ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Action Agency: National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, through its Sustainable Fisheries Division

Activity: Endangered Species Act Section 7 Consultation on the Atlantic Sea Scallop Fishery Management Plan [ECO ID: GARFO-2020-00437]

Consulting Agency: National Marine Fisheries Service, Greater Atlantic Regional Fisheries Office, through its Protected Resources Division

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Approved by: ______________________________
Michael Pentony
Regional Administrator

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TABLE OF CONTENTS

Contents

1.0 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.), requires each federal agency to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a federal agency may affect a species or critical habitat protected under the ESA, that agency is required to consult with either the NOAA Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (FWS), depending upon the species and/or critical habitat that may be affected. In instances where NMFS or U.S. FWS are themselves authorizing, funding, or carrying out an action that may affect listed species, the agency must conduct intra-service consultation. Since the action described in this document is approved and implemented by the NMFS Greater Atlantic Regional Fisheries Office (GARFO), this office has requested formal intra-service section 7 consultation.

NMFS GARFO has reinitiated formal intra-service consultation, in accordance with section 7(a)(2) of the ESA and 50 CFR 402.16, given the exceedance of the incidental take statement (ITS) of the 2012 Biological Opinion for the Atlantic Sea Scallop Fishery Management Plan (Scallop FMP). As the ITS of the 2012 Opinion was exceeded, the fishery may be affecting listed species in a manner, or to an extent, not previously considered. This document represents NMFS's Opinion on the effects of the authorization of the scallop fishery on ESA-listed species under NMFS jurisdiction, in accordance with section 7 of the ESA.

NMFS GARFO reinitiated formal intra-service section 7 consultation on the authorization of the scallop fishery under the Scallop FMP on February 14, 2020 [Consultation No. GARFO-2020-00437].[1] For the purposes of this consultation, NMFS GARFO, through its Sustainable Fisheries Division (SFD), which administers the scallop fishery through the Scallop FMP, is the federal action agency and NMFS GARFO, through its Protected Resources Division (PRD), is the consulting agency. This Opinion is based on information developed by NMFS GARFO as well as other scientific data, literature, and reports cited throughout this document. A complete administrative record of this consultation will be kept on file electronically at NMFS GARFO.

2.0 CONSULTATION HISTORY

Prior to this formal consultation and Opinion, the authorization of the scallop fishery under the Scallop FMP was last reviewed via a formal consultation initiated by NMFS GARFO on February 28, 2012, and completed on July 12, 2012 (ITS later amended on remand on April 20, 2015, and November 27, 2018). Consultation was reinitiated in 2012 due to the ESA listing of five distinct population segments (DPSs) of Atlantic sturgeon that overlapped in distribution with the scallop fishery, new information on sea turtles that was not considered in the previous 2008

[1] After we reinitiated consultation, the D.C. district issued a decision on our 2012 Opinion. In that decision, the court directed us "either to more clearly explain whether there is a correlation between the dredge hour surrogate and the numerical take limit, and its selection of 359,757 dredge hours or, if unable to do so, to select a more appropriate surrogate or other mechanism for monitoring loggerhead takes resulting from dredge fishing." Oceana, Inc. v. Ross, No. CV 08-1881 (PLF), 2020 WL 5834838, at *11 (D.D.C. Oct. 1, 2020). We are attempting to address the court's concerns in this Opinion.

Opinion (e.g., updated dredge and trawl bycatch estimates and serious injury/mortality determinations), and several modifications to the fishery including the requirement to use turtle deflector dredges (TDDs). The 2012 Opinion concluded that the authorization of the scallop fishery under the Scallop FMP would not jeopardize the continued existence of Northwest Atlantic DPS loggerhead, leatherback, Kemp's ridley, or green sea turtles, the five listed DPSs of Atlantic sturgeon, or any other ESA-listed species under NMFS jurisdiction (NMFS 2012).

As described in the 2012 Opinion, ESA-listed sea turtles and Atlantic sturgeon were expected to interact with scallop dredge and/or trawl gear used in the fishery, such that they would come into physical contact with the gear (*i.e.*, be struck by or swim into it) and/or be potentially captured in the dredge bag, frame, or chains of the dredge or the codend of the trawl. Integral to the effects and jeopardy analyses of the 2012 Opinion was the knowledge that mandated gear modifications including chain mats (effective August 25, 2006) and TDDs (effective May 1, 2013), which are currently required during months (May-November) and in areas (west of 71°W longitude) where sea turtles are most prevalent, would prevent most captures of sea turtles in the dredge bag and resulting injuries or mortalities that could follow from such capture either below water or on the deck of the fishing vessel. In accordance with ESA section 7 regulations (50 CFR 402.02), all such interactions with gears used in the scallop fishery are considered "incidental takes." An ITS was provided with the 2012 Opinion along with non-discretionary Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&Cs) to minimize the impacts of incidental take. As described in the most recently amended ITS from November 27, 2018, up to 322 Northwest Atlantic DPS loggerhead sea turtles (92 lethal) were anticipated to interact with scallop dredge gear in any consecutive two-year period while up to 700 (330 lethal) were anticipated to interact with scallop trawl gear in any consecutive five-year period following issuance of the Opinion. In addition, the annual take of up to two leatherback (both lethal), three Kemp's ridley (up to two lethal), and two green sea turtles (both lethal) were anticipated to occur in scallop dredge and trawl gear combined. Finally, up to one Atlantic sturgeon from either the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, or South Atlantic DPS was anticipated to be captured annually in scallop trawl gear; with one mortality due to capture occurring every 20 years.

Prior to 2012, NMFS GARFO completed formal section 7 consultations on the scallop fishery in 2003, 2004 (twice), 2006, and 2008. For a brief summary of those prior Opinions, please refer to the 2012 Scallop Opinion (NMFS 2012). Aside from the six prior formal consultations on the Scallop FMP itself, NMFS has also informally reviewed a number of framework adjustments, amendments, research set-aside (RSA) projects, exempted fishing permits (EFPs), and emergency actions associated with the Scallop FMP in regards to their effects on ESA-listed species. These reviews have concluded that either the proposed actions may affect, but were not likely to adversely affect, ESA-listed species under NMFS jurisdiction or that the proposed actions did not trigger reinitiation of formal consultation.

Cause for Reinitiating

As provided in 50 CFR 402.16, reinitiation of formal 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 if: (1) the amount or extent of incidental take specified in the ITS 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 action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in the Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

In this instance, reinitiation trigger #1 (exceedance of the ITS) was met based upon a recent data query and quality assurance/quality control (QA/QC) review conducted through our dredge effort monitoring scheme, which has been required in our Opinions on the Scallop FMP since 2006. We have been using an effort surrogate to monitor sea turtle takes since 2006 as that is the year that chain mats were first required in the dredge fishery. The use of chain mats made it difficult to monitor sea turtle interactions with the gear that were happening underwater, as the likelihood of a sea turtle entering the dredge bag and being hauled up and observed on the deck of the fishing vessel became much lower due to the gear modification.

Under the 2012 Opinion, we used fishing effort (specifically, Mid-Atlantic dredge hours from May-November) as a surrogate for take, to monitor the incidental take of sea turtles in the scallop dredge fishery in the short term. We assumed that the incidental take level for loggerhead sea turtles exempted by the 2012 Opinion (322 individuals over any two-year period in dredge gear) would be exceeded if, over any future two-year period, the fishery exceeded the average number of estimated dredge hours from 2007-2008, the first two-year period after the implementation of chain mats on which the take estimates for sea turtles in the ITS of the 2012 Opinion are based.

The GARFO Analysis and Program Support Division performed a dredge effort data query annually as part of the incidental take monitoring scheme for the 2012 Opinion. In early 2019, as we submitted our annual data request to them, we discovered the presence of two gear codes in the GARFO vessel trip report (VTR) database that had not been previously queried, but needed to be included for a complete analysis. Upon receipt of the effort data, we reviewed the results for the most recent fishing year (which was 2018) as well as for prior years dating back to 2012. The 2019 query, incorporating data from the two additional scallop gear codes, indicated that scallop fishing effort from May-November in the Mid-Atlantic was substantially higher in 2016 than previously reported and, as a result, exceeded the ITS effort surrogate established in the 2012 Opinion for the 2015-2016 and 2016-2017 periods. The ITS trigger established in the 2012 Opinion was set at a two-year average of 359,797 dredge hours. From May-November 2016, the scallop fleet was discovered to have expended 451,741 hours of scallop dredge effort in Mid-Atlantic waters. Based upon that effort total, the average dredge hours for 2015-2016 and 2016-2017 were 365,500 and 376,717 hours. The 2012 Opinion stated that, *"If the two-year benchmark average of 359,797 dredge hours is exceeded in the future, then we will reinitiate consultation because we assume the higher level of effort will result in a level of sea turtle take in excess of the levels exempted by the ITS."*

Based on our investigation into and discovery that a trigger for reinitiation of consultation was met due to the ITS dredge effort surrogate being exceeded in the 2015-2016 and 2016-2017 time periods, we recommended on February 13, 2020, that GARFO SFD request reinitiation of formal section 7 consultation on the scallop fishery. The following day, on February 14, 2020, GARFO SFD sent us a memorandum requesting reinitiation of consultation. On February 19, 2020, we issued a memorandum back to GARFO SFD commencing formal consultation retroactive to the date of February 14, 2020, when all information required to reinitiate consultation was received. On March 4, 2020, and March 24, 2021, we issued memoranda determining that the authorization of the scallop fishery during the reinitiation period will not violate ESA section 7(a)(2) or 7(d) and that we would complete a new Opinion on or before the court ordered deadline of July 1, 2021, for completion of the latest remand.

In addition to the ITS exceedance, several new sources of information on the effects of the scallop fishery on sea turtles have become available since we issued the most recent Opinion in 2012. In 2015, Kimberly Murray of the NEFSC published two bycatch estimate reports for loggerhead sea turtles; one for scallop dredge gear and the other for bottom trawl gear (Murray 2015a, 2015b). Those reports were reviewed by GARFO PRD shortly after their publication and did not trigger the need to reinitiate consultation on the scallop fishery at that time as the estimates of sea turtle takes in both gear types were lower than what was exempted by the 2012 Opinion. In 2020, Kimberly Murray again prepared bycatch estimate reports for sea turtles in scallop dredge and bottom trawl gear per our five-year rotational cycle (Murray 2020a, 2020b). These most recent bycatch estimate reports by Murray (2020a, 2020b) provide the best available information on the estimated amount of sea turtle interactions occurring in both the dredge and trawl components of the fishery. These reports include new estimates of sea turtle bycatch, including unobservable, yet quantifiable (or "inferred") interactions such as a sea turtle interacting with modified gear such as a chain mat and TDD equipped dredge. For the scallop dredge fishery, the average annual estimate of observable plus inferred sea turtle interactions from the 2015-2019 time period was 155 loggerheads per year (CV = 0.27, 95% CI: 99-219), of which an estimated 53 were lethal. The 155 loggerhead interactions equate to 31 adult equivalents per year and 11 adult equivalent mortalities. Interaction rates were not estimated for Kemp's ridley sea turtles because only two were observed in the Mid-Atlantic (and one on Georges Bank) in the entire pooled time series, nor were interaction rates estimated for green or leatherback sea turtles due to a lack of observed records in the recent past (Murray 2020a). For the scallop trawl fishery, Murray (2020b) estimated the total bycatch of loggerhead, leatherback, Kemp's ridley, and green sea turtles in U.S. Atlantic bottom trawl gear during the period of 2014-2018 inclusive of both the U.S. Mid-Atlantic and Georges Bank areas. Linden (2020) then partitioned the amount of bottom trawl takes that were directly attributable to the scallop fishery over the five-year period, which equated to 6.60 loggerheads (95% CI: 1.34-12.83), 0.89 Kemp's ridleys (95% CI: 0.41-1.51), 0.18 leatherbacks (95% CI: 0-0.43), and 0.26 green sea turtles (95% CI: 0-0.76). These bycatch estimates from Murray (2020a, 2020b) and partitioning analysis from Linden (2020) represent new information on the effects of the scallop fishery on sea turtles. With the issuance of these latest bycatch estimate reports, the development of new methods to apportion bottom trawl takes of sea turtles in the U.S. Atlantic to the scallop fishery, and the adoption of a monitoring program/approach that focuses on a five-year cycle of dredge and trawl bycatch estimates for sea turtles going forward, the agency can accurately monitor and evaluate sea turtle interactions in the scallop dredge and trawl fisheries in the years to come.

In addition, there is new information available on the levels of post-interaction mortality to sea turtles in the scallop dredge and trawl fisheries. The Northeast Sea Turtle Injury Workgroup, which assesses sea turtle injuries and mortalities observed in Greater Atlantic Region fishing gear (Upite 2011; Stacy *et al*. 2016; NMFS 2017), recently compiled post-interaction mortality results for the 2014-2018 and 2015-2019 time periods (Memoranda from Carrie Upite, Sea

Turtle Recovery Coordinator, to Jennifer Anderson, ARA for Protected Resources; February 26, 2020, and April 26, 2021) and those rates for sea turtles are different than those considered in the 2012 Opinion.

Based upon the information presented above, and in accordance with the regulations at 50 CFR 402.16, formal consultation was reinitiated to reconsider the effects of the authorization of the scallop fishery under the Scallop FMP on ESA-listed sea turtles. In addition, we are also assessing the effects of the scallop fishery on other ESA-listed species and critical habitats in the action area such as the five listed DPSs of Atlantic sturgeon, ESA-listed whales, shortnose sturgeon, Atlantic salmon, and recently listed giant manta rays and oceanic white-tip sharks.

