedrock and cobble, with few benthic invertebrates present, there are not likely to be any effects to the benthic community that would affect the ability of Atlantic sturgeon to forage in the project area. All effects of project installation will be insignificant and discountable.

7.2.2 Operations

The operation of the turbines will involve spinning blades. In the Biological Assessment (BA) prepared for this project, Verdant has conducted an analysis of the potential for listed species present in the East River to interact with the turbine blades (see KHPS-Fish Interaction Model, submitted to NMFS with the BA for a complete description of the model). The model developed by Verdant combines various parameters, including: water velocity distribution, channel geometry, physical and operation characteristics of the units, and specific fish characteristics (size, burst swimming speed, and swimming velocity in relationship to water velocity. The model does not make any assumptions about fish behavior; that is, it does not incorporate any likelihood that if a fish detects the presence of the turbines, that the fish would avoid an interaction. As sturgeon are highly mobile, it is likely that the model presents a very conservative estimate of the likelihood of interactions between an individual fish and the turbines. The model uses 9 parameters and was applied to calculate the strike probability for one turbine, Install A (2 turbines), Install B-1 (one tri-frame, 3 turbines), Install B-2 (4 tri-frames, 12 turbines) and Install C (10 tri-frames, 30 turbines). The turbines in the field are treated as if the fish had an equal opportunity to go through all 30 turbines; however, in reality, as the turbines are grouped together in 3s on a tri-frame, it would be more likely that a fish going through one turbine in a tri-frame would not pass through either one of the other two turbines. This also leads to the model presenting a very conservative estimate of the likelihood of interactions between an individual fish and the turbines.

As explained above, Verdant has developed a fish-strike model. Included in the BA was an analysis of the probability of any individual Atlantic sturgeon, if present in the East River, being struck by a turbine blade. The calculated probability of a strike for Install B-1 (one tri-frame) is 0.26%, Install B-2 (4 tri-frames) is 1.03% and Install C (10 tri-frames) is 2.59%. This model predicts only the probability of an individual Atlantic sturgeon, present in the East River, being struck by a turbine blade. Work done by Amaral et al. (2008) tested the effects of leading edge turbine blades on fish strike survival and injury. For white sturgeon ranging in size from 100-150mm, blade strike survival at mean blade speeds of 10.6-12.2 m/s (comparable to the Verdant RITE outer edge blade speed of 10.5 m/s) was 100% for sturgeon stuck in the head and caudal region and 97.4% for those struck in the midsection.

The information available indicates that there is a low probability of an Atlantic sturgeon, if present in the East River, being struck by a turbine blade (up to 2.6% depending on the number of turbines present), and that even if struck, there is a very low probability of injury or mortality expected (0-2.6%, depending on where on the body the strike occurs). As explained above in the description of the model, the model is a very conservative estimate of the likelihood of blade strike given that it assumes that fish will demonstrate no avoidance behavior and that it assumes that a fish is exposed to all three turbines in a tri-frame when realistically exposure is likely to be limited to only one turbine per tri-frame and at least some avoidance behavior is expected.

As noted above, Atlantic sturgeon are not resident in the East River. Information on the presence of Atlantic sturgeon in the East River is extremely limited. However, as noted in Savoy and Pacileo (2003) and as evidenced by detection of tagged fish, occasional Atlantic sturgeon are present in the East River. As the number of Atlantic sturgeon in the project area is unknown and is likely highly variable, it is difficult to make an accurate prediction of the risk posed by the Verdant project on this species. Using the results of the model, the results of which are very conservative and likely overstate risk, any given Atlantic sturgeon in the East River has less than a 3% probability of being struck by a turbine blade and even if struck has less than a 3% probability of being killed. Given this, the number of Atlantic sturgeon likely to interact with the turbines is expected to be extremely low and the potential of mortality is also extremely low. Based on this, it is extremely unlikely that there will be an interaction between Atlantic sturgeon and the RITE turbines. Therefore, the effects of operation are discountable.

7.3 Capture in trawl gear

The capture of Atlantic sturgeon in otter trawls used for commercial fisheries is well documented (see for example, Stein *et al.*2004 and ASMFC 2007). Atlantic sturgeon are also captured incidentally in trawls used for scientific studies. No information on bycatch rates that could be applied to the Verdant study to predict future catch is available from the literature. However, several scientific studies have been carried out in nearby waters that help us to predict the likely number of Atlantic sturgeon to be encountered in the Verdant study. The State of New Jersey carries out a near-shore trawl survey annually since 1988. This information allows us to predict future interactions. To date, a total of 322 Atlantic sturgeon captures have been recorded, with an average encounter rate of 3.4% (*i.e.*, the percent of trawl samples that captured an Atlantic sturgeon; range of 0-7% of samples had sturgeon annually). The mathematical average number of sturgeon per sample is 0.03 over this time period. Of the trawl samples that captured Atlantic sturgeon, the average was 2 sturgeon per sample, with a range of 0-4.

Dunton *et al.* (2010) describes the catch per unit effort (CPUE) of two trawl surveys carried out off Long Island; the young-of-the-year bluefish survey and the New York trawl survey for subadult Atlantic sturgeon. The sampling area encompassed the waters inshore of a depth of 30 m; the practical inshore limit was 8–10 m from Montauk Point to the entrance of New York Harbor. Tows were conducted for a duration of 20 minutes at a tow speed of 3–3.5 knots. The net was a three-to-one two-seam trawl (25-m headrope, 30.6-m footrope) with forward netting of 12-cm stretched mesh tapering down to the rear netting of 8-cm stretched mesh and lined with a 6.0-mm mesh liner within the codend. The CPUE for Atlantic sturgeon in these two surveys averaged 0.3 Atlantic sturgeon per tow for both these surveys (Dunton *et al.* 2010).

Since 1984, the CT Department of Energy and Environmental Protection (DEEP) has conducted 5,994 tows in Long Island Sound for the Long Island Sound Trawl survey (LISTS). A total of 431 Atlantic sturgeon have been captured in 144 LIS Trawl Survey tows since May 1994, yielding an overall encounter rate of 2.4% of LISTS tows.

The fall period (September-October) accounted for 64.3% of sturgeon captured during 2,110 tows. Spring sampling (April-June) accounted for 27.2% of the expanded sturgeon catch in 3,043 tows. The frequency of LISTS tows that encounter Atlantic sturgeon (percent of positive tows) is similar in the spring and fall periods, varying from 0.0%-6.3% in the spring and from 0.0% to 7.5% in the fall. Sturgeon ranged from 54 to 213 cm FL. Up to 47 Atlantic sturgeon have been captured in a single tow. An average of 40 samples have been taken on each of 157 monthly cruises since May 1984. The mathematical average is about three Atlantic sturgeon per survey or about 0.07 sturgeon per sample.

We expect fewer sturgeon to be present in the East River than in any of the areas sampled with the studies noted above. However, we do not know how many fewer sturgeon are present in the East River as compared to the other areas sampled so it is difficult to adjust those capture numbers to account for the lower sturgeon numbers in the action area. The NY surveys average 0.3 sturgeon per sample. Using the NY CPUE to predict the number of Atlantic sturgeon in the Verdant survey would likely be an overestimate because this study targets Atlantic sturgeon and takes place in times and areas where the likelihood of capture is maximized. The NJ survey occurs over a range of habitats off the coast of New Jersey that are not comparable to the East River. For these reasons, CT's Long Island Sound Trawl survey is the closest approximation to the Verdant survey. The encounter rate for the CT survey ranges from 0-7.5% with an average of about 0.07 sturgeon per sample. The Verdant trawl survey will result in about 24 samples per year for four years for a total of about 100 samples. Using the CT CPUE, we predict a total of seven captures by Verdant during the four years of sampling.

Based on the mixed stock analysis, we expect that 79% of the captured Atlantic sturgeon will originate from the NYB DPS, 10% from the SA DPS, 7% from the CB DPS, 4% from the GOM DPS, and 0.5% from the Carolina DPS. Applying these percentages to the expected number of captures (seven), we expect that six of the captured Atlantic sturgeon will originate from the NYB DPS and one will originate from either the South Atlantic, Chesapeake Bay, Gulf of Maine or Carolina DPS.

The short duration of the tow and careful handling of any sturgeon once on deck is likely to result in a low potential for mortality. None of the 322 Atlantic sturgeon captured in past NJ ocean trawl surveys have had any evidence of injury and there have been no recorded mortalities. The NEFSC surveys have recorded the capture of 110 Atlantic sturgeon since 1972; the NEAMAP survey has captured 102 Atlantic sturgeon since 2007. To date, there have been no recorded injuries or mortalities. In the Hudson River, a trawl survey that incidentally captures shortnose and Atlantic sturgeon has been ongoing since the late 1970s. To date, no injuries or mortalities of any sturgeon have been recorded. Based on this information, we expect that all Atlantic sturgeon captured in the Verdant trawl surveys will be alive and will be released uninjured.