3.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is the authorization of the Atlantic sea scallop (*Placopecten magellanicus*) fishery managed under the Scallop FMP, consistent with all applicable regulations including Framework Adjustment 32, which became effective on April 1, 2020, and Framework Adjustment 33, for which an interim final rule was published and effective on May 19, 2021.

Framework 32 established scallop specifications and other measures for fishing year 2020, in addition to measures to protect small scallops and reduce the bycatch of flatfish. Framework 33 set specifications for the scallop fishery for fishing year 2021, including days-at-sea allocations, individual fishing quotas (IFQs), and sea scallop access area trip allocations, and precautionary default 2022 specifications, in case the next framework is implemented after the April 1 start of the 2022 fishing year. The Framework 33 specifications will result in a reduction in projected landings compared to fishing year 2020 (40.0 million pounds for fishing year 2021 compared to 51.6 million pounds for fishing year 2020). This is due primarily to a decrease in harvestable biomass and a lack of significant recruitment in recent years. Framework 33 also allocates effort into three rotational access areas (Mid-Atlantic, Nantucket Lightship-South-Deep, and Closed Area II), opens Closed Area I to limited access general category (LAGC) IFQ trips and to research set-aside compensation fishing, maintains an existing seasonal closure in Closed Area II from August 15 through November 30 to reduce bycatch of Georges Bank yellowtail flounder and northern windowpane flounder, and closes areas to fishing to protect small scallops and reduce bycatch of flatfish. Analysis of the scallop fishery will include all vessels with a federal permit under the Scallop FMP when fishing in federal waters. Through those permits, NMFS authorizes fishing in federal waters (>3 nautical miles from shore) in the action area.

It is important to note that commercial fishing vessels are often permitted to operate within multiple federal fisheries at once, and as a result, landings from a particular trip can include multiple species of fish or shellfish managed under multiple FMPs. However, because scallops are a federally-managed species with a requirement to declare into the fishery, we are able to use the declarations to identify trips targeting scallops. For the purposes of this Opinion, fishing effort under the Scallop FMP will include actions that result in fishing for and landings of scallops by federally permitted dredge and bottom trawl vessels who have declared into the fishery and are operating within federal waters.

Previous Opinions completed on the scallop fishery have assessed the effects of the authorization of the fishery on ESA-listed species and designated critical habitat (NMFS 2003, 2004a, 2004b, 2006, 2008, 2012). As the data available at the time the Opinions were written did not allow us to separate out the effects from federally-permitted vessels fishing in state waters from those fishing in federal waters, these past Opinions considered the authorization of the fishery to include all federally-permitted vessels fishing in state and federal waters in the action area. With new tools and data available, we are able to refine our effects analysis to evaluate fishing activities in federal waters. As NMFS does not authorize, fund, or carry out fishing activities in state waters, these activities are not considered part of the proposed action in this Opinion. Dually permitted vessels (i.e., possessing both a state and federal permit) can still operate in state waters without federal authorization. Consequently, this Opinion evaluates effects from fishing activities (e.g., bycatch, gear collisions, or vessel collisions) by vessels with federal permits in federal waters only. The effects analysis will consider the effects to ESA-listed species from transits through state and federal waters to scallop fishing grounds in federal waters.

3.1 Description of the Fishery

- Management

At present, the U.S. scallop fishery primarily includes vessels with “limited access” (LA) permits. Two types of allocations are given to each vessel. The first are trips (with a trip limit, typically of 18,000 pounds of meats) to rotational access areas that had been closed to scallop fishing in the past. The second are days at-sea (DAS), which can be used in areas outside the access areas. Vessels fishing under DAS with either two standard 15.5-foot New Bedford scallop dredges or with scallop trawl gear are restricted to a seven-man crew in order to limit their shucking power. Another set of vessels (i.e., small dredge vessels in the LAGC IFQ fleet) are required to use one, 10.5-foot dredge and have a more restrictive five-man crew limit. The percentage of landings from the access area trips have increased since the access area program was created.

Amendment 10 the Scallop FMP (69 FR 35194; June 23, 2004) established the access area rotational program to promote optimal yield in the fishery. Under the rotation program, the New England Fishery Management Council (NEFMC, or Council) closes areas with large concentrations of fast-growing, small scallops before the scallops are exposed to fishing. Scallops grow fastest when they are very small and protection of these small scallops through area closures is critical in the rotational management of the scallop resource.

After a period of closure, and after evaluation according to the criteria and procedures established in the FMP, the areas will re-open for scallop fishing, when the scallops are larger and more suitable for harvest. This process boosts scallop meat yield and yield per recruit. When the areas are open for access (i.e., “access areas”) (Figure 1), vessels are allocated a number of trips with corresponding trip limits that they may use in those dedicated access areas. Once the high concentrations of scallops in an access area have been fished down, the Council may decide to close the area again if it appears that the resource will rebound in a few years after protecting any small scallops that may be there, or the Council could convert the area back to an “open area”. Open areas are where LA vessels fish for scallops under DAS allocations.

The remainder of U.S. scallop landings comes from vessels operating under "general category" (GC) permits that are restricted to 600 pounds per trip, with a maximum of one trip per day. This type of permit had been open access, but was converted to a limited access individual transferable quota (ITQ) fishery in March 2010 with an annual allocation of 5.5% of the total projected scallop catch (about two to three million pounds depending on the overall allocation). Amendment 11 also developed a separate limited entry program for general category fishing in the Northern Gulf of Maine (NGOM) (Figure 1). The NGOM fleet is made up of smaller dayboat vessels with a 200-pound possession limit, with a maximum of one trip per day. In addition, a separate limited entry incidental catch permit was adopted that permits vessels to land and sell up to 40 pounds of scallop meat per trip while fishing for other species.

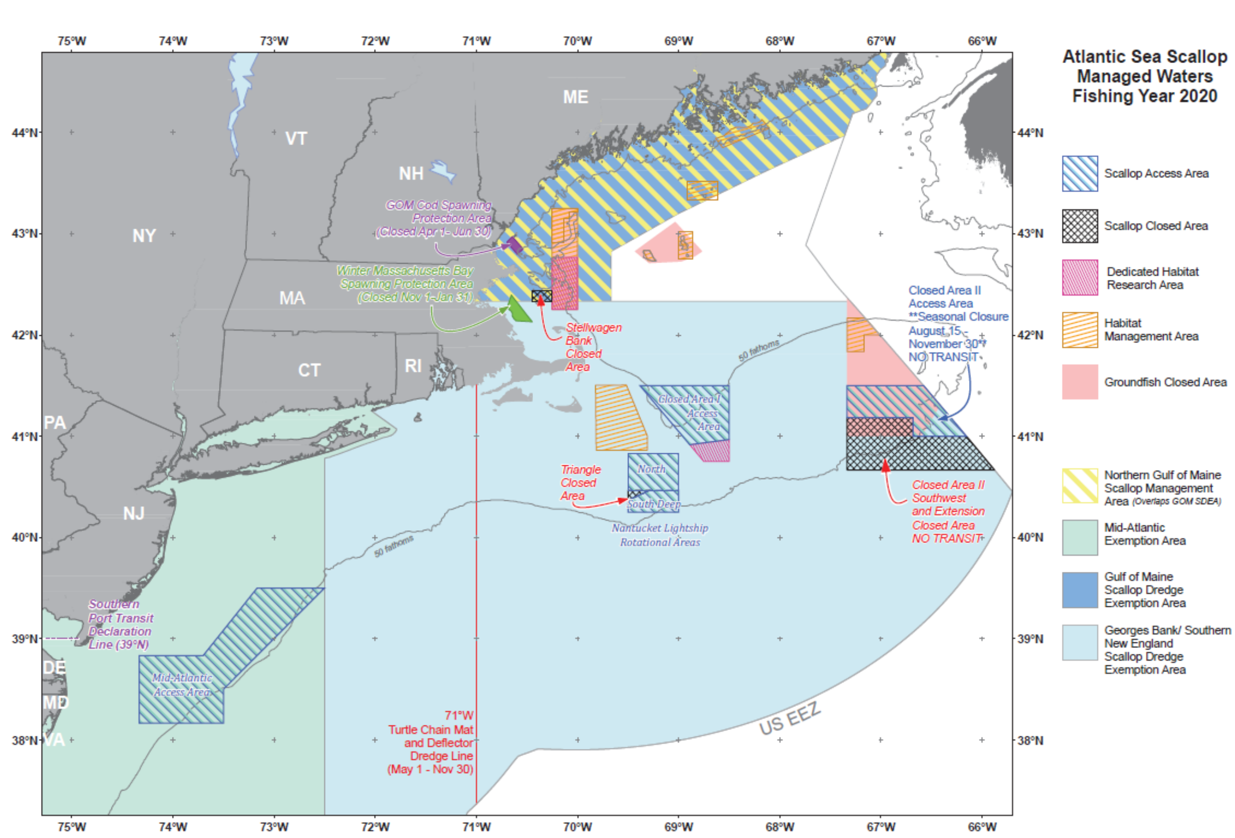

Figure 1. Atlantic Sea Scallop Managed Waters Fishing Year 2020.

- Seasonality

The fishing year (FY) for the scallop fishery is defined for management purposes as April 1 through the last day of March (50 CFR 648.2). The commercial fishery operates year-round in U.S. waters (Hart 2001), although seasonal peaks in scallop landings are evident, generally in the summer months. These peaks may be influenced by management measures, market conditions, weather, and scallop spawning, among other factors. Recreational fishing for scallops is insignificant (Hart 2006). In recent years, the NGOM fishery has occurred in April and May.

- Distribution

Scallops are found in the Northwest Atlantic Ocean from North Carolina to Newfoundland, along the continental shelf, typically on sand and gravel bottoms (Packer *et al.* 1999; Hart and Chute 2004). However, scallops are not evenly distributed throughout this area, and they often occur in aggregations called beds (Hart and Chute 2004). Major aggregations of scallops in U.S. waters occur in the Mid-Atlantic region from Virginia to Long Island, on Georges Bank, in the Great South Channel, and in the Gulf of Maine (Hart and Rago 2006). For the purposes of this Opinion, the Mid-Atlantic region refers to the Mid-Atlantic Bight, which is defined as the coastal ocean area between Cape Hatteras, North Carolina and Long Island, New York. In the Mid-Atlantic region and Georges Bank, scallops are harvested primarily at depths of 30-100 meters, while the bulk of landings from the Gulf of Maine are from nearshore, relatively shallow waters (<40 meters) (NEFSC 2010). Landings from Georges Bank and the Mid-Atlantic region have dominated the fishery since 1964 (NEFSC 2010). Recreational diver harvesting of scallops in shallow coastal waters of the U.S. Atlantic accounts for an extremely small amount of landings.

- Closures

Each year the Council may choose to close certain areas to scallop fishing as part of the rotational access area program. These closures will vary annually depending on the condition of the scallop resource in the area. Beyond the closures implemented as part of the Scallop FMP, the scallop fleet cannot fish in the habitat management areas that prohibit bottom tending mobile gear (Figure 1).

- Stock status

The most recent stock assessment for scallops occurred in 2018 (SARC-65; NEFSC 2018). SARC-65 estimated total biomass to be 317,334 metric tons in 2017 and overall fishing mortality (F) was estimated at 0.12. That biomass estimate is well above the overfishing threshold of 58,383 metric tons, and estimated F is well below the overfished threshold of 0.64 (OFL). Therefore, overfishing is not occurring, and this resource is not overfished.

3.2 Description of the Gear

The characteristics of trawl gear vary based on the species targeted. An overview of bottom otter trawl gear and the components of the gear, in general, is provided in the Supplemental Environmental Impact Statement for Amendment 10 to the Scallop FMP (NEFMC 2003). Briefly, bottom otter trawls are comprised of a net to catch the target species (NEFMC 2003). Doors attached to two cables are used to keep the mouth of the net open while deployed. A sweep runs along the bottom of the net mouth (NEFMC 2003). Depending on the bottom type and species targeted, the sweep may be configured with chains, “cookies” (small rubber disks), or larger rubber disks (rock-hoppers or roller gear) that help to prevent the net from snagging on bottom that contains rocks or other structures (NREFHSC 2002; NEFMC 2003).

A scallop trawl is a type of bottom otter trawl that is modified to catch scallops (Murray 2007). Scallop trawls differ from the general bottom otter trawl in that scallop trawls generally have no overhang in the net (the floatline, or headline, and the groundrope at the opening of the net are parallel to each other), and the doors are closer to the wings of the trawl (H. Milliken, NEFSC, pers. comm. in Murray 2007). Tickler chains are sometimes used ahead of the trawl to help move scallops off of the sea bed (NEFMC 2003; Murray 2007).

The components of a commercial scallop dredge have been described in several documents, which are summarized as follows. The dredge frame keeps the dredge bag spread wide and on the bottom (NEFMC 2003). The cutting bar, which is located on the bottom aft part of the frame, rides about four inches off the seabed (Smolowitz 1998). In a flat area, it remains off the bottom, but in areas of sand waves, for example, the cutting bar hits the top of the sand waves and tends to knock them down (Smolowitz 1998). Shoes on the cutting bar are in contact with and ride along the substrate surface (NREFHSC 2002; NEFMC 2003). A sweep chain in the form of an arc is attached to each shoe and the bottom of the ring bag (Smolowitz 1998). The bag, which drags on the substrate when fished, is made up of metal rings with twine mesh on the top and, sometimes, chafing gear on the bottom (NEFMC 2003). The very end of the ring bag is the club stick, which is responsible for maintaining the shape of the ring bag, especially while dumping the catch on deck (Smolowitz 1998). For scalloping on hard bottoms, rock chains running front to back from the frame to the ring bag, are used in addition to tickler chains, which run from side to side between the frame and the ring bag (Smolowitz 1998). Fishermen use rock chains when fishing on rocky bottoms to prevent boulders from getting into the ring bag, which would cause damage to the gear or to the scallops in the bag (Smolowitz 1998). The number and configuration of rock chains depends on the size of rocks the fishermen wish to exclude, which varies by area (NEFSC pers. comm.) Underwater video of dredges being towed at speeds of five knots show that the chains do not dig into the bottom (Smolowitz 1998). Instead they tend to skip over the bottom, hitting it periodically and bouncing up organisms like starfish that are on the bottom (Smolowitz 1998). Dredges also have a twine top, which allows for reduced bycatch of groundfish and other finfish (NEFMC 2003).