7.4 Interactions with the research vessel

As noted in the 2007 Status Review and the proposed rule, in certain geographic areas vessel strikes have been identified as a threat to Atlantic sturgeon. While the exact number of Atlantic sturgeon killed as a result of being struck by boat hulls or propellers is unknown, it is an area of concern in the Delaware and James rivers. Brown and Murphy (2010) examined twenty-eight dead Atlantic sturgeon observed in the Delaware River from 2005-2008. Fifty-percent of the mortalities resulted from apparent vessel strikes and 71% of these (10 of 14) had injuries consistent with being struck by a large vessel (Brown and Murphy 2010). Eight of the fourteen vessel struck sturgeon were adult-sized fish (Brown and Murphy 2010). Given the time of year in which the fish were observed (predominantly May through July; Brown and Murphy 2010), it is likely that many of the adults were migrating through the river to the spawning grounds.

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but they may be related to size and speed of the vessels, navigational clearance (*i.e.*, depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of Atlantic sturgeon in the area (e.g., foraging, migrating, etc.). It is important to note that vessel strikes have only been identified as a significant concern in the Delaware and James rivers and current thinking suggests that there may be unique geographic features in these areas (e.g., potentially narrow migration corridors combined with shallow/narrow river channels) that increase the risk of interactions between vessels and Atlantic sturgeon. The risk of vessel strikes between Atlantic sturgeon and research vessels operating in the East River is likely to be low given that the research vessels are likely to be operating at slow speeds and there are no restrictions forcing Atlantic sturgeon into close proximity with the vessel as may be present in some rivers.

Given the large volume of vessel traffic in the action area and the wide variability in traffic in any given day, the increase in traffic (one vessel, traveling at relatively slow speeds, less than 3 knots) associated with the Verdant surveys is extremely small. Given the small and localized increase in vessel traffic that would result from the Verdant surveys and the slow speed that the vessel will be operating at, it is unlikely that there would be any detectable increase in the risk of vessel strike. As such, effects to Atlantic sturgeon from the increase in vessel traffic are likely to be discountable.

7.5 Effects to Prey

Atlantic sturgeon feed primarily on small benthic invertebrates and occasionally on small fish such as sand lanceBecause of the small size or benthic nature of these prey species, it is unlikely that the surveys will capture any sturgeon prey items. Thus, the Verdant surveys will not affect the availability of prey for Atlantic sturgeon. Because of this, we have determined that any effects to Atlantic sturgeon prey or foraging Atlantic sturgeon will be insignificant and discountable.

7.6 Effects to Habitat

The survey will be carried out with a mid-water trawl that will not contact the river bottom. Therefore, effects to the bottom are extremely unlikely.

8.0 CUMULATIVE EFFECTS

Cumulative effects, as defined in 50 CFR§402.02, are those effects of future State or private activities, not involving Federal activities, which are reasonably certain to occur within the action area. Future Federal actions are not considered in the definition of "cumulative effects."

Activities reasonably certain to occur in the action area and that are carried out or regulated by the State of New York and that may affect Atlantic sturgeon include the authorization of state fisheries and the regulation of point and non-point source pollution through the National Pollutant Discharge Elimination System. We are not aware of any local or private actions that are reasonably certain to occur in the action area that may affect listed species. While there may be other in-water construction or coastal development within the action area, all of these activities are likely to need a permit or authorization from the US Army Corps of Engineers and would therefore, be subject to section 7 consultation.

State Water Fisheries - Future recreational and commercial fishing activities in state waters may capture Atlantic sturgeon. In the past, it was estimated that up to 100 shortnose sturgeon were captured in shad fisheries in the Hudson River each year, with an unknown mortality rate. Atlantic sturgeon were also incidentally captured in NY state shad fisheries. In 2009, NY State closed the shad fishery indefinitely. That state action is considered to benefit both sturgeon species. Should the shad fishery reopen, Atlantic sturgeon would be exposed to the risk of interactions with this fishery. However, we have no indication that reopening the fishery is reasonably certain to occur.

Information on interactions with Atlantic sturgeon for other fisheries operating in the action area is not available, and it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the Status of the Species/Environmental Baseline section. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the status of the species/environmental baseline section.

State PDES Permits – The state of New York has been delegated authority to issue NPDES permits by the EPA. These permits authorize the discharge of pollutants in the action area. The states will continue to authorize the discharge of pollutants through the SPDES permits.

However, this Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the status of the species/environmental baseline section.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

NMFS has estimated that the surveys to be carried out by Verdant will result in the capture of seven Atlantic sturgeon, consisting of six NYB DPS and one from either the South Atlantic, Chesapeake Bay, Gulf of Maine or Carolina DPS. No injuries or mortality is anticipated during the trawl surveys and all affected sturgeon are expected to recover from capture without any reduction in fitness or impact on survival. As explained in the "Effects of the Action" section, all other effects to Atlantic sturgeon, including to their prey, will be insignificant or discountable.

9.1 Gulf of Maine DPS

Individuals originating from the GOM DPS are likely to occur in the action area. The GOM DPS has been listed as threatened. While Atlantic sturgeon occur in several rivers in the GOM DPS, recent spawning has only been documented in the Kennebec river. The capture of a larvae in the Androscoggin River suggests that spawning may also be occurring in this river. No total population estimates are available. GOM origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

NMFS has estimated that the proposed Verdant survey will result in the capture of seven Atlantic sturgeon over a ten year period of which one is expected to be GOM DPS Atlantic sturgeon. The following analysis applies to anticipated effects on one individual from the GOM DPS, but given the nature of the effects (*i.e.*, non-lethal), it applies equally well to the worst case, which is the unlikely scenario of all seven Atlantic sturgeon being from the GOM DPS. No injury or mortality is anticipated. The survival of any GOM DPS Atlantic sturgeon will not be affected by these surveys. As such, there will be no reduction in the numbers of GOM DPS Atlantic sturgeon and no change in the status of this species or its trend.

Reproductive potential of the GOM DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from capture and the short duration of any capture and handling (*i.e.*, less than 30 minutes total, 15 minute tow plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, as the proposed action will occur outside of the rivers where GOM DPS fish are expected to spawn (*i.e.*, the Kennebec River in Maine), the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede GOM DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Based on the information provided above, the capture of one GOM DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of GOM DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the GOM DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. Recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the potential for the GOM DPS to rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. As such, we can consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not likely to result in any mortality or reductions in fitness or future reproductive output and therefore, it is not expected to affect the persistence of the GOM DPS of Atlantic sturgeon. There will not be a change in the status or trend of the GOM DPS of Atlantic sturgeon. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.2 New York Bight DPS

We expect that 79% of the Atlantic sturgeon in the action area will originate from the NYB DPS. The NYB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the NYB DPS, recent spawning has only been documented in the Delaware and Hudson rivers. NYB DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the Hudson or Delaware River spawning populations or for the DPS as a whole. Some Delaware River fish have a unique genetic haplotype (the A5 haplotype); however, whether there is any evolutionary significance or fitness benefit provided by this genetic makeup is unknown. Genetic evidence indicates that while spawning continued to occur in the Delaware River and in some cases Delaware River origin fish can be distinguished genetically from Hudson River origin fish, there is free interchange between the two rivers. This relationship is recognized by the listing of the New York Bight DPS as a whole and not separate listings of a theoretical Hudson River DPS and Delaware River DPS. Thus, while we can consider the loss of Delaware River fish on the Delaware River population and the loss of Hudson River fish on the Hudson River population, it is more appropriate, because of the interchange of individuals between these two populations, to consider the effects of these mortalities on the New York Bight DPS as a whole.

We have estimated that the proposed Verdant survey will result in the capture of seven Atlantic sturgeon over a four year period of which six are expected to be NYB DPS Atlantic sturgeon. The following analysis applies to anticipated effects on six individuals from the NYB DPS, but given the nature of the effects (*i.e.*, non-lethal), it applies equally well to the worst case, which is the unlikely scenario of all seven Atlantic sturgeon being from the NYB DPS. No injury or mortality is anticipated. The survival of any NYB DPS Atlantic sturgeon will not be affected by these surveys. As such, there will be no reduction in the numbers of NYB DPS Atlantic sturgeon and no change in the status of this species or its trend.