New Bedford style scallop dredges are the main gear type in all regions (Figure 2). These dredges are generally 15.5 feet wide, and full-time limited access vessels can pull two dredges at a time. Small dredge vessels are only allowed to use one dredge up to 10.5 feet wide. A standard 15-foot dredge frame weighs approximately 4,500 pounds (Memorandum to the File, E. Keane, March 2008). Vessels travel at speeds of 4-5 knots when towing dredge gear (NREFHSC 2002; Murray 2004b, 2005), although the speed of the gear moving through the water column during haulback is usually slower, approximately 1-4 miles per hour (0.9-3.5 knots) (NMFS 2006a).

In 2012, Framework Adjustment 23 to the Scallop FMP (77 FR 20728; April 6, 2012) implemented the requirement that all LA vessels (regardless of permit category or dredge size), and IFQ vessels that fish with a dredge with a width of 10.5 feet or greater, use a TDD (Figure 3) in the Mid-Atlantic (west of 71°W longitude) from May through October, the time and place that sea turtles are thought to be most prevalent. The TDD is designed to reduce injury and mortality of sea turtles that come into contact with scallop dredges on the sea floor by deflecting sea turtles over the dredge frame and dredge bag.

The TDD requires the following low-profile design:

(1) The cutting bar must be located in front of the depressor plate.
(2) The angle between the front edge of the cutting bar and the top of the dredge frame must be less than or equal to 45 degrees.
(3) All bale bars must be removed, except the outer bale (single or double) bars and the center support beam, leaving an otherwise unobstructed space between the cutting bar and forward bale wheels, if present. The center support beam must be less than 6 inches wide. For the purpose of flaring and safe handling of the dredge, a minor appendage, not to exceed 12 inches in length, may be attached to the outer bale bar.
(4) Struts must be spaced no more than 12 inches apart from each other.
(5) For all dredges with widths of 10 feet, 6 inches or greater, the TDD must include a straight extension ("bump out") connecting the outer bale bars to the dredge frame. This "bump out" must exceed 12 inches in length.

All vessels are also required to use turtle chain mats (Figure 4) in the Mid-Atlantic from May through November. Per our regulations, a chain mat must be composed of horizontal and vertical chains configured such that the openings formed by the intersecting chains have no more than four sides. The length of each side of the openings created by the intersecting chains must be less than or equal to 14 inches (35.5 centimeters). The chain mat must cover the dredge bag opening in order to prevent sea turtles from swimming or being swept inside.

In 2015, NMFS aligned the TDD and chain mat regulations through Framework Adjustment 26 to the Scallop FMP by making the area (west of 71°W longitude) and season (May through November) for these requirements consistent (80 FR 22119; May 1, 2015). The TDD provides a conservation benefit to sea turtles by reducing the severity of interactions on the ocean bottom. By deflecting sea turtles over the dredge rather than under the cutting bar, the TDD is expected to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). When combined with the effects of chain mats, which decrease captures in the dredge bag, the TDD provides greater benefits to sea turtles than a standard New Bedford dredge by significantly reducing serious injury/mortality.

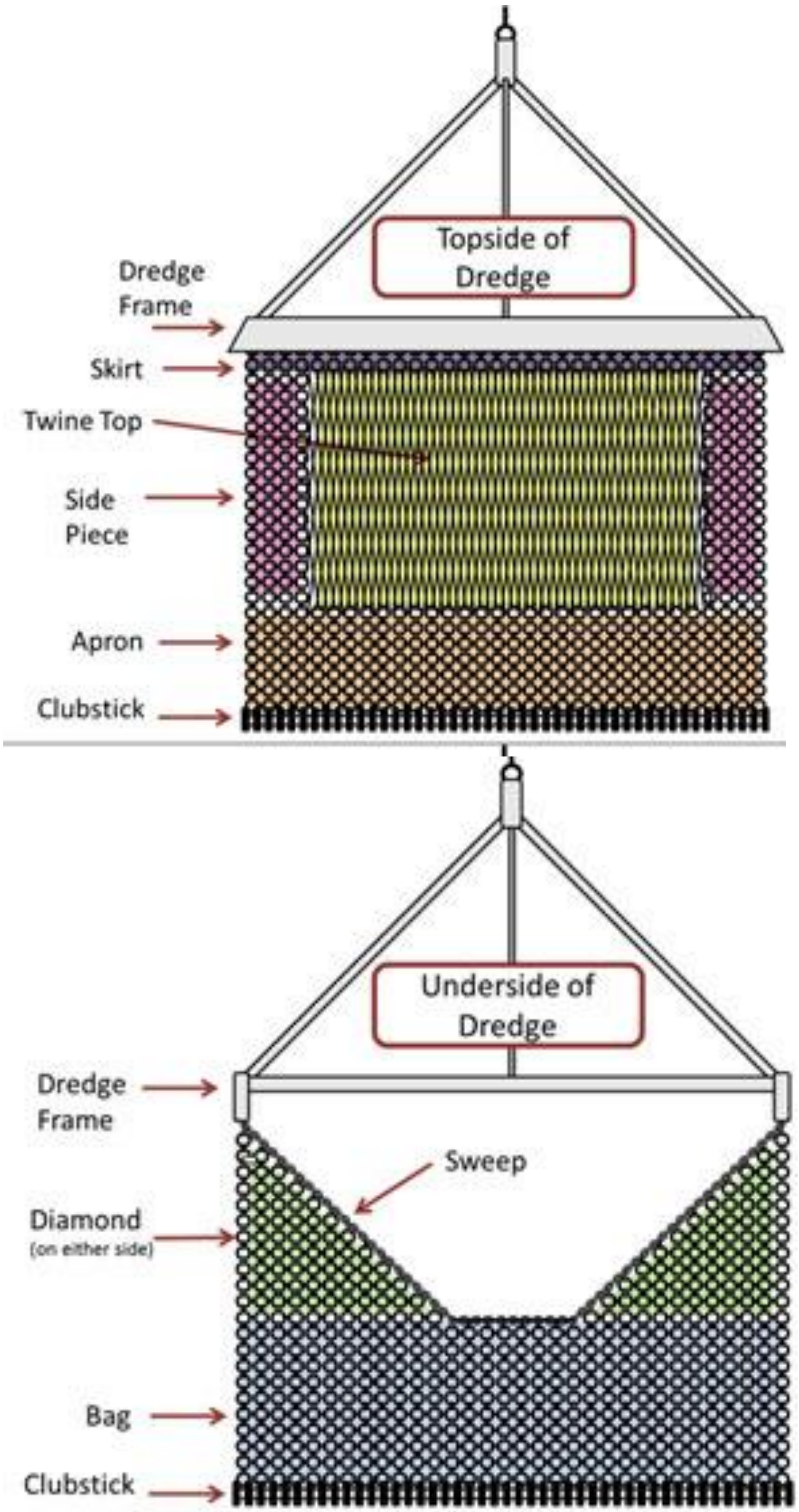

Figure 2. Diagram of a Standard New Bedford Style Scallop Dredge.

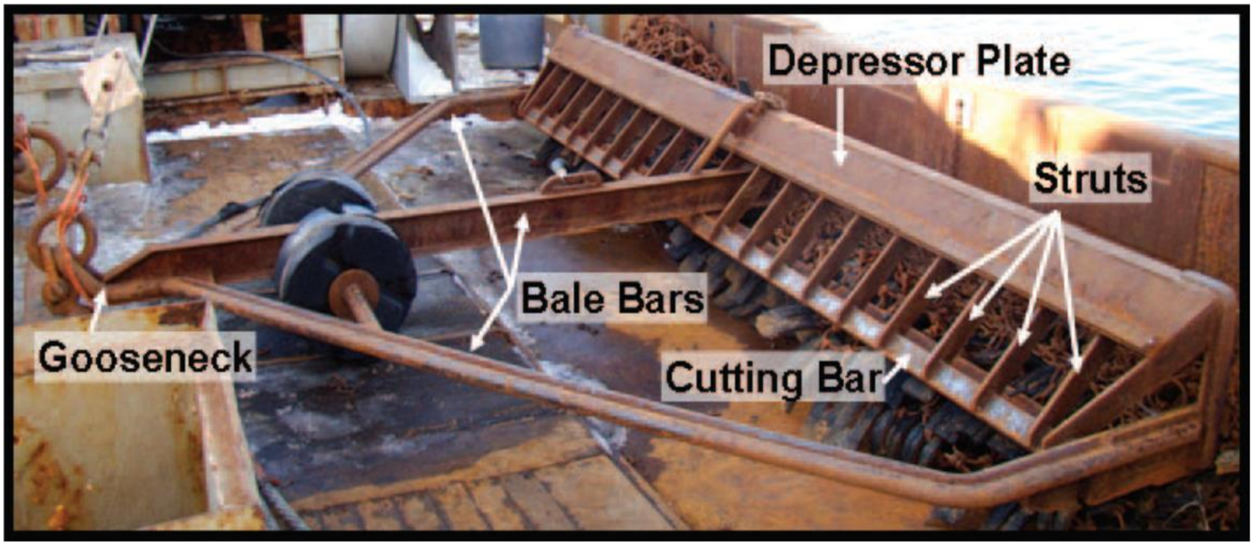

Figure 3. Turtle Deflector Dredge Example. Required specifications are that the cutting bar must be located in front of the depressor plate; the angle between the front edge of the cutting bar and the top of the dredge frame must be less than or equal to 45 degrees; all bale bars must be removed except the outer bale bars and the center support beam, struts must be spaced no more than 12 inches apart from each other; and the dredge must include a straight extension ("bump out") connecting the outer bale bars to the dredge frame.


Figure 4. Turtle Chain Mat Example. The chain mat is the rectangular grid of chains in the center of the dredge (outlined by the blue box) that keeps turtles from swimming into or being caught in the dredge bag.

3.3 Description of Fishing Effort

The limited access program and DAS allocations, first established under Amendment 4, remain the basic effort control measures for the scallop fishery. There are eight different categories of scallop limited access permits (starting at 2). Depending on the type of limited access permit for which a vessel qualified, the owner of a vessel with a scallop limited access permit may have the option of fishing with dredge gear, a small dredge, or trawl nets. The permit categories are:

- Full-time dredge gear (Category 2)
- Part-time dredge gear (Category 3)
- Occasional dredge gear (Category 4)
- Full-time small dredge (Category 5)
- Part-time small dredge (Category 6)
- Full-time trawl (Category 7)
- Part-time trawl (Category 8)
- Occasional trawl (Category 9)

Open area DAS and scallop access area trip allocations to a scallop vessel vary depending on whether the vessel qualifies in the full-time, part-time, or occasional permit category. The greatest number of DAS access area trips are allocated to vessels that qualify in the full-time permit category (see https://www.fisheries.noaa.gov/permit/atlantic-sea-scallop for additional information on scallop fishery permit categories).

Limited access vessels assigned to either the part-time or occasional categories can increase their DAS and access area allocation by opting into the small dredge program, which effectively places them one category higher (e.g., a part-time limited access vessel becomes a full-time limited access vessel in the small dredge program, and an occasional limited access vessel becomes a part-time limited access vessel in the small dredge program). The small dredge program requires participating vessels to: (1) fish exclusively with one dredge no more than 10.5 feet in width; (2) have only one dredge on board or in use; and (3) have no more than five people (versus seven for limited access vessels not in the small dredge program), including the operator, on board (NEFMC 2003). Crew limits affect how fast a haul of scallops can be shucked and, as a result, how quickly subsequent hauls can be made. The number active limited access permits has been relatively stable since 2009 (Table 1). This fleet is responsible for the about 94.5% of the landings. Limited access vessel landings were relatively high from 2009-2012 (over 50 million pounds annually), decreased from 2013-2016 (around 30 million pounds annually), and then returned to prior 2009-2012 levels in 2017-2018 (Table 2).

Table 1. Number of Limited Access Vessels by Permit Category (2009-2018).

PERMIT CAT	Category	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
FT	2	245	251	252	252	250	249	250	250	249	249
FT-NET	7	11	11	11	11	11	12	11	11	11	10
FT-SMD	5	53	52	52	51	52	53	51	51	51	54
FT	Full-time	309	314	315	314	313	314	312	312	311	313
PT	3	2	2	2	2	2	2	2	2	2	1
PT-SMD	6	30	32	32	31	30	32	31	32	31	31
PT	Part-time	32	34	34	33	32	34	33	34	33	32
SUM		341	348	349	347	345	348	345	346	344	345

Table 2. Scallop landings (lb) by limited access vessels by permit category.

FISHYEAR	'FT'	'FT-SMD'	'FT-NET'	'PT'	'PT-SMD'	Total (lbs.)
2009	41,411,655	7,298,416	1,847,312	226,968	1,516,859	52,301,210
2010	42,779,955	6,792,986	1,788,545	238,648	1,902,279	53,502,413
2011	44,097,327	7,309,724	1,937,170	211,192	1,722,153	55,277,566
2012	42,749,294	7,063,239	1,756,899	210,977	1,442,388	53,222,797
2013	30,791,957	4,094,184	1,226,997	154,673	954,055	37,221,866
2014	24,836,675	3,179,401	880,098	107,759	709,398	29,713,331
2015	27,036,665	4,079,589	933,717	140,919	865,263	33,056,153
2016	29,781,474	4,821,326	1,279,350	199,145	1,276,757	37,358,052
2017	39,668,120	7,173,447	1,740,087	218,980	1,566,268	50,366,902
2018	45,463,989	7,861,387	1,619,563		1,820,059	56,764,998

Beginning in the 2010 fishing year, LAGC-IFQ vessels were allocated 5% of the estimated scallop catch resulting in a decline in landings by the general category vessels.[2] Vessels with both LA and IFQ permits are allocated the remaining 0.5% of the allocation. The number of vessels in the IFQ-only fleet fluctuates each year as a vessel has the option to temporarily or permanently transfer its IFQ (Table 3). The Council's IFQ program report presented on June 2017 provides a detailed review of the trends of the IFQ fishery during 2010-2015.[3] Table 4 presents the number of IFQ only permits (i.e., excluding LA vessels with IFQ permits) and their scallop landings during 2009-2018.

Table 3. Number of active vessels with LAGC permits by permit category (excludes LA vessels with LAGC permits).

FISHYEAR	IFQ only	NGOM Only	Incidental Only
2009	202	8	59
2010	143	9	51
2011	139	8	55
2012	118	11	65
2013	115	24	58
2014	126	25	53
2015	122	24	44
2016	135	31	51
2017	129	35	35
2018	123	40	36

Table 4. LAGC IFQ active vessels and landings (excluding LA vessels with IFQ permits).

Fish Year	Permit (IFQ only)	IFQ only landings lbs.
2009	202	3,759,904
2010	143	2,170,666
2011	139	2,870,826
2012	118	2,869,312
2013	115	2,302,402
2014	126	2,103,751
2015	122	2,413,760
2016	135	3,493,944
2017	129	2,588,370
2018	123	2,828,544

[2] The general category scallop fishery has always been a comparatively small but diverse part of the overall scallop fishery. Beside LAGC-IFQ permits, there is also a separate limited entry program for general category fishing in the Northern Gulf of Maine (NGOM). Furthermore, a separate limited entry incidental catch permit was adopted that will permit vessels to land and sell up to 40 pounds of scallop meat per trip while engaged in other fisheries. During the transition period to the full-implementation of Amendment 11, the general category vessels were allocated 10% of the scallop TAC.

[3] http://s3.amazonaws.com/nefmc.org/3.170615_Draft_LAGC_IFQ_ProgramReview_wAppendicies.pdf

3.4 Exempted Fishing Permits, Educational Activities, and Research Set-Aside

Regulations at 50 CFR 600.745 allow the NMFS GARFO Regional Administrator to authorize the targeting or incidental harvest of species managed under an FMP or fishing activities that would otherwise be prohibited for scientific research, limited testing, public display, data collection, exploration, health and safety, environmental cleanup, hazardous waste removal purposes, or for educational activities. Every year, NMFS GARFO may issue a small number of EFPs and/or exempted educational activity authorizations (EEAAs) exempting the collection of a limited number of scallops from Greater Atlantic federal waters from regulations implementing the Scallop FMP. For example, between 2015 and 2020, NMFS GARFO issued 30 EFPs and two EEAAs relative to the scallop fishery. The EFPs and EEAA involved fishing by commercial or research vessels using methods that were similar or identical to those of the scallop fishery, which is the primary subject of this Opinion. The only differences involved (a) the use of modified gear (*e.g.*, dual mesh twine tops, low profile dredges), which was not authorized under the FMP at the time, or (b) requests for additional DAS or trips to scallop access areas beyond what the annual specifications for the fishery allowed. Nearly all the permitted fishing effort occurred in waters off southern New England and the Mid-Atlantic.

For the 30 EFPs and two EEAAs examined between 2015 and 2020, we were able to conclude that in all cases, the types and rates of interactions with listed species from those activities would be similar to those analyzed in the most recent Opinion. Given our past experience with and knowledge of the usual applicants (and when and where they fish), we expect that future EFPs and/or EEAAs would propose fishing types and associated fishing effort similar to previous EFPs/EEAAs and, therefore, not introduce a significant increase in effort levels for the overall fishery considered in this Opinion. As a result, the issuance of those EFPs and EEAAs would be expected to fall within the level of effort and impacts considered in this Opinion. For example, the issuance of an EFP to an active commercial vessel that is similar to the ones described above likely does not add additional effects compared to those that would otherwise accrue from the vessel's normal commercial activities (unless, for example, that vessel was looking for exemptions from the TDD requirements in areas with high concentrations of sea turtles). Similarly, issuance of an EFP or EEAA to a vessel to conduct a minimal number of scallop tows/trips with dredge or bottom trawl gear likely would not add sufficient fishing effort to produce a detectable change in the overall amount of fishing effort in a given year. Therefore, we consider the future issuance of most EFPs and EEAAs by NMFS GARFO to be within the scope of this Opinion. If an EFP or EEAA is proposed which modifies this agency action in a manner that causes an effect to listed species or critical habitat not considered in this Opinion (i.e., is beyond the scope of the fishery activities considered), then additional section 7 consultation would be necessary.

Each year, 1.25 million pounds of the total allowable scallop catch is used to fund the Scallop RSA Program. In 1998, the scallop industry opted to set aside a portion of their total annual scallop catch in order to promote greater industry involvement in scientific research. Now, each year when NMFS GARFO and the Council set the annual catch limits for the fishery, a portion is reserved for cooperative research projects. The Scallop RSA Program currently supports research on the following topics: (1) industry-based surveys of access areas, (2) bycatch reduction, (3) loggerhead sea turtle population information and bycatch avoidance, and (4) impacts from offshore wind facilities. Since 2004, nearly 200 research projects have been supported through RSA allocations. For the 2021-2022 funding period, 13 cooperative research projects between scallop fishermen and scientists were selected for funding. For this funding period, the Scallop RSA Program is expected to generate approximately $12.5 million in awards, of which approximately $3 million will support research projects and approximately $9.5 million will compensate industry partners who harvest the set-aside scallops. As is the case with EFPs and EEAAs, we consider the future issuance of most RSA grants to be within the scope of this Opinion, as that level of scallop fishing effort has already been accounted for and analyzed here. If we determine that the distribution of effort or the types of gear utilized in an RSA project are not within the scope of this Opinion, additional section 7 consultation would be necessary.

3.5 Observer Program

Fisheries observer programs for listed species in the Greater Atlantic Region cover nearly all fisheries for which there is a federal FMP and some state fisheries as well. Observer coverage is typically allocated in proportion to fishing effort, by month and port, with vessels selected randomly for coverage (Murray 2009a). Levels of observer coverage in these fisheries may also vary depending on the amount of funding available to offset the cost of observers and the likelihood of bycatch of non-target species (including listed species) during normal fishing operations. In the Greater Atlantic Region, there are four important fisheries observer programs: the Northeast Fisheries Observer Program (NEFOP), the At-Sea Monitoring Program (ASM), the Industry Funded Scallop Program (IFS), and the Industry Funded Monitoring Program (IFM) for herring, all of which are overseen by the NEFSC Fishery Monitoring and Research Division (FMRD). Fisheries observers undergo an extensive three-week training class, led by the NEFSC; the sea turtle and ESA-listed fish components include classroom training, hands on workshops, and exams on species identification, measuring, tagging, and handling (among other things). Ultimately, the data collected by fisheries observer programs can be used to estimate the amount and extent of bycatch of listed species in commercial fisheries and to track and monitor the ITSs of FMP Opinions.

The scallop fishery utilizes the IFS program under NEFOP that requires scallop vessel owners to pay for the cost of carrying observers. A portion of the scallop resource is set-aside to help offset the cost of observers. Information on the industry-funded scallop fishery observer program under the NEFOP can be found at https://www.fisheries.noaa.gov/new-england-mid-atlantic/fisheries-observers/northeast-industry-funded-scallop-observers. For FY 2020, NMFS set observer coverage rates for the limited access fleet at 5% for open areas and the Mid-Atlantic Access Area and 10% for the Closed Area I, Closed Area II, Nantucket Lightship-North, and Nantucket Lightship-South Access Areas. Additionally, NMFS set the LAGC IFQ coverage rates at 3.5% for the Mid-Atlantic Access Area and 5% for the open areas, Closed Area I, Closed Area II, Nantucket Lightship-North, and Nantucket Lightship-South Access Areas (https://www.fisheries.noaa.gov/new-england-mid-atlantic/commercial-fishing/atlantic-sea-scallop-fishery-fishing-year-2020-observer). These observer coverage rates in the scallop fishery have been relatively consistent from year to year over the past decade. Regulations implementing the scallop fishery observer program can be found at 50 CFR 648.11(k).

3.6 Action Area

Action area means all areas affected directly, or indirectly, by the federal action, and not just the immediate area involved in the action (50 CFR §402.02). The management unit for the Scallop FMP is defined as the range of the scallop resource along the U.S. Atlantic coast. Scallops range from Newfoundland to North Carolina along the continental shelf of North America. The effects of the scallop fishery managed under the Scallop FMP have been summarized as impacts resulting from the fishing gear moving through the water column, coming in contact with and disturbing the sea bed, and the collision with, capture of, or removal of various species from the environment (some of which are discarded as unwanted or regulatory discards) (NEFMC 2003). For the purposes of this Opinion, the action area encompasses all federal Exclusive Economic Zone (EEZ) waters from Maine through the Virginia/North Carolina scallop stock area (which ends at the southern boundaries of NMFS statistical areas 635, 636, 637, 638, and 639, at 35°N latitude). This includes state waters (0-3 nautical miles) as vessels fishing in the federal scallop fishery transit to the fishing grounds through these waters.

4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

ESA-listed species and designated critical habitats occur in the action area of the proposed action. Table 5 summarizes the species and critical habitats that occur in the action area and may be adversely affected (e.g., there have been observed or documented interactions in the scallop fishery or with gear types similar to those used in the fishery). Section 4.1 details which species and critical habitats are not likely to be adversely affected by the proposed action because the effects of the proposed action are deemed insignificant, discountable, or completely beneficial. Section 4.2 summarizes the biology and ecology of those species that may be adversely affected by the proposed action and details information on their life histories in the action area, if known.

Table 5: ESA-listed species and designated critical habitat in the action area of the proposed action.

Species	Status	Potential to be adversely affected by the proposed action?
Marine Mammals: Cetaceans		
North Atlantic right whale (*Eubalaena glacialis*)	Endangered	No
Fin whale (*Balaenoptera physalus*)	Endangered	No
Sei whale (*Balaenoptera borealis*)	Endangered	No
Sperm whale (*Physeter macrocephalus)*	Endangered	No
Blue whale (*Balaenoptera musculus*)	Endangered	No
Marine Reptiles: Sea Turtles		
Loggerhead sea turtle (*Caretta caretta*), Northwest Atlantic DPS	Threatened	Yes
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered	Yes
Kemp's ridley sea turtle (*Lepidochelys kempii*)	Endangered	Yes
Green sea turtle (*Chelonia mydas*), North Atlantic DPS	Threatened	Yes

Species	Status	Potential to be adversely affected by the proposed action?
Hawksbill sea turtle (*Eretmochelys imbricata*)	Endangered	No
Fish		
Atlantic sturgeon *(Acipenser oxyrinchus)*		
Gulf of Maine DPS	Threatened	Yes
New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs	Endangered	Yes
Shortnose sturgeon (*Acipenser brevirostrum*)	Endangered	No
Atlantic salmon (*Salmo salar*), Gulf of Maine DPS	Endangered	No
Giant manta ray (*Manta birostris)*	Threatened	No
Oceanic whitetip shark (*Carcharhinus longimanus*)	Threatened	No
Critical Habitat		
North Atlantic right whale	Designated	No
Northwest Atlantic DPS of loggerhead sea turtle	Designated	No

4.1 Species and Critical Habitats Not Likely to be Adversely Affected by the Proposed Action

As indicated in Table5, we have determined that the action considered in this Opinion is not likely to adversely affect a number of species that are listed as threatened or endangered under the ESA. Additionally, we have determined that the proposed action is not likely to adversely affect any designated critical habitat found in the action area (Table 5). Destruction or adverse modification of critical habitat is a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species (50 CFR 402.2). Below, we present our rationale for our "not likely to adversely affect" determinations.

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Saint John River in New Brunswick, Canada. The species is anadromous in the southern portion of its range (*i.e.*, south of Chesapeake Bay), while some northern populations are amphidromous (NMFS 1998a). Given the range of the species (remaining mostly in the river systems, with some coastal migrations between rivers), and the proposed action primarily occurring in federal waters >3 nautical miles from shore, shortnose sturgeon are not expected to be present in areas where scallop vessels are fishing. In addition, adverse effects are not expected since interactions with shortnose sturgeon have never been documented from the scallop fishery. We have reviewed all available observer records and there have been no observed captures of shortnose sturgeon in scallop dredge, trawl, or any other gear when the primary trip or haul target was scallops (NEFOP database). Vessel strikes are also considered unlikely to occur. Shortnose sturgeon are primarily demersal, occupying the bottom of the water column, and would rarely be at risk from moving vessels, which need sufficient water to navigate without encountering the bottom. Given the species distribution, there is very limited overlap with vessels participating in the fisheries considered in this Opinion, even in state waters where vessels are transiting. Because there are no proposed changes to the scallop fishery that would increase the likelihood of interactions between shortnose sturgeon and this fishery, we do not anticipate any future interactions. Because of this, effects to shortnose sturgeon from the scallop fishery are extremely unlikely and therefore discountable[4].