Reproductive potential of the NYB DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from capture and the short duration of any capture and handling (*i.e.*, less than 30 minutes total, 15 minute tow plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, as the proposed action will occur outside of the rivers where NYB DPS fish are expected to spawn (*i.e.*, the Hudson River and Delaware River), the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede NYB DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Based on the information provided above, the capture of six or fewer NYB DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of NYB DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the NYB DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. Recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the potential for the NYB DPS to rebuild to a point where listing is no longer appropriate. No Recovery Plan for the NYB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. As such, we can consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

There will not be a change in the status or trend of the NYB DPS of Atlantic sturgeon. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.3 Chesapeake Bay DPS

Individuals originating from the CB DPS are likely to occur in the action area. The CB DPS has been listed as endangered. While Atlantic sturgeon occur in several rivers in the CB DPS, recent spawning has only been documented in the James River. No estimates of the number of spawning adults, the DPS as a whole or any life stage have been reported. We expect that 7% of the Atlantic sturgeon in the action area will originate from the CB DPS. Chesapeake Bay DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the James River spawning population or for the DPS as a whole.

We have estimated that the proposed Verdant survey will result in the capture of seven Atlantic sturgeon over a four year period of which one is expected to be a CB DPS Atlantic sturgeon. The following analysis applies to anticipated effects on one individual from the CB DPS, but given the nature of the effects (*i.e.*, non-lethal), it applies equally well to the worst case, which is the unlikely scenario of all seven Atlantic sturgeon being from the CB DPS. No injury or mortality is anticipated. The survival of any CB DPS Atlantic sturgeon will not be affected by these surveys. As such, there will be no reduction in the numbers of CB DPS Atlantic sturgeon and no change in the status of this species or its trend.

Reproductive potential of the CB DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from capture and the short duration of any capture and handling (*i.e.*, less than 30 minutes total, 15 minute tow plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, as the proposed action will occur outside of the rivers where CB DPS fish are expected to spawn (*i.e.*, the James River in Virginia), the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede CB DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Based on the information provided above, the capture of one CB DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of CB DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the CB DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. Recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the potential for the CB DPS to rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. As such, we can consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

There will not be a change in the status or trend of the CB DPS of Atlantic sturgeon. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.4 South Atlantic DPS

Individuals originating from the SA DPS are likely to occur in the action area. The SA DPS is listed as endangered. The SA DPS consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. An estimate of 343 spawning adults per year is available for the Altamaha River, GA, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson, 2006); because males and females do not spawn every year, this estimate represents a portion of the total number of Altamaha adults. Males spawn every 1-5 years and females every 2-5 years; using this information and assuming a 1:1 sex ratio, we could estimate a total adult population size of 513-855 Altamaha River origin adults. Fisheries bycatch data suggests that the ratio of subadults to adults is at least 3:1. Therefore, we estimate that there are at least 1,539-2,565 Altamaha River origin subadults. The ASSRT estimated that there are less than 300 spawning adults (total of both sexes) in each of the other river systems where spawning occurs. There are no reported population estimates for any spawning rivers or the DPS as a whole. We expect that 10% of the Atlantic sturgeon in the action area will originate from the SA DPS. South Atlantic DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for any of the spawning populations or for the DPS as a whole.

We have estimated that the proposed Verdant survey will result in the capture of seven Atlantic sturgeon over a four year period of which one is expected to be a SA DPS Atlantic sturgeon. The following analysis applies to anticipated effects on one individual from the SA DPS, but given the nature of the effects (*i.e.*, non-lethal), it applies equally well to the worst case, which is the unlikely scenario of all seven Atlantic sturgeon being from the SA DPS. No injury or mortality is anticipated. The survival of any SA DPS Atlantic sturgeon will not be affected by these surveys. As such, there will be no reduction in the numbers of SA DPS Atlantic sturgeon and no change in the status of this species or its trend.

Reproductive potential of the SA DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from capture and the short duration of any capture and handling (*i.e.*, less than 30 minutes total, 15 minute tow plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, as the proposed action will occur outside of the rivers where SA DPS fish are expected to spawn, the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede SA DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Based on the information provided above, the capture of one SA DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of SA DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the SA DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the potential for the SA DPS to rebuild to a point where listing is no longer appropriate. No Recovery Plan for the SA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. As such, we can consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not likely to result in any mortality or reductions in fitness or future reproductive output and therefore, it is not expected to affect the persistence of the SA DPS of Atlantic sturgeon. There will not be a change in the status or trend of the SA DPS of Atlantic sturgeon. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

9.5 Carolina DPS

Individuals originating from the CA DPS are likely to occur in the action area. The CA DPS is listed as endangered. The CA DPS consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. There are no estimates of the size of the CA DPS. The ASSRT estimated that there were fewer than 300 spawning adults in each of the six spawning rivers. We expect that 0.5% of the Atlantic sturgeon in the action area will originate from the CA DPS. Carolina DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for any of the spawning populations or for the DPS as a whole.

We have estimated that the proposed Verdant survey will result in the capture of seven Atlantic sturgeon over a four year period of which one is expected to be a CA DPS Atlantic sturgeon. The following analysis applies to anticipated effects on one individual from the CA DPS, but given the nature of the effects (*i.e.*, non-lethal), it applies equally well to the worst case, which is the unlikely scenario of all seven Atlantic sturgeon being from the CA DPS. No injury or mortality is anticipated. The survival of any CA DPS Atlantic sturgeon will not be affected by these surveys. As such, there will be no reduction in the numbers of CA DPS Atlantic sturgeon and no change in the status of this species or its trend.

Reproductive potential of the CA DPS is not expected to be affected in any way. As all sturgeon are anticipated to fully recover from capture and the short duration of any capture and handling (*i.e.*, less than 30 minutes total, 15 minute tow plus up to 10-15 minutes of handling time) will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, as the proposed action will occur outside of the rivers where CA DPS fish are expected to spawn, the proposed action will not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds.

The proposed action is not likely to reduce distribution because the action will not impede CA DPS Atlantic sturgeon from accessing any seasonal concentration areas, including foraging, spawning or overwintering grounds in the action area or elsewhere. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Based on the information provided above, the capture of one CA DPS Atlantic sturgeon surveys will not appreciably reduce the likelihood of survival of this species (*i.e.*, it will not increase the risk of extinction faced by this species) given that: (1) there will be no mortality and therefore, no reduction in the numbers of CA DPS Atlantic sturgeon; (2) there will be no effect to the fitness of any individuals and no effect on reproductive output of the CA DPS of Atlantic sturgeon; (3) and, the action will have only a minor and temporary effect on the distribution of CA DPS Atlantic sturgeon in the action area (related to the temporary capture and handling of captured individuals) and no effect on the distribution of the species throughout its range.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CA DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. Recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the potential for the CA DPS to rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. As such, we can consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not likely to result in any mortality or reductions in fitness or future reproductive output and therefore, it is not expected to affect the persistence of the CA DPS of Atlantic sturgeon. There will not be a change in the status or trend of the CA DPS of Atlantic sturgeon. As there will be no reduction in numbers or future reproduction the action would not cause any reduction in the likelihood of improvement in the status of the CA DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause any mortality or reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the CA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action, is not likely to appreciably reduce the survival and recovery of this species.

10.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under NMFS jurisdiction, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS's biological opinion that Verdant's Seasonal Species Characterization-Netting Plan as required by Article 401 of the pilot license issued by FERC, may adversely affect but is not likely to jeopardize the continued existence of the GOM, NYB, CB or SA DPSs of Atlantic sturgeon. We have also determined that the proposed action is not likely to adversely affect shortnose sturgeon, the NWA DPS of loggerhead sea turtles, Kemp's ridley, green, or leatherback sea turtles. Because no critical habitat is designated in the action area, none will be affected by the action.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof." 16 U.S.C. 1532(8). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. "Otherwise lawful activities" are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA Section 9 (51 FR 19936, June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person "to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA.]" 16 U.S.C. 1538(g). See also 16 U.S.C. 1532(13)(definition of "person"). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by FERC so that they become binding conditions for the exemption in section 7(o)(2) to apply. FERC has a continuing duty to regulate the activity covered by this Incidental Take Statement. If FERC(1) fails to assume and implement the terms and conditions or (2) fails to require Verdant and their contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to grants, permits and/or contracts as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, FERC or Verdant (as the group carrying out the action) must report the progress of the action and its impact on the species to the NMFS as specified in the Incidental Take Statement [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Anticipated Amount or Extent of Incidental Take

Based on the information presented in the Opinion, we anticipate that the surveys described in this Opinion, to be carried out by Verdant as required by the license issued by FERC during four years between now and May 2022, will result in the capture of:

- A total of no more than seven Atlantic sturgeon. Based on mixed stock analyses, we anticipate that six of the Atlantic sturgeon will be NYB DPS origin, with the remainder from the CB, SA, GOM or Carolina DPS. No mortality is anticipated.

This level of incidental take is anticipated for the entire period considered in this Opinion. In the accompanying Opinion, we determined that this level of anticipated take is not likely to result in jeopardy to any DPS of Atlantic sturgeon.

11.2 Reasonable and Prudent Measures

In order to effectively monitor the effects of this action, it is necessary to monitor the impacts of the proposed action to document the amount of incidental take (*i.e.*, the number of Atlantic sturgeon captured, collected, injured or killed) and to examine any Atlantic sturgeon that are captured during this monitoring. Monitoring provides information on the characteristics of the turtles and sturgeon encountered and may provide data which will help develop more effective measures to avoid future interactions with listed species. We do not anticipate any additional injury or mortality to be caused by handling and examining sturgeon as required in the RPMs. All live animals are to be released back into the water following the required documentation.

NMFS believes the following reasonable and prudent measures are necessary or appropriate to minimize and monitor impacts of incidental take of listed Atlantic sturgeon:

1. Any listed species caught during the survey must be handled and resuscitated according to established procedures.

2. Any listed species caught and retrieved in the sampling gear must be identified to species.

3. Any listed species caught and retrieved in the sampling gear must be properly documented.

4. NMFS NERO must be notified regarding all interactions with or observations of listed species.

11.3 Terms and Conditions

In order to be exempt from prohibitions of section 9 of the ESA, FERC must comply with the following terms and conditions of the Incidental Take Statement, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Any taking that is in compliance with the terms and conditions specified in this Incidental Take Statement shall not be considered a prohibited taking of the species concerned (ESA Section 7(o)(2)).

1. To implement RPM#1 above, FERC must ensure that Verdant and/or their contractors give priority to handling and processing any sturgeon that are captured in the sampling gear. Handling times must be minimized for these species.

2. To implement RPM#1 above, FERC must ensure that Verdant and/or their contractors resuscitate any Atlantic sturgeon that may appear to be dead by providing a running source of water over the gills.

3. To implement RPM#1 above, FERC must ensure that there is a Passive Integrated Transponder (PIT) tag reader on board all vessels used for the survey and that this reader is used to scan any captured Atlantic sturgeon for tags. Any recorded tags must be reported to the USFWS tagging database. Any untagged sturgeon must be tagged with PIT tags and the tag numbers recorded and reported to the USFWS tagging database. Any staff inserting PIT tags must follow the procedures outlined in Appendix B and must have previous training in PIT tag implementation.

4. To comply with RPM #2 above, FERC must ensure that Verdant has at least one crew member who is experienced in the identification of sturgeon on the vessel(s) used for the trawl survey at all times that the on-water survey work is conducted. Experience would include personnel that have received training as a NMFS fisheries observer or who have career experience in the identification of sturgeon. Information provided as Appendix C can aid in species identification.

5. To comply with RPM #2 above, FERC must ensure that Verdant and/or their contractors obtain genetic samples from all captured Atlantic sturgeon. This must be done in accordance with the procedures provided in Appendix D.

6. To comply with RPM #3, FERC must ensure that all sturgeon are weighed, measured and photographed. The condition of each animal must be recorded and any injuries documented.

7. To comply with RPM #3, FERC must ensure that any dead Atlantic sturgeon are retained and held in cold storage until disposal can be discussed with NMFS. The form included as Appendix E must be filled out and submitted to NMFS.

8. To comply with RPM #4, FERC must ensure that Verdant notifies NMFS PRD within 24 hours of any interaction with a listed species. The form included as Appendix F must be filled out and provided to NMFS. These reports should be sent by fax (978)281-9394 or e-mail (Incidental.take@noaa.gov). For purposes of monitoring the incidental take of sturgeon during the surveys, reports must be made for any Atlantic sturgeon: (a) found alive, dead, or injured within the sampling gear; (b) found alive, dead, or injured and retained on any portion of the sampling gear outside of the net bag; or (c) interacting with the vessel and gear in any other way must be reported to NMFS.

9. To comply with RPM #4, FERC must ensure that Verdant provides a written report to NMFS NERO within 30 days of any interaction between any ESA-listed species and the gear and/or vessel used during the survey. The report must include: a clear photograph of the animal (multiple views if possible, including at least one photograph of the head scutes); identification of the animal to the species level; GPS or Loran coordinates describing the location of the interaction; time of interaction; date of interaction; condition of the animal upon retrieval (alive uninjured, alive injured, fresh dead,

decomposed, comatose or unresponsive); the condition of the animal upon return to the water; GPS or Loran coordinates of the location at which it was released; and a description of the care or handling provided. This report must be sent to the NMFS Northeast Regional Office, Attn: Section 7 Coordinator, 55 Great Republic Drive, Gloucester, MA 01930 or by e-mail (incidental.take@noaa.gov).

10. To comply with RPM #4, FERC must ensure that Verdant provide a written report to NMFS NERO within 60 days of completion of the on-water work, indicating either that no interactions with ESA-listed species occurred, or providing the total number of interactions that occurred with ESA-listed species. Any reports required by Term and Condition 9 that have not been provided to NMFS NERO must be included in this report. This report must be sent to the NMFS Northeast Regional Office, Attn: Section 7 Coordinator, 55 Great Republic Drive, Gloucester, MA 01930 or by e-mail (incidental.take@Noaa.gov).

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will ensure that FERC and Verdant monitor the impacts of the trawl surveys in a way that allows for the detection, identification and reporting of all interactions with listed species. The discussion below explains why each of these RPMs and Terms and Conditions are necessary or appropriate to minimize or monitor the level of incidental take associated with the proposed action. The RPMs and terms and conditions involve only a minor change to the proposed action; none of them will result in a delay to the survey or significantly increase costs.

RPM #1 and the accompanying Term and Condition establish the requirements for handling Atlantic sturgeon captured in gear used in the surveys in order to avoid the likelihood of injury to these species from the hauling, handling, and emptying of the trawl gear.

RPMs #2-4 and the accompanying Terms and Conditions specify the collection of information for any ESA-listed species observed captured in the gear. This is essential for monitoring the level of incidental take associated with the proposed action. The taking of fin clips allows NMFS to run genetic analysis to determine the DPS of origin for Atlantic sturgeon. This allows us to determine if the actual level of take has been exceeded. Sampling of fin tissue is used for genetic sampling. This procedure does not harm sturgeon and is common practice in fisheries science. Tissue sampling does not appear to impair the sturgeon's ability to swim and is not thought to have any long-term adverse impact. NMFS has received no reports of injury or mortality to any sturgeon sampled in this way.

12.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed actions are not likely to jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all Federal agencies to utilize their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The following additional measures are recommended:

1. FERC should advise the Principal Investigator for the Verdant surveys to provide guidance, before each survey cruise, to the vessel crew members (including scientific crew and vessel operators) to the effect that: (a) all personnel are alert to the possible presence of Atlantic sturgeon in the study area, (b) care must be taken when emptying the trawl gear to avoid damage to Atlantic sturgeon that may be caught in the trawl but are not visible upon retrieval of the gear, and (c) the trawl is emptied as quickly as possible after retrieval in order to determine whether Atlantic sturgeon are present in the gear.

13.0 REINITIATION OF CONSULTATION

This concludes formal consultation on Verdant's RITE project and Seasonal Species Characterization-Netting Plan as required by Article 401 of the pilot license issued by FERC. As provided in 50 CFR§402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In the event that the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
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MAY 10 2011

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

RE: Docket No. P-12611-005 ESA Section 7 Consultation for the RITE Project.

Dear Secretary Bose:

This is in response to your letter dated January 13, 2011, requesting consultation pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended regarding the Federal Energy Regulatory Commission's (FERC) proposed issuance of a pilot license to Verdant Power, LLC (Verdant) for the development of the Roosevelt Island Tidal Energy (RITE) Project, East Channel Pilot (RITE East Channel Pilot). The proposed project would be in the East River, New York. As noted in the January 13, 2011, letter, the FERC has made the preliminary determination that the proposed action is not likely to adversely affect any species listed by NOAA's National Marine Fisheries Service (NMFS) and has requested NMFS concurrence with this determination. Additional information on the effects of the proposed action, including clarification of installation methodologies and clarification of the blade strike analysis was provided by RITE staff by e-mail and telephone on March 25, 2011.

Proposed Project

The RITE East Channel Pilot would consist of: (1) a field array of thirty 5-meter diameter axial flow Kinetic Hydropower System (KHPS) turbine-generator units mounted on ten tri-frame mounts, with a total capacity of 1 MW at 35 KW each; (2) underwater cables from each turbine to five shoreline switchgear vaults, that interconnect to a Control Room and interconnection points; and, (3) appurtenant facilities to ensure safe navigation and turbine operation. The project will be constructed in three phases: install B1, three Gen 5 turbines on a tri-frame; install B2, up to three additional tri-frames of three turbines; and, install C, up to six additional triframes (no more than 30 Gen 5 KHPS total).