The naturally spawned and conservation hatchery populations of anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, including those that were already listed in November 2000, are listed as endangered under the ESA (NMFS 2009a, 2009b). These populations include those in the Dennys, East Machias, Machias, Pleasant, Narraguagus, Ducktrap, Sheepscot, Penobscot, Androscoggin, and Kennebec Rivers as well as Cove Brook. Juvenile salmon in New England rivers typically migrate to sea in May after a two- to three-year period of development in freshwater streams, and remain at sea for two winters before returning to their U.S. natal rivers to spawn (Reddin 2006). The preferred habitat of post-smolt salmon in the open ocean is principally the upper ten meters of the water column, although there is evidence of forays into deeper water for shorter periods. In contrast, adult Atlantic salmon demonstrate a wider depth profile (ICES 2005). Results from a 2001-2003 post-smolt trawl survey in the nearshore waters of the Gulf of Maine indicate that Atlantic salmon post-smolts are prevalent in the upper water column throughout this area in mid to late May (Lacroix and Knox 2005). Therefore, fishing close to the bottom with dredge and trawl gear, as practiced throughout the scallop fishery, reduces the potential for catching Atlantic salmon as either post-smolts or adults.

In its report on salmon bycatch, the Working Group for North Atlantic Salmon (WGNAS) concluded that bycatch of Atlantic salmon in Northeast Atlantic commercial fisheries was not an obvious concern. The 2006 WGNAS report also discussed potential salmon bycatch implications from these fisheries and indicated there was insufficient information to quantify bycatch, although based on information reviewed so far, there was no evidence of major bycatch of salmon in Northeast fisheries (ICES 2006). We find it is highly unlikely that the action being considered in this Opinion will affect the Gulf of Maine DPS of Atlantic salmon given that the scallop fishery does not occur in or near the rivers where concentrations of Atlantic salmon are likely to be found. We have reviewed all available observer records from the NEFOP and there have been no observed captures of Atlantic salmon in scallop dredge, trawl, or any other gear when the primary trip or haul target was scallop. Because there are no proposed changes to the scallop fishery that would increase the likelihood of interactions between Atlantic salmon and this fishery, we do not anticipate any future interactions. Because of this, effects to Atlantic salmon from this fishery are highly unlikely and therefore discountable. Neither this species nor its designated critical habitat will be considered further in this Opinion.

The hawksbill sea turtle is uncommon in the waters of the continental U.S. Hawksbills prefer tropical, coral reef habitats, such as those found in the Caribbean and Central America. The waters surrounding Mona and Monito Islands (Puerto Rico) are designated as critical habitat for

[4] When the terms “discountable” or “discountable effects” appear in this document, they refer to potential effects that are found to support a “not likely to adversely affect” conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with our regulatory definition of “effects of the action.”

the species, and Buck Island (St. Croix, U.S. Virgin Islands) also contains especially important foraging and nesting habitat for hawksbills. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting in these areas is rare. Hawksbills have been recorded from all U.S. states adjacent to the Gulf of Mexico and along the east coast of the U.S. as far north as Massachusetts, although sightings north of Florida are rare. Aside from Florida, Texas is the only other U.S. state where hawksbills are sighted with any regularity. Since the scallop fishery does not operate in waters that are typically used by hawksbill sea turtles, it is highly unlikely that the fishery will adversely affect this sea turtle species. We have reviewed all available observer records from the NEFOP and there have been no observed captures of hawksbill sea turtles in scallop dredge, trawl, or any other gear when the primary trip or haul target was scallop. Because there are no proposed changes to the scallop fishery that would increase the likelihood of interactions between hawksbills and this fishery, we do not anticipate any future interactions. Because of this, effects to hawksbill sea turtles from this fishery are highly unlikely and therefore discountable.

Right and fin whales occur in Mid-Atlantic and New England waters over the continental shelf. Sei whales are generally restricted to continental shelf edge-slope waters greater than 200 meters in depth (Horwood 2002; Hayes et al. 2017). All three of these species follow a similar, general pattern of foraging at high latitudes (e.g., southern New England and Canadian waters) in the spring and summer months and calving in lower latitudes (i.e., off of Florida for right whales) in the winter months (CeTAP 1982; Hain *et al.* 1992; Clark 1995; Perry *et al.* 1999; Horwood 2002; Kenney 2002). Based on this information, the scallop fishery may overlap with the distribution of these three large whale species during part of each year, particularly in Mid-Atlantic waters in the early spring and fall, and in southern New England waters in the spring and summer. One interaction between a large whale and scallop fishing gear is known to have occurred. In 1983, a humpback whale became entangled in the cables of scallop dredge gear off of Chatham, Massachusetts. Nevertheless, we have determined that this was a unique and very rare event that is extremely unlikely to reoccur given that large whales have the speed and maneuverability to get out of the way of oncoming scallop fishing gear and vessels. Also, observer coverage of many fishing trips using mobile gear (e.g., dredge and trawl gear) has shown that these gear types do not pose a reasonable risk of entanglement or capture for ESA-listed large whales. Therefore, we conclude that these three large whales are extremely unlikely to interact with gear or vessels used in the scallop fishery and effects are therefore discountable.

We have also determined that any effects of the authorization of the scallop fishery on the availability of prey for fin and sei whales will be insignificant and discountable. Like right whales, sei whales feed on copepods (Perry *et al.* 1999). The scallop fishery will not affect the availability of copepods for foraging sei whales because copepods are very small organisms that will pass through scallop fishing gear rather than being captured in it. Dense aggregations of late stage and diapausing *Calanus finmarchicus* in the Gulf of Maine and Georges Bank region will not be affected by the scallop fishery. In addition, the physical and biological conditions and structures of the Gulf of Maine and Georges Bank region and the oceanographic conditions in Jordan, Wilkinson, and Georges Basin that aggregate and distribute *Calanus finmarchicus* are not affected by the scallop fishery. Fin whales feed on krill as well as small schooling fish (*e.g.*, sand lance, herring, and mackerel) (Aguilar 2002). Scallop fishing gear operates on or very near the bottom. Fish species caught in scallop gear are species that live in benthic habitat (on or very near the bottom) such as flounders versus schooling fish such as herring and mackerel that occur within the water column. Therefore, the authorization of the scallop fishery will not affect the availability of prey for foraging fin whales. In addition, the scallop fishery does not operate in low latitude waters where the overwhelming majority of calving and nursing occurs for these large whale species (Aguilar 2002; Horwood 2002). Therefore, the authorization of the scallop fishery will not affect the oceanographic conditions that are conducive for calving and nursing. Based on this analysis, the authorization of the scallop fishery is not likely to adversely affect prey species or important feeding and calving habitats for fin or sei whales.

Blue whales do not regularly occur in waters of the U.S. EEZ (Waring *et al.* 2012; Lesage 2018). In the North Atlantic, blue whales are most frequently sighted in the Gulf of St. Lawrence from April to January (Sears 2002). Over the last 48 years, there have only been 42 sightings of blue whales in waters of the U.S. EEZ from Maine to Key West, Florida, reported in OBIS SEAMAP (http://seamap.env.duke.edu/). This is less than one blue whale sighting per year within the action area. In a recent study on the seasonal acoustic occurrence of whales in the New York Bight, researchers detected blue whales, using passive acoustic monitoring, on 11% of the survey days (Muirhead *et al.* 2018). The whales were detected from January to March and detections increased with recorder distance from shore, suggesting that the individuals occurred to the seaward, offshore end of the recording array (which extended to the shelf edge) or beyond. A single blue whale was also tracked moving south-southwest along the shelf edge (Muirhead *et al.* 2018). Calving for the species occurs in low latitude waters outside of the area where the scallop fishery operates. Blue whales feed on euphausiids (krill) (Sears 2002) which are too small to be captured in scallop fishing gear. Given that the species is unlikely to occur in areas where the scallop fishery operates (i.e., limited co-occurrence), and that the fishery will not affect the availability of blue whale prey or areas where calving and nursing of young occurs, we have determined that the effects from the authorization of the scallop fishery on blue whales are extremely unlikely. This conclusion is further supported by the fact that there have been no observed or documented U.S. Atlantic fishery-related mortalities or serious injuries to blue whales to date (Henry *et al.* 2017, Henry *et al.* 2015, 2016, Henry *et al.* 2019, Waring *et al.* 2010). Based on this information, the effects of the scallop fishery on blue whales are extremely unlikely and therefore discountable.

Unlike blue whales, sperm whales do regularly occur in waters of the U.S. EEZ. However, the distribution of the sperm whale in the U.S. EEZ occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring *et al.* 2012). In contrast, the scallop fishery operates primarily in continental shelf waters. The average water depth of sperm whale sightings observed during the CeTAP surveys was 1,792 meters (CeTAP 1982). Female sperm whales and young males almost always inhabit waters deeper than 1,000 meters and at latitudes less than 40° N (Whitehead 2002). Sperm whales feed on larger organisms that inhabit the deeper ocean regions (Whitehead 2002). Calving for the species occurs in low latitude waters outside of the area where the scallop fishery operates. Given that sperm whales are unlikely to occur in areas (based on water depth) where the scallop fishery operates, and that the fishery will not affect the availability of sperm whale prey or areas where calving and nursing of young occurs, we have determined that the effects from the authorization of the scallop fishery on sperm whales are extremely unlikely, and therefore, the fishery is not likely to adversely affect sperm whales.

Globally, the main threat to giant manta rays is commercial fishing. Giant manta rays are targeted and caught as bycatch in a number of fisheries throughout their range, with high rates of removal from industrial purse-seine and artisanal gillnet fisheries (83 FR 2916; January 22, 2018). These mortalities generally occur outside the action area and involve gear types not used by the scallop fishery.

Information on population sizes and distribution of giant manta rays in the Atlantic is lacking. While giant manta rays in the Atlantic have been confirmed as far north as offshore around the Hudson Canyon region near Long Island, New York (Normandeau Associates and APEM Ltd 2017; as cited in 84 FR 66652), the species is considered rare north of Cape Hatteras, North Carolina. Bycatch of giant manta rays in the Atlantic Ocean has been observed in purse-seine, trawl, and longline fisheries; however, as was noted in a study by Oliver et al. (2015); as cited in Miller and Klimovich (2017), based on the available data, giant manta rays do not appear to be a significant component of the bycatch. Based on NEFOP data for the period 2010-2019, two giant manta rays were observed in bottom trawl gear (both in 2014), but neither were in gears identified as scallop trawls or where scallops were the target or primary landed species. Considering that the volume and extent of scallop fishing in the action area is much lower than other trawl fisheries, especially in the southern Mid-Atlantic near North Carolina, giant manta rays are extremely unlikely to be captured in the scallop fishery. For this reason, the fishery may affect but is not likely to adversely affect giant manta rays as all effects are discountable.

In the western Atlantic, oceanic whitetip sharks occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. It is a highly migratory species that is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands (Bonfil *et al.* 2008, Young *et al.* 2017). The species can be found in waters temperatures between 15°C and 28°C, but it exhibits a strong preference for the surface mixed layer in water with temperatures above 20°C (Bonfil *et al.* 2008) and is considered a surface-dwelling shark. Little is known about movements or possible migration paths (Young *et al.* 2017). Currently, the most significant threat to oceanic whitetip sharks is mortality in commercial fisheries, largely driven by demand of the international shark fin trade and bycatch-related mortality, as well as illegal, unreported, and unregulated fishing. Oceanic whitetip sharks are generally not targeted, but they are frequently caught as bycatch in many global fisheries, including pelagic longline fisheries targeting tuna and swordfish, purse seine, gillnet, and artisanal fisheries (Young *et al.* 2017).

Although bottom tending gears utilized in the scallop fishery have the potential to interact with oceanic whitetip sharks, these sharks are typically found farther offshore in the open ocean, on the continental shelf, or around oceanic islands in deep water greater than 184 meters. They have a strong preference for the surface mixed layers in waters warmer than 20°C (Young *et al.* 2017). Given the offshore distribution of oceanic whitetip sharks, little overlap between scallop fishing gear and oceanic whitetip sharks is expected. As a surface-dwelling species, oceanic whitetip sharks are unlikely to interact with gears that are fished deeper in the water column such as bottom trawls and dredges. In addition, there have not been any observed interactions between the scallop fishery and oceanic whitetip sharks (NEFSC observer/sea sampling database, unpublished data) since the beginning of the observer program in 1989. Given their offshore distribution and the diffuse vessel traffic, of which a limited number of vessels are scallop fishing vessels, it is also extremely unlikely that there will be interactions between oceanic white tip sharks and the vessels in this Opinion. Given this information and the pelagic surface-dwelling nature of oceanic whitetip sharks, it is extremely unlikely and, therefore, discountable that the scallop fishery would interact with oceanic whitetip sharks.

We have determined that the action considered in the Opinion is not likely to adversely affect designated critical habitat for North Atlantic right whales (Figure 5). The two areas designated as critical habitat contain approximately 29,763 square nautical miles of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1, Northeastern U.S. Foraging Area) and off the Southeast U.S. coast (Unit 2, Southeastern U.S. Calving Area) (81 FR 4838, January 27, 2016). The scallop fishery only overlaps with Unit 1 of the critical habitat. Specifically, we considered whether the scallop fishery is likely to affect the essential physical or biological features (PBFs) that afford the designated area overall value for the conservation of North Atlantic right whales.