The Verdant Gen 5 KHPS turbine consists of four major components: rotor with 3 fixed blades, nacelle, pylon and yaw mechanism; generator and drivetrain; and, the riverbed mounting system (3 KHPS turbines on one tri-frame mount). The RITE pilot project of 30 KHPS turbines would encompass a project boundary of approximately 21.6 acres, which includes 21.2 acres of underwater land lease, and 0.4 acres of shoreline right-of-way. The pilot will include 480V electrical cables from each of the 30 KHPS turbines. Cables will travel through the pylon assembly of each turbine in the tri-frame mount. For each tri-frame mount, the three turbine cables will be bundled together into a set, which will then be paired with another set and routed from the field, weighted along the riverbed, to five shoreline switchgear vaults. The individual turbine cable lengths from the turbine-generation to the respective vaults range from 233 to 322 feet, with an average of 282 feet. Construction is scheduled to occur in phases, beginning in the fourth-quarter of 2011 and being completed in 2014. The parameters of the turbines are as follows: 1.0m rotor hub diameter, 5.0m rotor tip diameter, 3 blades, approximately 40 revolutions per minute at full load.

The Verdant KHPS is designed to capture energy from the flow in both ebb and flood directions by yawing with the changing tide, using a passive weathervaning system with a downstream rotor. The turbines will have a fixed blade design.

NMFS Listed Species in the Action Area

The proposed project will be constructed and operated in the east channel of the East River, New York. The East River is a tidal strait connecting New York Harbor to Western Long Island Sound. The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50CFR§402.02). For this project, the action area corresponds to the project footprint. This area is expected to encompass all effects of the proposed project.

A population of the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) occurs in the Hudson River and has been documented from the Troy Dam to the waters near Staten Island in New York Harbor. Shortnose sturgeon have been captured near the confluence of the East River and New York Harbor and at least two shortnose sturgeon tagged in the Hudson River have been recaptured in the Connecticut River. It is unknown whether these fish traveled through the East River and through Long Island Sound (the most direct route) or exited New York Harbor into the Atlantic Ocean and swam around southern Long Island and back into Long Island Sound. Shortnose sturgeon are primarily a riverine species. Limited information is available on the frequency of migrations away from the natal river. However, as evidenced by the movement between the Hudson and Connecticut Rivers referenced above and the documented movement of shortnose sturgeon from the Merrimack River, MA to the Kennebec River, ME as well as between the Kennebec and Penosbcot Rivers, Maine, at least limited coastal movements occur. While the East River is not likely to be a high use area for sturgeon and there have been no documented captures of shortnose sturgeon in this waterbody, given the known distribution of shortnose sturgeon in nearby waters and the documented occurrences of shortnose sturgeon making coastal migrations from their natal rivers, the best available information indicates that occasional transient shortnose sturgeon may be present in the East River. As juvenile shortnose sturgeon have limited tolerance to salinity, only adult shortnose sturgeon are likely to occur in the action area.

Listed sea turtles occur seasonally in certain New York waters. The sea turtles in these waters are typically small juveniles with the most abundant being the federally threatened loggerhead

(*Caretta caretta*) followed by the federally endangered Kemp's ridley (*Lepidochelys kempi*), federally endangered green sea turtles (*Chelonia mydas*), and federally endangered leatherback sea turtles (*Dermochelys coriacea*).

Like shortnose sturgeon, there have been no documented captures of sea turtles in the East River and it is not likely to be a high use area for these species. Ruben and Morrealle (2000) review the available information on sea turtle use of the New York Bight. In this review, which includes information on the New York Harbor area, the authors report that there is an extremely low number of sightings or captures of sea turtles in the area. They also note that this is not due to a lack of sampling or monitoring studies but rather that it likely reflects the true rarity of these species in the area, particularly the upper Harbor. NMFS has reviewed the available information on distribution of sea turtles in the New York Bight. As noted above, sea turtles are occasionally documented in western Long Island Sound and few individuals have been documented in New York Harbor. No sea turtles have been documented in the East River. Based on information summarized in Ruben and Morreale (1999)[1], in New York waters, sea turtles are most likely to be present in areas with sandy substrates, depths of 15-49 feet, current of less than 2 knots, and with high concentrations of sea turtle forage. The project area has depths of approximately 30 feet, making it consistent with the depths likely to be utilized by sea turtles in New York waters. However, the substrate consists of cobbles and bedrock with no sandy sediment. Additionally, current in the area is greater than 2 knots more than 73% of the time. Based on these factors and the lack of evidence of sea turtles in the East River, it is reasonable to conclude that the presence of sea turtles in the action area is extremely unlikely.

Effects of the Action

The proposed RITE project could affect listed species during construction/deployment and during operations. Effects of these activities are considered below. As noted above, sea turtles are extremely unlikely to occur in the action area; thus, this analysis is limited to effects to shortnose sturgeon.

Construction/Deployment

Sediment in the project area consists of bedrock, boulders and cobbles. Installation of tri-frame mounts and electric cables may disturb substrate and could result in a temporary increase in turbidity. The tri-frame structure relies on shape and weight for its restraint on the bottom, but may be pinned with hand tools to the bedrock if necessary. Given that there are no soft sediments in the project area, any increase in turbidity is expected to be extremely small and localized and is not expected to affect the behavior of any shortnose sturgeon present in the action area. Additionally, as the units will be deployed on bedrock and cobble, with few benthic invertebrates present, there are not likely to be any effects to the benthic community that would affect the ability of shortnose sturgeon to forage in the project area.

Operations

The operation of the turbines will involve spinning blades. In the Biological Assessment (BA) prepared for this project, Verdant has conducted an analysis of the potential for listed species

[1] Ruben, H. and S. Morrealle. 1999. Biological Assessment for Sea Turtles in the New York Bight Complex. Unpublished Report - Submitted to NMFS by the US Army Corps of Engineers..

present in the East River to interact with the turbine blades (see KHPS-Fish Interaction Model, submitted to NMFS with the BA for a complete description of the model). The model developed by Verdant combines various parameters, including: water velocity distribution, channel geometry, physical and operation characteristics of the units, and specific fish characteristics (size, burst swimming speed, and swimming velocity in relationship to water velocity. The model does not make any assumptions about fish behavior; that is, it does not incorporate any likelihood that if a fish detects the presence of the turbines, that the fish would avoid an interaction. As adult shortnose sturgeon are highly mobile, it is likely that the model presents a very conservative estimate of the likelihood of interactions between an individual fish and the turbines. The model uses 9 parameters and was applied to calculate the strike probability for one turbine, Install A (2 turbines), Install B-1 (one tri-frame, 3 turbines), Install B-2 (4 tri-frames, 12 turbines) and Install C (10 tri-frames, 30 turbines). The turbines in the field are treated as if the fish had an equal opportunity to go through all 30 turbines; however, in reality, as the turbines are grouped together in 3s on a tri-frame, it would be more likely that a fish going through one turbine in a tri-frame would not pass through either one of the other two turbines. This also leads to the model presenting a very conservative estimate of the likelihood of interactions between an individual fish and the turbines.

Using the model, the probability of any individual shortnose sturgeon, if present in the East River, being struck by a turbine blade is 0.08%. The probability of a strike for Install B-1 (one tri-frame) is 0.23%, Install B-2 (4 tri-frames) is 0.91% and Install C (10 tri-frames) is 2.8%. This model predicts only the probability of an individual shortnose sturgeon, present in the East River, being struck by a turbine blade. Work done by Amaral et al. (2008)[2] tested the effects of leading edge turbine blades on fish strike survival and injury. For white sturgeon ranging in size from 100-150mm, blade strike survival at mean blade speeds of 10.6-12.2 m/s (comparable to the Verdant RITE outer edge blade speed of 10.5 m/s) was 100% for sturgeon stuck in the head and caudal region and 97.4% for those struck in the midsection.

The information available indicates that there is a very low probability of a shortnose sturgeon, if present in the East River, being struck by a turbine blade (up to 2.8% depending on the number of turbines present), and that even if struck, there is a very low probability of injury or mortality expected (0-2.6%, depending on where on the body the strike occurs). As explained above in the description of the model, the model is a very conservative estimate of the likelihood of blade strike given that it assumes that fish will demonstrate no avoidance behavior and that it assumes that a fish is exposed to all three turbines in a tri-frame when realistically exposure is likely to be limited to only one turbine per tri-frame and at least some avoidance behavior is expected.