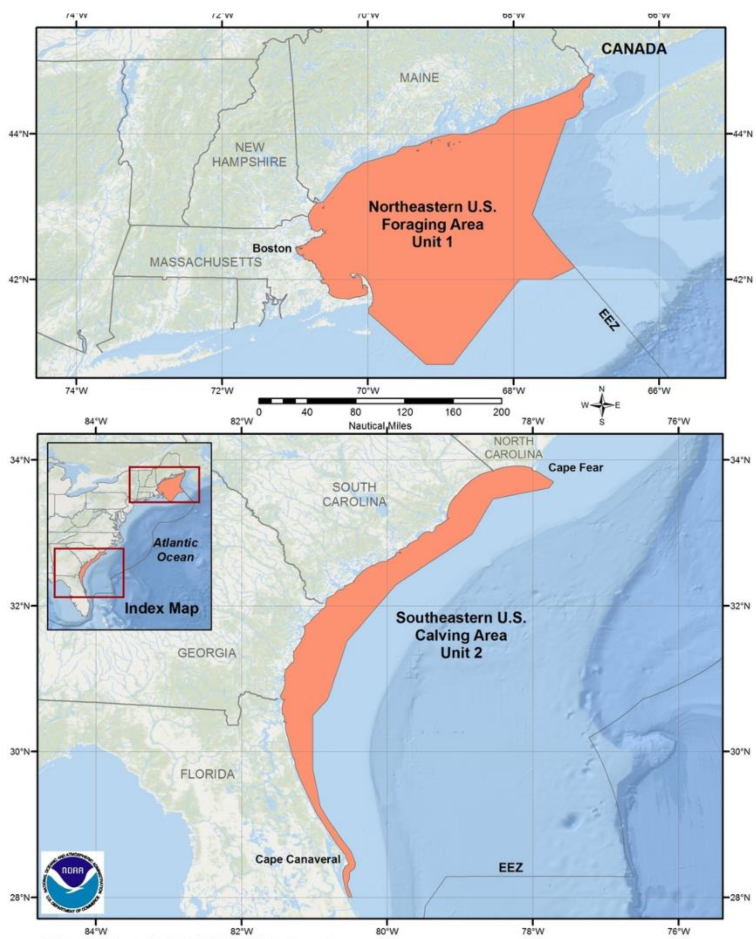

Figure 5. North Atlantic right whale critical habitat.

The Northeastern U.S. foraging habitat (Unit 1) is defined by the distribution, aggregation and retention of *Calanus finmarchicus*, the primary and preferred prey of North Atlantic right whales (NMFS 2015c). The essential physical features identified in the final rule include prevailing currents, bathymetric features (such as basins, banks, and channels), oceanic fronts, density gradients, and flow velocities. The essential biological features include dense aggregations of copepods, specifically late stage *C. finmarchicus* in the Gulf of Maine and Georges Bank region, as well as aggregations of diapausing (overwintering) populations in the deep basins of the region (i.e., Jordan, George's, and Wilkinson basins) as these populations of *C. finmarchicus* serve as source populations for the overall Gulf of Maine population (Johnson *et al.* 2006, Lynch *et al.* 1998, Meise and O'Reilly 1996). It should also be noted that based on changes in right whale and *C. finmarchicus* distributions since 2010, the continental shelf south of New England and the Gulf of Saint Lawrence in Canada (Khan *et al.* 2018, Record *et al.* 2019) (https://fish.nefsc.noaa.gov/psb/surveys/MapperiframeWithText.html) have become increasingly important foraging habitats for North Atlantic right whales indicating that important prey sources may also be present outside of the designated critical habitat area.

In designating critical habitat, NMFS evaluated and identified activities that may destroy or adversely modify the essential physical and biological features (NMFS 2015b, c). This analysis evaluated whether fishing activity will adversely affect the late-stage dense *C. finmarchicus* aggregations that trigger right whale foraging behavior, the overwintering populations of *C. finmarchicus* in deep water basins, or the physical and oceanographic features that allow these deep water populations to supply the Gulf of Maine *C. finmarchicus* population. It is extremely unlikely that fishing vessels will have any potential to affect the essential biological and physical oceanographic features (i.e., currents, temperature, and bathymetry) of critical habitat. Therefore, the analysis focuses on fishing gears used in the scallop fishery (i.e., dredges and bottom trawls).

Copepods are extremely small organisms that will pass through or around the fishing gears rather than being captured on or in them. In addition, turbidity created from fishing activities is, as described below, expected to be temporary in nature and will not impact the long-term viability of copepod aggregations. While fishing activities may temporarily disturb localized copepod concentrations, this disturbance is not expected to significantly change the quality or quantity of the aggregations to a degree that will impact the conservation of right whales. In addition, any effects from fishing gear on the environment in areas right whales are present are further limited by the requirement that gear not be set within 500 yards of the sighted right whales (50 CFR 224.103(c)), avoiding localized disturbance of copepod populations on which the whales may be feeding. Haulbacks should also not be initiated if right whales are sighted within, or close to, 500 yards from the vessel. However, if haulback operations are initiated and a right whale subsequently approaches the vessel, under most circumstances, the haulback should be completed because of safety concerns and requirements for safe vessel operation (62 FR 6729, February 14, 1997).

Bottom-tending mobile gear, such as trawls and dredges, have the potential to temporarily disturb resting copepod populations found in deep water basins as the gear moves through areas where the aggregations occur and temporarily increases turbidity. However the effect of this sediment resuspension is likely minimal for several reasons. First, while fine sediment may take up to 24 hours to resettle, the plumes created by bottom trawling are "laterally advected some distance by tidal currents before settling" (Pilskaln *et al.* 1998). This dispersal would result in lower concentrations of sediment spread out over a larger area, and the localized turbidity would likely be temporary. Additionally, the Gulf of Maine, particularly Wilkinson and Jordan Basin, already has a pervasive "nepheloid layer" (i.e. a layer of water containing suspended sediment) that can reach between 20-40 meters in thickness (Pilskaln *et al.* 1998) so it is expected that any copepod aggregation in those areas is adapted to a highly turbid environment.

As *C. finmarchicus* enter the pre-adult stage, if they build enough lipid stores, they may enter a suspended state of development (diapause) as they retreat to depths where they remain neutrally buoyant. Emergence from diapause is synchronized to allow *C. finmarchicus* or their progeny access to favorable environmental conditions, typically phytoplankton produced during the spring bloom (Baumgartner and Tarrant 2017). The cues triggering the termination of the diapausing state are not clearly understood, however, hypotheses include light and photoperiod cues or the "existence of an endogenous long-range timer that arouses copepods from diapause after some period of time has elapsed (Campbell *et al.* 2004, Hirche 1996, Miller *et al.* 1991). Given that diapause is triggered and maintained; it is unlikely that plumes would disturb Calanus when they are in this state of suspended growth. These plumes are also not expected to have an impact energy stores and temperature/light sensitivity that keep these zooplankton in their overwintering state at depth. This is considered an adaptive strategy that allows the zooplankton to suspend development until conditions are optimal for reproductive success. A portion of the pre-adult population will not retreat to depths and instead will molt into adult stages and reproduce prior to the emergence of the diapausing population if conditions allow (though there is a chance that the conditions will not be favorable) (Baumgartner and Tarrant 2017). These alternative survival strategies allow for maximum productivity and continuous replenishment of the stock with varying environmental conditions.

Bottom-tending mobile gear may also impact resting copepod eggs by increasing mortality of eggs that come into contact with the gear or decreasing the eggs' chances of hatching if it is re-suspended by the plume (Drillet *et al.* 2014). On the other hand, the resuspension of the eggs into the water column may also potentially increase recruitment back into the water column (Drillet *et al.* 2014). This trade-off is not well understood, and it is not clear how these impacts differ from natural "bioturbation or storm events under different environmental conditions" (Drillet *et al.* 2014). There is also no indication of what role sitting eggs play in the overall population recruitment in the Gulf of Maine. A significant supply of the Gulf of Maine's *C. finmarchicus* population found in Jordan and George's Basins are supplied from the Scotian Shelf and Scotian Slope waters (Johnson *et al.* 2006, Miller *et al.* 1998) with only Wilkinson's Basin restocking internally (Johnson *et al.* 2006). Given these multiple sources for *Calanus*, it is unlikely that any localized decrease in hatching success of resting or re-suspended eggs would affect the population at-large or to a degree, that meets the destruction or adverse modification threshold for designated critical habitat as a whole.

It should be noted that when designating critical habitat, NMFS's assessment of activities that may destroy or adversely modify the essential physical and biological features considered dredging. However, in that analysis, "dredging" referred to the removal of material from the bottom of water bodies to deepen, widen, or maintain navigation corridors, anchorages, or berthing areas, as well as sand mining (NMFS 2015b, c). Dredges typically used for navigational deepening or sand mining operations include hopper and cutterhead dredges. Although dredge size varies by location, hydraulic hopper dredges have draghead widths from a few feet to 12 feet; cutterhead diameters typically range from 16-20 inches (maximum 36 inches). These dredges disturb the sediment surface (down to 12 or more inches) creating turbidity plumes that last up to a few hours. In contrast, scallop dredges ride above the substrate surface, creating turbulence that stirs up the substrate and kicks scallops up and into the bag. The shoes on the dredge are in contact and ride along the surface. Dredges range is width from 5.5 to approximately 15 feet. They are used in high and low energy sand environments and high energy gravel environments (NREFHSC (Northeast Region Essential Fish Habitat Steering Committee) 2002). As described above, turbidity from scallop dredges is expected to minimal. Navigational/sand mine dredging has not been found to limit the recovery of North Atlantic right whale (NMFS 2017a) or their critical habitat (NMFS 2015b). Based on this, we have determined that the best available information indicates that dredging associated with commercial fishing activities does not adversely affect right whale critical habitat.

Based on the above, we have determined that the effects of the fishing gears and vessels used by the scallop fishery on the availability of copepods for foraging right whales are likely so small that they cannot be meaningfully measured, detected, or evaluated, and are therefore insignificant. In addition, as noted above, it is extremely unlikely that the authorization of fishing gears and vessels will affect the large-scale physical oceanographic conditions in the Gulf of Maine. As a result, the effects of the authorization of the scallop fishery on those physical features are discountable. Because the effects of the scallop fishery on PBFs that characterize the feeding habitat for North Atlantic right whales are all insignificant and discountable, the authorization of the scallop fishery is not likely to adversely affect this critical habitat.

We have determined that the action in this Opinion is not likely to adversely affect designated critical habitat for the NWA DPS of loggerhead sea turtles. Critical habitat is designated for nesting beaches and 38 occupied areas within the at-sea range of the NWA DPS (79 FR 29755, July 10, 2014; 79 FR 39856, July 10, 2014). These marine areas in the Atlantic Ocean contain one or a combination of nearshore reproductive habitat, overwintering habitat, breeding habitat, migratory habitat, and *Sargassum* habitat (Figure 6). There is limited overlap of NWA DPS critical habitat and the scallop fishery. Setting and hauling gear and fishing vessel movements are not expected to significantly alter the physical or biological features of the critical habitat areas to levels that would affect life history patterns of individual turtles or the health of prey species found in these habitats.

The constricted migratory habitat is high use migratory corridors that are limited in width by land on one side and the edge of the continental shelf and Gulf Stream on the other. Primary constituent elements (PCEs) that support this habitat are (1) constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory passage and (2) passage conditions that allow for migration to/from nesting, breeding, and/or foraging areas (NMFS (National Marine Fisheries Service) 2013). Migratory habitat in the Atlantic includes areas off North Carolina and Florida. However, scallop dredge and trawl gears deployed in migratory habitat areas fluctuate in time and space and are not permanent obstructions. We do not expect the gears used in the scallop fishery to meaningfully alter the passage conditions that allow for migration to/from nesting, breeding, and foraging habitats.

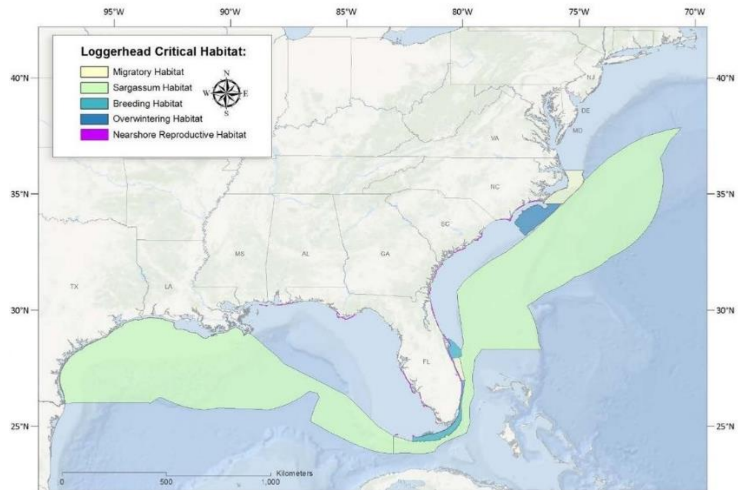

Figure 6. Loggerhead sea turtle critical habitat.