As noted above, shortnose sturgeon are not resident in the East River. Information on movements outside of the natal river by this species is extremely limited. There are only two documented occurrences of shortnose sturgeon from the Hudson River being detected outside of the Hudson River. As explained above, the East River is a tidal strait with habitat that is not consistent with the types of habitat known to be used by shortnose sturgeon. No shortnose sturgeon have been documented in the East River. The rarity of shortnose sturgeon in the East

[2] Amaral, S. et al. 2008. Effects of Leading Edge Turbine Blade Thickness on Fish Strike Survival and Injury. Proceedings of Hydrovision 2008. HCI Publications, St. Louis, Missouri.

River reduces the exposure that shortnose sturgeon would have to the turbines. Given the rarity of shortnose sturgeon in the action area and the low probability of a strike even if a shortnose sturgeon was present in the East River, it is extremely unlikely that there will be any interactions between the turbines and any shortnose sturgeon. As such, the effects of the operation of the Verdant RITE project on shortnose sturgeon are discountable.

Conclusion
Based on the analysis that all effects of the proposed project will be insignificant or discountable, NMFS is able to concur with the determination that the approval of the proposed project by FERC is not likely to adversely affect any listed species under NMFS jurisdiction. Therefore, no further consultation pursuant to section 7 of the ESA is required. Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (c) If a new species is listed or critical habitat designated that may be affected by the identified action.

Technical Assistance for Proposed Species
On October 6, 2010, NMFS published two proposed rules to list five distinct population segments (DPS) of Atlantic sturgeon under the ESA. NMFS is proposing to list four DPSs as endangered (New York Bight, Chesapeake Bay, Carolina and South Atlantic) and one DPS of Atlantic sturgeon as threatened (Gulf of Maine DPS). As you know, once a species is proposed for listing, as either endangered or threatened, the conference provisions of the ESA may apply (see ESA §7(a)(4) and 50 CFR 402.10). As stated at 50 CFR 402.10, "Federal agencies are required to confer with NMFS on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat."

NMFS has reviewed the proposed action in order to provide guidance to FERC as to whether a conference is required in this case. Atlantic sturgeon are known to occur in the Hudson River and Long Island Sound and also are likely to occur in the East River, although not likely in high numbers. Research conducted by Savoy and Pacileo (2003)[3] suggests that the East River is used by juvenile Atlantic sturgeon to migrate from the Hudson River to western Long Island Sound; however, there is no information on the number of Atlantic sturgeon likely to be present in the East River.

As explained above, Verdant has developed a fish-strike model. Included in the BA was an analysis of the probability of any individual Atlantic sturgeon, if present in the East River, being struck by a turbine blade. The calculated probability of a strike for Install B-1 (one tri-frame) is 0.26%, Install B-2 (4 tri-frames) is 1.03% and Install C (10 tri-frames) is 2.59%. This model predicts only the probability of an individual Atlantic sturgeon, present in the East River, being

[3] Savoy, T. and D. Pacileo. 2003. Movements and important habitats of subadult Atlantic sturgeon in Connecticut waters. Transactions of the American Fisheries Society. 132: 1-8.

struck by a turbine blade. Work done by Amaral et al. (2008) tested the effects of leading edge turbine blades on fish strike survival and injury. For white sturgeon ranging in size from 100-150mm, blade strike survival at mean blade speeds of 10.6-12.2 m/s (comparable to the Verdant RITE outer edge blade speed of 10.5 m/s) was 100% for sturgeon stuck in the head and caudal region and 97.4% for those struck in the midsection.

The information available indicates that there is a low probability of an Atlantic sturgeon, if present in the East River, being struck by a turbine blade (up to 2.6% depending on the number of turbines present), and that even if struck, there is a very low probability of injury or mortality expected (0-2.6%, depending on where on the body the strike occurs). As explained above in the description of the model, the model is a very conservative estimate of the likelihood of blade strike given that it assumes that fish will demonstrate no avoidance behavior and that it assumes that a fish is exposed to all three turbines in a tri-frame when realistically exposure is likely to be limited to only one turbine per tri-frame and at least some avoidance behavior is expected.

As noted above, Atlantic sturgeon are not resident in the East River. Information on the presence of Atlantic sturgeon in the East River is extremely limited. However, as noted in Savoy and Pacileo (2003), Atlantic sturgeon are suspected to move between the Hudson River and western Long Island Sound through the East River. As the number of Atlantic sturgeon in the project area is unknown and is likely highly variable, it is difficult to make an accurate prediction of the risk posed by the Verdant project on this species. Using the results of the model, the results of which are very conservative and likely overstate risk, any given Atlantic sturgeon in the East River has less than a 3% probability of being struck by a turbine blade and even if struck has less than a 3% probability of being killed. Given this, the number of Atlantic sturgeon likely to interact with the turbines is expected to be low and the number of Atlantic sturgeon potentially killed by the proposed action is expected to be extremely low, if any. Based on this, it is not likely that the proposed project would appreciably reduce the survival and recovery of any DPS of Atlantic sturgeon and therefore it is not reasonable to anticipate that this action would be likely to jeopardize the continued existence of any DPS of Atlantic sturgeon. As such, no conference is necessary for Atlantic sturgeon. Should project plans change, NMFS recommends that FERC discuss the potential need for conference with NMFS.

On March 16, 2010, NMFS published a proposed rule to list two distinct population segments (DPS) of loggerhead sea turtles as threatened and seven distinct population segments of loggerhead sea turtles as endangered, including the Northwest Atlantic DPS. This rule, when finalized, would replace the existing listing for loggerhead sea turtles. Currently, the species is listed as threatened range-wide. In the analysis above, NMFS has considered effects to the current global listing of loggerhead sea turtles. If any loggerhead sea turtles were in the action area, they are likely to be from the Northwest Atlantic DPS. As explained above, no loggerhead sea turtles are expected to occur in the action area. As the proposed action will not affect any loggerhead sea turtles, it is not reasonable to anticipate that this action would be likely to jeopardize the continued existence of any DPS of loggerhead sea turtles. As such, no conference is necessary for loggerhead sea turtles. Should project plans change, NMFS recommends that FERC discuss the potential need for conference with NMFS.

Should you have any questions about this correspondence please contact Julie Crocker at (978) 282-8480 or by e-mail (Julie.Crocker@Noaa.gov).

Sincerely,

Patricia A. Kurkul
Regional Administrator

EC: Crocker, F/NER3
Rusanowsky, F/NER4
Jensen, ACOE

File Code: Sec 7 FERC Verdant RITE East River pilot
PCTS I/NER/2011/00103

APPENDIX B

PIT Tagging Procedures for Shortnose and Atlantic sturgeon
(adapted from Damon-Randall *et al.* 2010)

Passive integrated transponder (PIT) tags provide long-term marks. These tags are injected into the musculature below the base of the dorsal fin and above the row of lateral scutes on the left side of the Atlantic sturgeon (Eyler *et al.* 2009), where sturgeon are believed to experience the least new muscle growth. Sturgeon should not be tagged in the cranial location. Until safe dorsal PIT tagging techniques are developed for sturgeon smaller than 300 mm, only sturgeon larger than 300 mm should receive PIT tags.

It is recommended that the needles and PIT tags be disinfected in isopropyl alcohol or equivalent rapid acting disinfectant. After any alcohol sterilization, we recommend that the instruments be air dried or rinsed in a sterile saline solution, as alcohol can irritate and dehydrate tissue (Joel Van Eenennam, University of California, pers. comm.). Tags should be inserted antennae first in the injection needle after being checked for operation with a PIT tag reader.

Sturgeon should be examined on the dorsal surface posterior to the desired PIT tag site to identify a location free of dermal scutes at the injection site. The needle should be pushed through the skin and into the dorsal musculature at approximately a 60 degree angle (Figure 3). After insertion into the musculature, the needle angle should be adjusted to close to parallel and pushed through to the target PIT tag site while injecting the tag. After withdrawing the needle, the tag should be scanned to check operation again and tag number recorded.

Some researchers check tags in advance and place them in individual 1.5 ml microcentrifuge tubes with the PIT number labeled to save time in the field.

Because of the previous lack of standardization in placement of PIT tags, we recommend that the entire dorsal surface of each fish be scanned with a PIT tag reader to ensure detection of fish tagged in other studies. Because of the long life span and large size attained, Atlantic sturgeon may grow around the PIT tag, making it difficult to get close enough to read the tag in later years. For this reason, full length (highest power) PIT tags should be used.

Fuller et al. (2008) provide guidance on the quality of currently available PIT tags and readers and offer recommendations on the most flexible systems that can be integrated into existing research efforts while providing a platform for standardizing PIT tagging programs for Atlantic sturgeon on the east coast. The results of this study were consulted to assess which PIT tags/readers should be recommended for distribution. To increase compatibility across the range of these species, the authors currently recommend the Destron TX1411 SST 134.2 kHz PIT tag and the AVID PT VIII, Destron FS 2001, and Destron PR EX tag readers. These readers can read multiple tags, but software must be used to convert the tag ID number read by the Destron PR EX. The FWS/Maryland Fishery Resources Office (MFRO) will collect data in the coastal tagging database and provide approved tags for distribution to researchers.