Sargassum habitat is important to various life stages of loggerheads, particularly post-hatchlings. Generally, the *Sargassum* habitat included in the designation and occurring in the action area is along the Atlantic coast from the western edge of the Gulf Stream eastward. PCEs that support this habitat include (1) convergence zones, surface-water downwelling (movement of denser water downward in the water column) areas, major current margins and other locations where there are concentrated components of the *Sargassum* community in suitable water temperatures; (2) *Sargassum* in concentrations to support adequate prey abundance; (3) available prey and other material associated with *Sargassum* habitat; and (4) sufficient water depth and proximity to available currents to ensure offshore transport and forage and cover requirements for post-hatchling loggerheads. In designating critical habitat, NMFS identified possible activities that may require special management considerations; commercial fishing activities were not included (79 FR 39856, July 10, 2014). While commercial fishing gear may have some interactions with *Sargassum* during deployment and retrieval (e.g., *Sargassum* could become entangled/ensnared in the mesh or structure of the gear itself), the effects are expected to be temporary and isolated in nature and, because of the fluid nature of the pelagic environment, recovery time is rapid (79 FR 39856, July 10, 2014). The scallop fishery does not affect water depths, currents, convergence zones, downwelling areas, major current margins or other locations with concentrated components of the *Sargassum* community in any way. While vessels may transit the areas, any disruption of *Sargassum* habitat is not anticipated to be of a sufficient magnitude to significantly affect the distribution of *Sargassum* mats. In addition, the fishery will not affect the availability of loggerhead prey or other material associated with *Sargassum* because it does not target or harvest smaller prey species or *Sargassum* and the amount of *Sargassum* removed through entanglement/ensnarement in the gear itself is likely to be minimal.

4.2 Species Likely to be Adversely Affected by the Proposed Action

This section examines the status of each species that are likely to be adversely affected (Table 5) by the proposed action. Under the ESA, species include any subspecies of any species and any distinct population segment of any species of vertebrate fish or wildlife that interbreeds when mature. This section considers the species as listed under the ESA, which may be globally or as a DPS. The status includes the current level of risk that the ESA-listed species face, based on factors considered in documents such as recovery plans, status reviews, and listing decisions. This section helps detail the species' current "reproduction, numbers, or distribution," which is considered in the jeopardy determination as described in 50 CFR. §402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology, is in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on NMFS' website: (https://www.fisheries.noaa.gov/species-directory/threatened-endangered), among others.

4.2.1 Sea Turtles

Leatherback and Kemp's ridley sea turtles are currently listed under the ESA at the species level, while loggerhead and green sea turtles are listed at the DPS level. Therefore, we are including information on the range-wide status of leatherback and Kemp's ridley sea turtles to provide the overall status of those species. Information on the status of loggerhead and green sea turtles is for the specific DPS affected by the proposed action (NWA DPS for loggerheads, North Atlantic DPS for greens). Additional background information on the status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (Conant *et al.* 2009, Hirth 1997, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1995, Seminoff *et al.* 2015, TEWG (Marine Turtle Expert Working Group) 1998, 2000, 2007, 2009) and recovery plans and five-year reviews for the loggerhead sea turtle (Bolten *et al.* 2019, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008), Kemp's ridley sea turtle (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015, NMFS (National Marine Fisheries Service) *et al.* 2011), green sea turtle (NMFS and USFWS 1991), and leatherback sea turtle (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992, 1998a, 2013).

4.2.1.1 Loggerhead sea turtle – NWA DPS

Loggerhead sea turtles are circumglobal and are found in the temperate and tropical regions of the Atlantic, Indian, and Pacific Oceans. The loggerhead is distinguished from other sea turtles by its reddish-brown carapace, large head, and powerful jaws. The species was first listed as threatened under the ESA in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and U.S. FWS designated nine DPSs of loggerhead sea turtles, with the NWA DPS listed as threatened (76 FR 58868). The NWA DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 7).

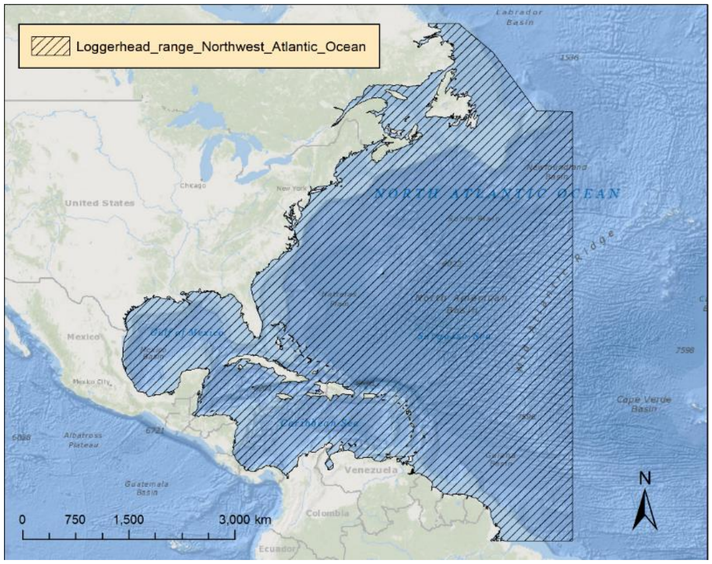

Figure 7. Range of the NWA DPS of loggerhead sea turtles.

We used information available in the 2009 status review (Conant *et al.* 2009), the final listing rule (76 FR 58868, September 22, 2011), the relevant literature, and recent nesting data from the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Nesting occurs on beaches where warm, humid sand temperatures incubate the eggs. Northwest Atlantic females lay an average of five clutches per year. The annual average clutch size is 115 eggs per nest. Females do not nest every year. The average remigration interval is three years. There is a 54% emergence success rate (Conant *et al.* 2009). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Loggerheads spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in coastal waters. Some juveniles may periodically move between the oceanic zone and coastal waters (Bolten 2003, Conant *et al.* 2009, Mansfield 2006, Morreale and Standora 2005, Witzell 2002). Coastal waters provide important foraging, inter-nesting, and migratory habitats for adult loggerheads. In both the oceanic zone and coastal waters, loggerheads are primarily carnivorous, although they do consume some plant matter as well (Conant *et al.* 2009). Loggerheads have been documented to feed on crustaceans, mollusks, jellyfish and salps, and algae (Bjorndal 1997, Donaton *et al.* 2019, Seney and Musick 2007).

Avens et al. (2015) used three approaches to estimate age at maturation. Mean age predictions associated with minimum and mean maturation straight carapace lengths were 22.5-25 and 36-38 years for females and 26-28 and 37-42 years for males. Male and female sea turtles have similar post-maturation longevity, ranging from 4-46 (mean 19) years (Avens *et al.* 2015).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. MtDNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71%-88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010). LaCasalla et al. (2013) found that loggerheads, primarily juveniles, caught within the Northeast Distant (NED) waters of the North Atlantic mostly originated from nesting populations in the southeast U.S. and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2%), primarily from the large eastern Florida rookeries. There was little evidence of contributions from the South Atlantic, Northeast Atlantic, or Mediterranean DPSs (LaCasella *et al.* 2013).

A more recent analysis assessed sea turtles captured in fisheries in the Northwest Atlantic and included samples from 850 turtles (including 24 caught during fisheries research) caught from 2000-2013 in coastal and oceanic habitats (Stewart *et al.* 2019). The turtles were primarily captured in pelagic longline and bottom otter trawls. Other gears included bottom longline, hook and line, gillnet, dredge, and dip net. Turtles were identified from 19 distinct management units; the western Atlantic nesting populations were the main contributors with little representation from the Northeast Atlantic, Mediterranean, or South Atlantic DPSs (Stewart *et al.* 2019). There was a significant split in the distribution of small (≤63 cm straight carapace length [SCL]) and large (>63 cm SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44%±15%) and the northern U.S. management units (33%±16%); small turtles came from central east Florida (64%±14%). South of Cape Hatteras, large turtles came mainly from central east Florida (52%±20%) and southeast Florida (41%±20%); small turtles came from southeast Florida (56%±25%). The authors concluded that bycatch in the western North Atlantic would affect the Northwest Atlantic DPS almost exclusively (Stewart *et al.* 2019).

Population Dynamics
A number of stock assessments and similar reviews (Conant *et al.* 2009, Heppell *et al.* 2005, NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center) 2001, 2009, Richards *et al.* 2011, TEWG (Marine Turtle Expert Working Group) 1998, 2000, 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size. As with other species, counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

Based on genetic analysis of nesting subpopulations, the NWA DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant *et al.* 2009). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct (Shamblin *et al.* 2014). The recent genetic analyses suggest that the NWA DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin *et al.* 2012).

The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). Using data from 2004-2008, the adult female population size of the DPS was estimated at 20,000 to 40,000 females (NMFS SEFSC (National Marine

Fisheries Service Southeast Fisheries Science Center) 2009). More recently, Ceriani and Meylan (2017) reported a five-year average (2009-2013) of more than 83,717 nests per year in the southeast U.S. and Mexico (excluding Cancun (Quintana Roo, Mexico). These estimates included sites without long-term (≥10 years) datasets. When they used data from 86 index sites (representing 63.4% of the estimated nests for the whole DPS with long-term datasets, they reported 53,043 nests per year. Trends at the different index nesting beaches ranged from negative to positive. In a trend analysis of the 86 index sites, the overall trend for the NWA DPS was positive (+2%) (Ceriani and Meylan 2017). Uncertainties in this analysis include, among others, using nesting females as proxies for overall population abundance and trends, demographic parameters, monitoring methodologies, and evaluation methods involving simple comparisons of early and later five-year average annual nest counts. However, the authors concluded that the subpopulation is well monitored and the data evaluated represents 63.4 % of the total estimated annual nests of the subpopulation and, therefore, are representative of the overall trend (Ceriani and Meylan 2017).

About 80% of loggerhead nesting in the southeast U.S. occurs in six Florida counties (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). The Peninsula Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the NWA DPS (Ceriani and Meylan 2017, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). As described above, FWRI's Index Nesting Beach Survey (INBS) collects standardized nesting data. The index nest counts for loggerheads represent approximately 53% of known nesting in Florida. There have been three distinct intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2019) (Figure 8). At core index beaches in Florida, nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In 2019, more than 53,000 nests were documented (Figure 8). The nest counts in Figure 9 represent peninsular Florida and do not include an additional set of beaches in the Florida Panhandle and southwest coast that were added to the program in 1997 and more recent years. Nest counts at these Florida Panhandle index beaches have an upward trend since 2010 (Figure 9 9).

The annual nest counts on Florida's index beaches fluctuate widely, and we do not fully understand what drives these fluctuations. In assessing the population, Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Trends by recovery unit were variable.

The Peninsular Florida Recovery Unit (PFRU) extends from the Georgia-Florida border south and then north (excluding the islands west of Key West, Florida) through Pinellas County on the west coast of Florida. Annual nest counts from 1989 to 2020 ranged from a low of 28,876 in 2007 to a high of 65,807 in 2016 (Bolten *et al.* 2019, FFWCC 2021). An increase in the number of loggerhead nests in the PFRU has been observed since 2007 and long-term nesting data from 1989-2020 reveal a complex pattern with three distinct phases: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2020) (FFWCC 2021). The recovery team cautions that using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten *et al.* 2019).

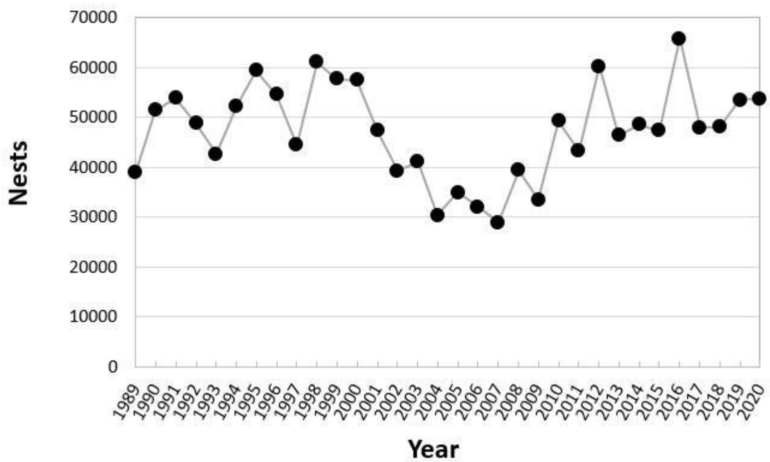

Figure 8. Annual nest counts for loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2020. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

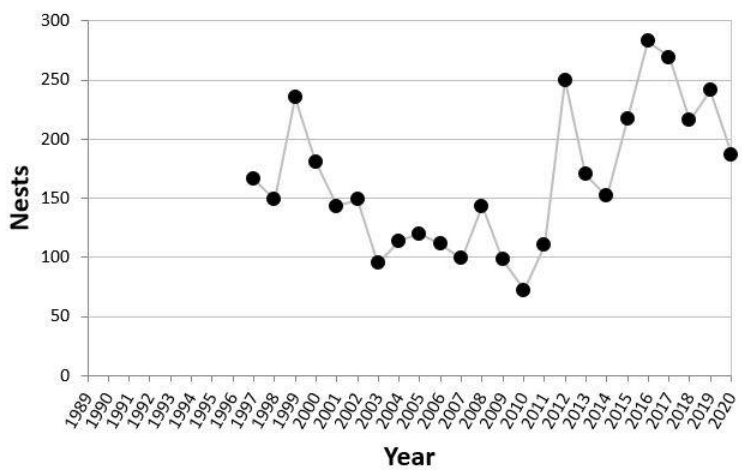

Figure 9. Annual nest counts on index beaches in the Florida Panhandle, 1997-2020. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

The Northern Recovery Unit (NRU), ranging from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS. Annual nest totals for this recovery unit from 1983 to 2019 have ranged from a low of 520 in 2004 to a high of 5,555 in 2019 (Bolten *et al.* 2019). From 2008 to 2019, counts have ranged from 1,289 nests in 2014 to 5,555 nests in 2019 (Bolten *et al.* 2019). Nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% (Bolten *et al.* 2019).

The Dry Tortugas Recovery Unit (DTRU) includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas recovery unit (Ceriani *et al.* 2019, Ceriani and Meylan 2017), which accounts for less than 1% of the NWA DPS (Ceriani and Meylan 2017).