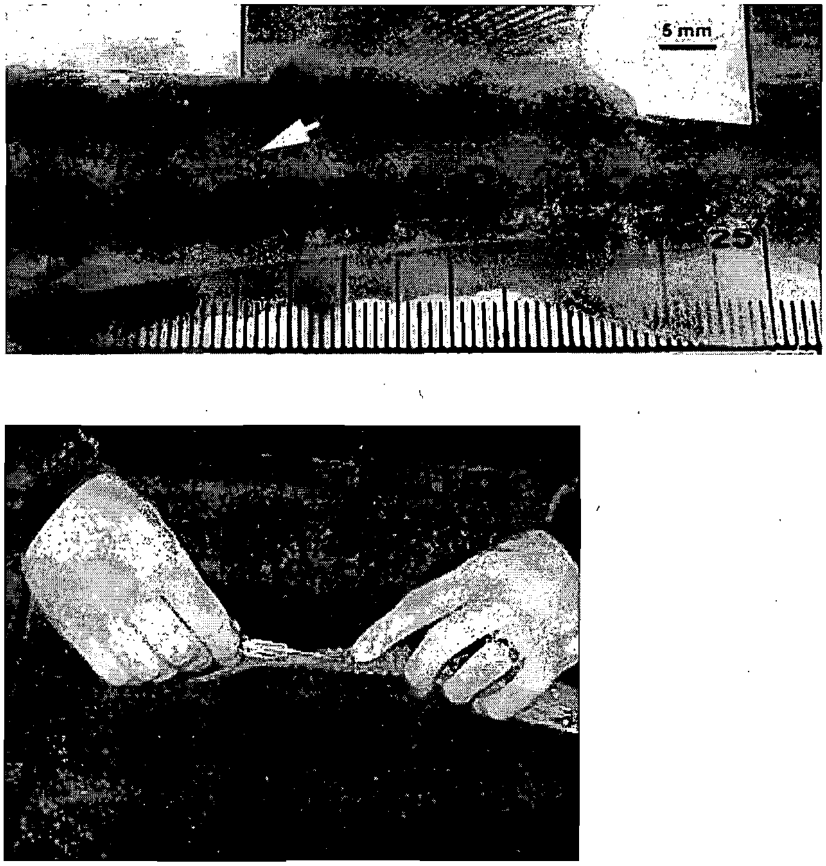


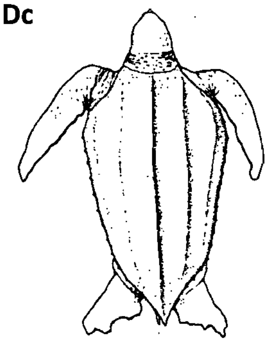
Figure 3. (from Damon-Randall *et al.* 2010). Illustration of PIT tag location (indicated by white arrow; top), and photo of a juvenile Atlantic sturgeon being injected with a PIT tag (bottom). *Photos courtesy of James Henne, US FWS.*

APPENDIX C

Identification Key for Sea Turtles and Sturgeon Found in Northeast U.S. Waters

SEA TURTLES

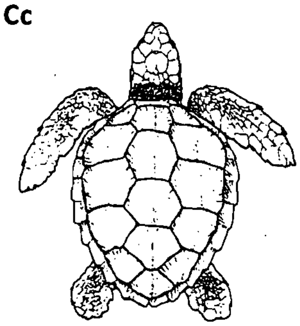
Dc



Leatherback (*Dermocheyls coriacea*)

Found in open water throughout the Northeast from spring through fall. Leathery shell with 5-7 ridges along the back. Largest sea turtle (4-6 feet). Dark green to black; may have white spots on flippers and underside.

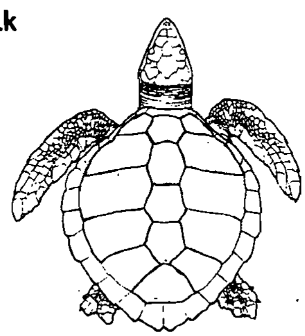
Cc



Loggerhead (*Caretta caretta*)

Bony shell, reddish-brown in color. Mid-sized sea turtle (2-4 feet). Commonly seen from Cape Cod to Hatteras from spring through fall, especially in southern portion of range. Head large in relation to body.

Lk

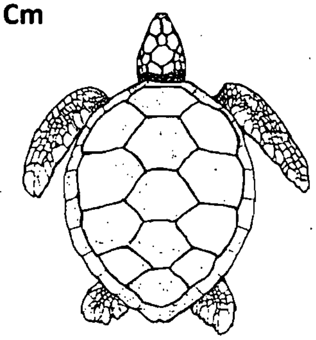


Kemp's ridley (*Lepidochelys kempi*)

Most often found in Bays and coastal waters from Cape Cod to Hatteras from summer through fall. Offshore occurrence undetermined. Bony shell, olive green to grey in color. Smallest sea turtle in Northeast (9-24 inches). Width equal to or greater than length.

APPENDIX C, continued (**Identification Key**)

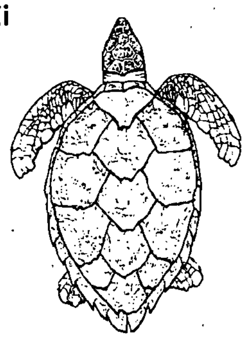
Cm



Green turtle (*Chelonia mydas*)

Uncommon in the Northeast. Occur in Bays and coastal waters from Cape Cod to Hatteras in summer. Bony shell, variably colored; usually dark brown with lighter stripes and spots. Small to mid-sized sea turtle (1-3 feet). Head small in comparison to body size.

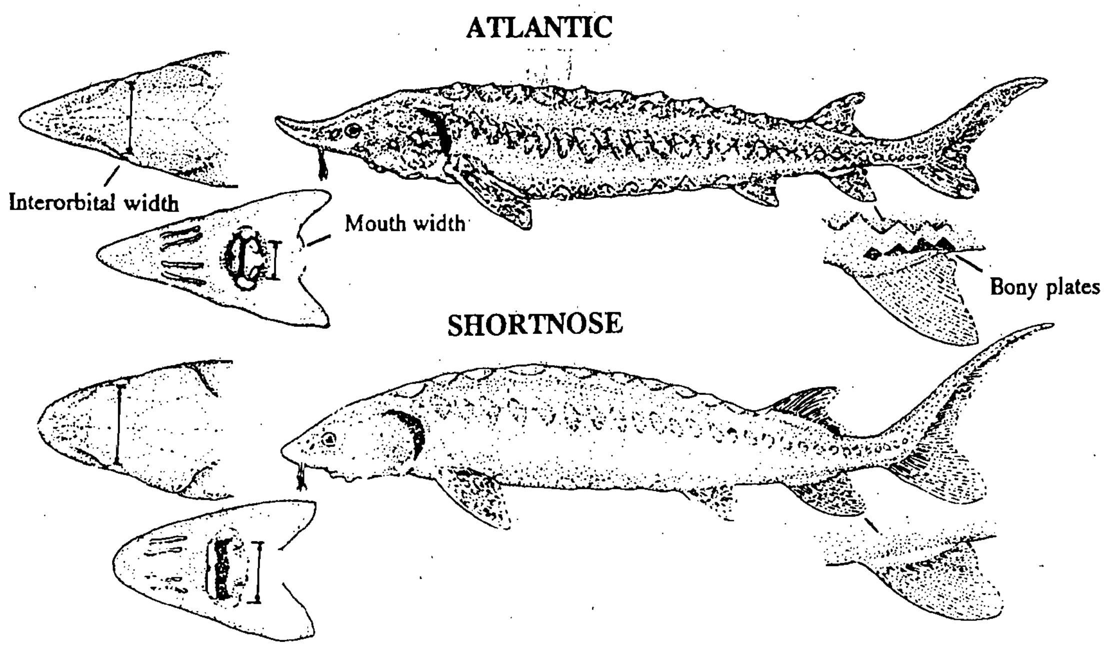
Ei



Hawksbill (*Eretmochelys imbricata*)

Rarely seen in Northeast. Elongate bony shell with overlapping scales. Color variable, usually dark brown with yellow streaks and spots (tortoise-shell). Small to mid-sized sea turtle (1-3 feet). Head relatively small, neck long.

Appendix C continued
Sturgeon Identification



Distinguishing Characteristics of Atlantic and Shortnose Sturgeon

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004

APPENDIX D

Procedure for obtaining fin clips from sturgeon for genetic analysis

Obtaining Sample

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.

2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.

3. Each fin clip should be placed into a vial of 95% non-denatured ethanol and the vial should be labeled with the species name, date, name of project and the fork length and total length of the fish along with a note identifying the fish to the appropriate observer report. All vials should be sealed with a lid and further secured with tape Please use permanent marker and cover any markings with tape to minimize the chance of smearing or erasure.

Storage of Sample

1. If possible, place the vial on ice for the first 24 hours. If ice is not available, please refrigerate the vial. Send as soon as possible as instructed below.

Sending of Sample

1. Vials should be placed into Ziploc or similar resealable plastic bags. Vials should be then wrapped in bubble wrap or newspaper (to prevent breakage) and sent to:

   Julie Carter
   NOAA/NOS – Marine Forensics
   219 Fort Johnson Road
   Charleston, SC 29412-9110
   Phone: 843-762-8547

   a. Prior to sending the sample, contact Russ Bohl at NMFS Northeast Regional Office (978-282-8493) to report that a sample is being sent and to discuss proper shipping procedures.

STURGEON SALVAGE FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 1614 (version 05-16-2012)

INVESTIGATORS'S CONTACT INFORMATION

Name: First ____________ Last ____________
Agency Affiliation ____________ Email ____________
Address ____________
____
Area code/Phone number ____________

UNIQUE IDENTIFIER (Assigned by NMFS)

DATE REPORTED:
Month ☐☐ Day☐☐ Year 20☐☐

DATE EXAMINED:
Month ☐☐ Day☐☐ Year 20☐☐

SPECIES: (check one)
- ☐ shortnose sturgeon
- ☐ Atlantic sturgeon
- ☐ Unidentified *Acipenser* species

Check "Unidentified" if uncertain.
See reverse side of this form for aid in identification.

LOCATION FOUND: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
River/Body of Water ____________ City ____________ State ____
Descriptive location (be specific) ____________
____
____
Latitude ____________ N (Dec. Degrees) Longitude ____________ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one)
- ☐ 1 = Fresh dead
- ☐ 2 = Moderately decomposed
- ☐ 3 = Severely decomposed
- ☐ 4 = Dried carcass
- ☐ 5 = Skeletal, scutes & cartilage

SEX:
- ☐ Undetermined
- ☐ Female ☐ Male

How was sex determined?
- ☐ Necropsy
- ☐ Eggs/milt present when pressed
- ☐ Borescope

MEASUREMENTS: **Circle unit**
Fork length ________ cm / in
Total length ________ cm / in
Length ☐ actual ☐ estimate
Mouth width (inside lips, see reverse side) ________ cm / in
Interorbital width (see reverse side) ________ cm / in
Weight ☐ actual ☐ estimate ________ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No

Tag #	Tag Type	Location of tag on carcass

CARCASS DISPOSITION: (check one or more)
- ☐1 = Left where found
- ☐2 = Buried
- ☐3 = Collected for necropsy/salvage
- ☐4 = Frozen for later examination
- ☐5 = Other (describe) ____________

Carcass Necropsied?
☐Yes ☐No
Date Necropsied: ____________
Necropsy Lead:
____

PHOTODOCUMENTATION:
Photos/vide taken? ☐ Yes ☐ No
Disposition of Photos/Video: ____________
____
____

SAMPLES COLLECTED? ☐ Yes ☐ No

Sample	How preserved	Disposition (person, affiliation, use)

Comments:
____
____
____

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 07-20-2009)

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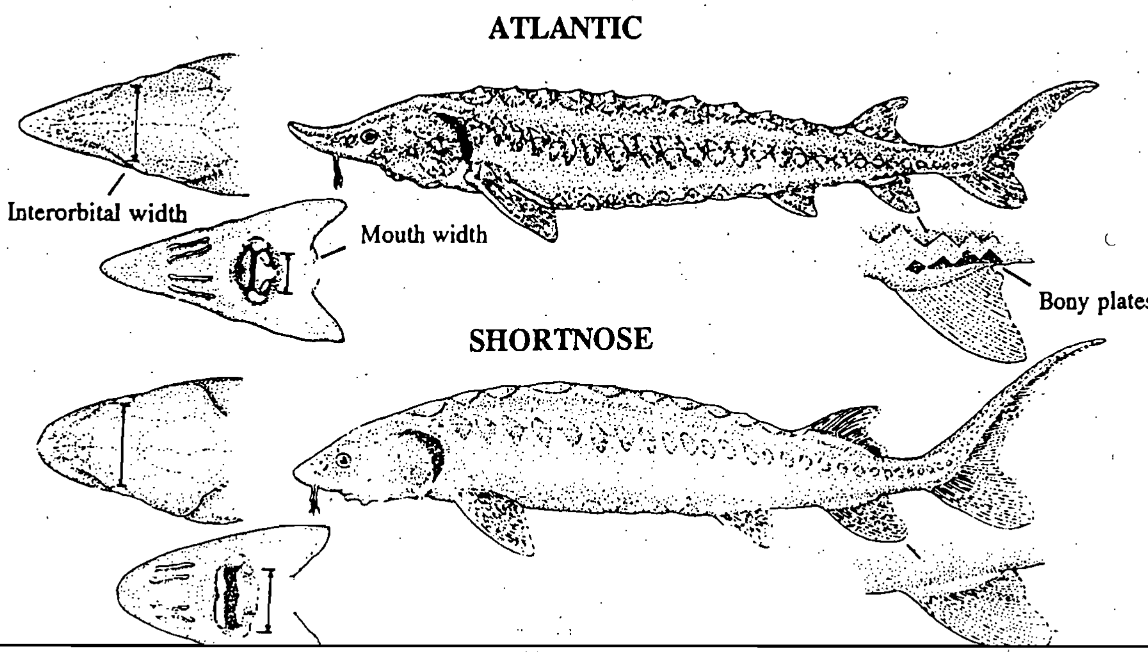
* From Vecsei and Peterson, 2004



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). **Please note if no wounds / abnormalities are found.**

____

____

____

____

____

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: Northeast Region Contacts – Shortnose Sturgeon Recovery Coordinator (Jessica Pruden, Jessica.Pruden@noaa.gov, 978-282-8482) or Atlantic Sturgeon Recovery Coordinator (Lynn Lankshear, Lynn.Lankshear@noaa.gov, 978-282-8473); **Southeast Region Contacts**- Shortnose Sturgeon Recovery Coordinator (Stephania Bolden, Stephania.Bolden@noaa.gov, 727-824-5312) or Atlantic Sturgeon Recovery Coordinator (Kelly Shotts, Kelly.Shotts@noaa.gov, 727-551-5603).

APPENDIX F

Incident Report: ESA Listed Species Take

Photographs should be taken and the following information should be collected from all listed fish and sea turtles (alive and dead) collected.

Observer's full name:____
Reporter's full name:____

Species Identification:______________________________________

Type of Gear and Length of deployment:

____
____

Date animal observed:_______________ Time animal observed: ______________________
Date animal collected:_______________ Time animal collected:______________________

Environmental conditions at time of observation (i.e., tidal stage, weather):

____
____

Water temperature (°C) at site and time of observation:______________________
Describe location of animal and how it was documented (i.e., observer on boat):

____

Sturgeon Information:
Species ________________________________

Fork length (or total length) ____________________ Weight ____________________

Condition of specimen/description of animal

____
____
____
____

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY
Fish tagged: YES / NO *Please record all tag numbers.* Tag # _______________

Photograph taken: YES / NO
(please label *species, date, geographic site* and *vessel name* when transmitting photo)

Genetics Sample taken: YES / NO
Genetics sample transmitted to: ____________________ on ____/_____/2012

APPENDIX F CONTINUED.

Sea Turtle Species Information: *(please designate cm/m or inches.)*
Species ______________________________ Weight (kg or lbs)____________________________

Sex (circle): Male Female Unknown How was sex determined? ____________________

Straight carapace length ______________ Straight carapace width ___________________

Curved carapace length ________________ Curved carapace width ____________________

Plastron length ______________________ Plastron width _____________________________

Tail length ____________________________ Head width ________________________________

Condition of specimen/description of animal______________________________________

____

Existing Flipper Tag Information
Left ______________________________ Right ____________________________________
PIT Tag # __________________________________

Miscellaneous:
Genetic biopsy taken: YES NO
Photos Taken: YES NO Is this a Recapture: YES NO

Turtle Release Information:
Date ____________________________ Time ________________________________
Lat _____________________________ Long ________________________________
State ___________________________ County _______________________________

Remarks: (note if turtle was involved with tar or oil, gear or debris entanglement, wounds or mutilations, propeller damage, papillomas, old tag locations, etc.)

____

____