The Northern Gulf of Mexico Recovery Unit (NGMRU) is defined as loggerheads originating from beaches in Franklin County on the northwest Gulf coast of Florida through Texas. From 1995 to 2007, there were an average of 906 nests per year on approximately 300 kilometers of beach in Alabama and Florida, which equates to about 221 females nesting per year (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). Annual nest totals for this recovery unit from 1997-2018 have ranged from a low of 72 in 2010 to a high of 283 in 2016 (Bolten *et al.* 2019). Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult because of changed and expanded beach coverage. However, there are now over 20 years of Florida index nesting beach survey data. A number of trend analyses have been conducted. From 1995 to 2005, the recovery unit exhibited a significant declining trend (Conant *et al.* 2009, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). Nest numbers have increased in recent years (Bolten *et al.* 2019) (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten *et al.* 2019).

The Greater Caribbean Recovery Unit (GCRU) encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita *et al.* 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart *et al.* 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013.

Status

Fisheries bycatch is the highest threat to the NWA DPS of loggerhead sea turtles (Conant *et al.* 2009). Other threats include boat strikes, marine debris, coastal development, habitat loss, contaminants, disease, and climate change. Nesting trends for each of the loggerhead sea turtle recovery units in the NWA DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Critical Habitat

Critical habitat for the NWA DPS of loggerhead sea turtles was described earlier in section 4.0 and we have determined that the proposed action is not likely to adversely affect it.

Recovery Goals
The recovery goal for the NWA DPS of loggerheads is to ensure that each recovery unit meets its recovery criteria alleviating threats to the species so that protection under the ESA are not needed. The recovery criteria relate to the number of nests and nesting females, trends in abundance on the foraging grounds, and trends in neritic strandings relative to in-water abundance. The 2008 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads includes the complete delisting criteria (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008).

Delisting criteria include:

1. Each recovery unit has recovered to a viable level and has increased for at least one generation. By recovery unit, over a 50-year period, the annual rate of increase is greater than or equal to 2% resulting in at least 14,000 nests annually for the Northern Recovery Unit; greater than or equal to 1% resulting in 106,100 nests annually for the Peninsular Florida Recovery Unit; greater than or equal to 3% resulting in at least 1,100 nests for the Dry Tortugas Recovery unit; and greater than or equal to 3% resulting in at least 4,000 nests annually for the Northern Gulf of Mexico Recovery Unit. For the Greater Caribbean Recovery Unit, the demographic criteria specifies that the total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually, has increased over 50 years.
2. The increases in the number of nests for each recovery unit must be a result of corresponding increases in the number of nesting females.
3. A network of in-water sites across the foraging range is established and measure abundance. A composite estimate of relative abundance from these sites is increasing for at least one generation.
4. Stranding trends are not increasing at a rate greater than the in-water relative abundance trends for similar age classes for at least one generation.
5. Listing factor recover criteria include criteria related to maintenance and protection of nesting habitat; development and implementation of a strategy to protect marine habitats important to loggerheads; implementation of nest protection strategies; elimination of legal harvest; reduction of nest predation; implementing legislation to ensure long-term protection of loggerheads and their habitats; implementation of strategies to reduce fisheries bycatch, marine debris ingestion and entanglement, and vessel strikes.

The recovery objectives to meet these goals include:

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.

9. Develop and implement local, state, federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

4.2.1.2 Leatherback sea turtle

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 10).

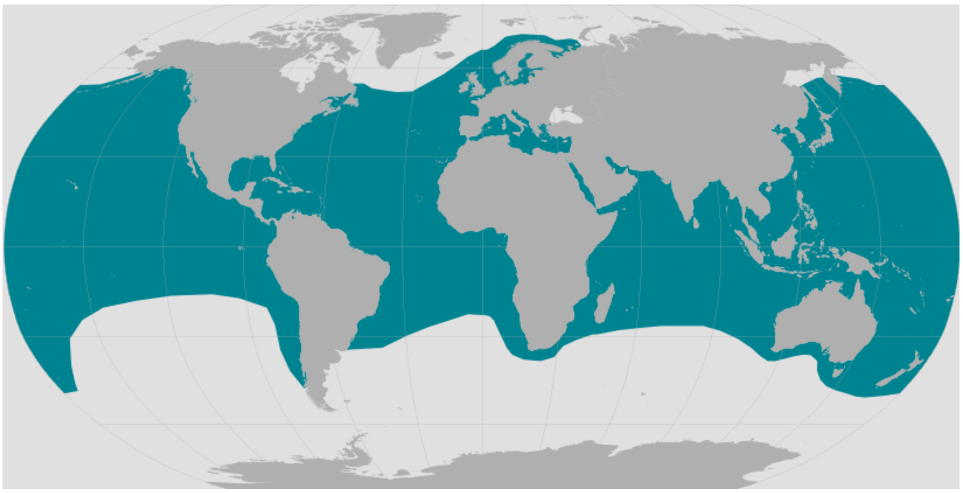

Figure 10. Range of the leatherback sea turtle. From NMFS https://www.fisheries.noaa.gov/species/leatherback-turtle).

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their plastron. The species was first listed under the Endangered Species Conservation Act (35 FR 8491, June 2, 1970) and has been listed as endangered under the ESA since 1973. In 2020, seven leatherback subpopulations that met the discreteness and significance criteria of a DPS were identified (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The subpopulation found within the action is area is the Northwest Atlantic DPS (Figure 11). NMFS and U.S. FWS concluded that the seven subpopulations, which met the criteria for DPSs, all met the definition of an endangered species. However, NMFS and U.S. FWS determined that the listing of DPSs was not warranted and leatherbacks continue to be listed at the global level (85 FR 48332, August 10, 2020). Even though listing as DPSs was not appropriate, the analysis in this Opinion looks at the range-wide and subpopulation statuses of the species and the subpopulations we describe align with the seven DPSs considered in the 2020 status review. We used information available in the most recent five-year review (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013), the critical habitat designation (44 FR 17710, March 23, 1979), the 2020 status review (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020), relevant literature, and recent nesting data from the FWRI to summarize the life history, population dynamics, and status of the species, as follows.

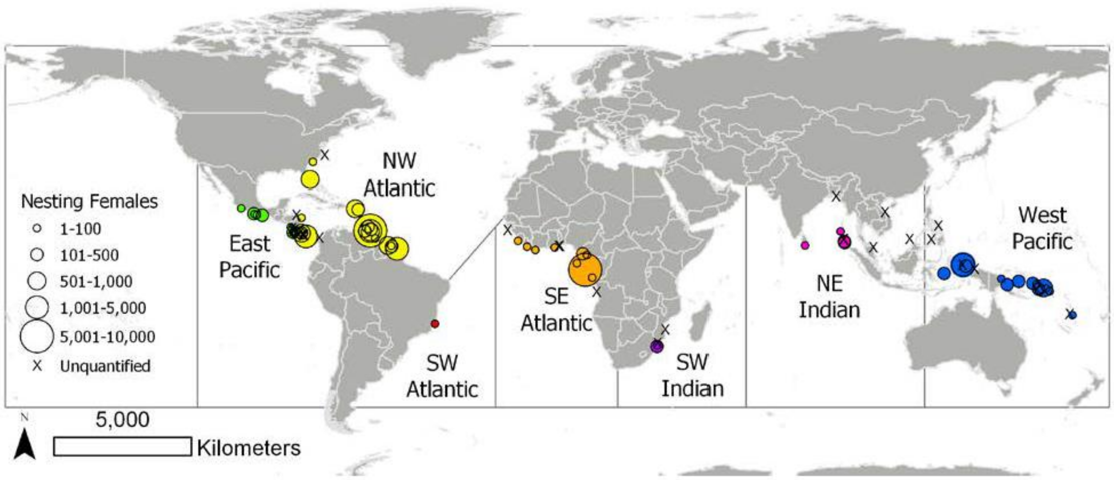

Figure 11. Leatherback sea turtle DPSs and nesting beaches (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Life History

Leatherbacks are a long-lived species. Preferred nesting grounds are in the tropics; though, nests span latitudes from 34°S in western Cape, South Africa to 38°N in Maryland (Eckert *et al.* 2012, Eckert *et al.* 2015). Females lay an average of five to seven clutches (range: 1-14 clutches) per season, with 20 to over 100 eggs per clutch (Eckert *et al.* 2012, Reina *et al.* 2002, Wallace *et al.* 2007). The average clutch frequency for the Northwest Atlantic DPS is 5.5 clutches per season (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). In the western Atlantic, leatherbacks lay about 82 eggs per clutch (Sotherland *et al.* 2015). Remigration intervals are 2-4 years for most populations (range 1-11 years) (Eckert *et al.* 2015, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020); the remigration interval for the Northwest Atlantic DPS is approximately three years (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergence success) is approximately 50% worldwide (Eckert *et al.* 2012).

Age at sexual maturity has been challenging to obtain given the species physiology and habitat use (Avens *et al.* 2019). Past estimates ranged from 5-29 years (Avens *et al.* 2009, Spotila *et al.* 1996). More recently, Avens et al. (2020) used refined skeletochronology to assess the age at sexual maturity for leatherback sea turtles in the Atlantic and the Pacific. In the Atlantic, the mean age at sexual maturity was 19 years (range 13-28) and the mean size at sexual maturity was 129.2 centimeters curved carapace length (CCL) (range 112.8-153.8). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 129.3 centimeters CCL (range 110.7-152.3) (Avens *et al.* 2019).

Leatherbacks have a greater tolerance for colder waters compared to all other sea turtle species due to their thermoregulatory capabilities (Paladino *et al.* 1990, Shoop and Kenney 1992, Wallace and Jones 2008). Evidence from tag returns, satellite telemetry, and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between temperate/boreal and tropical waters (Bond and James 2017, Dodge *et al.* 2015, Eckert *et al.* 2006, Fossette *et al.* 2014, James *et al.* 2005a, James *et al.* 2005b, James *et al.* 2005c, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992). Tagging studies collectively show a clear separation of leatherback movements between the North and South Atlantic Oceans (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James *et al.* 2005c, Wallace *et al.* 2006). Studies on the foraging ecology of leatherbacks in the North Atlantic show that leatherbacks off Massachusetts primarily consumed lion's mane jellyfish, sea nettles, and ctenophores (Dodge *et al.* 2011). Juvenile and small sub-adult leatherbacks may spend more time in oligotrophic (relatively low plant nutrient usually accompanied by high dissolved oxygen) open ocean waters where prey is more difficult to find (Dodge *et al.* 2011). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals are dependent upon foraging success and duration (Hays 2000, Price *et al.* 2004).

Population Dynamics

The distribution is global, with nesting beaches in the Atlantic, Pacific, and Indian Oceans. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020, Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson *et al.* 2011).

Analyses of mtDNA from leatherback sea turtles indicates a low level of genetic diversity (Dutton *et al.* 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian Oceans suggest that each of the rookeries represent demographically independent populations (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013). Using genetic data, combined with nesting, tagging, and tracking data, researchers identified seven global subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace *et al.* 2010). The 2020 status review concluded that the subpopulations identified by Wallace et al. (2010) are discrete and then evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

To evaluate the subpopulations and fine-scale structure in the Atlantic, Dutton et al. (2013) conducted a comprehensive genetic re-analysis of rookery stock structure. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton *et al.* 2013). While Dutton et al. (2013) identified fine-scale genetic partitioning in the Atlantic Ocean, the differences did not rise to the level of marked separation or discreteness (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). Other genetic analyses corroborate the conclusions of Dutton et al. (2013). These studies analyzed nesting sites in French Guiana (Molfetti *et al.* 2013), nesting and foraging areas in Brazil (Vargas *et al.* 2019), and nesting beaches in the Caribbean (Carreras *et al.* 2013). These studies all support three discrete populations in the Atlantic (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). While they detected fine-scale genetic differentiation in the Northwest, Southwest, and Southeast Atlantic populations, the status review team determined that none indicated that the genetic differences were sufficient to be considered marked separation (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Population growth rates for leatherback sea turtles vary by ocean basin. An assessment of leatherback populations through 2010 found a global decline overall (Wallace *et al.* 2013). Using datasets with abundance data series that are 10 years or greater, they estimated that leatherback populations have declined from 90,599 nests per year to 54,262 nests per year over three generations ending in 2010 (Wallace *et al.* 2013).

Several more recent assessments have been conducted. The Northwest Atlantic Leatherback Working Group was formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation estimated 20,000 mature individuals and approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019). Annual nest counts show high inter-annual variability within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). Using data from 24 nesting sites in 10 nations within the Northwest Atlantic DPS, the leatherback status review estimated that the total index of nesting female abundance for the Northwest Atlantic DPS is 20,659 females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). This estimate only includes nesting data from recently and consistently monitored nesting beaches. An index (rather than a census) was developed given that the estimate is based on the number of nests on main nesting beaches with recent and consistent data, and assumes a three-year remigration interval. This index provides a minimum estimate of nesting female abundance (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). This index of nesting female abundance is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG (Marine Turtle Expert Working Group) 2007). As described above, the IUCN Red List Assessment estimated 20,000 mature individuals (male and female). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG (Marine Turtle Expert Working Group) 2007, Tiwari *et al.* 2013). However, based on more recent analyses, leatherback nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease occurring during the most recent period of 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). The analyses for the IUCN Red List assessment indicate that the overall regional, abundance-weighted trends are negative (Northwest Atlantic Leatherback Working Group 2018, 2019). The dataset for trend analyses included 23 sites across 14 countries/territories. Three periods were used for the trend analysis: long-term (1990-2017), intermediate (1998-2017), and recent (2008-2017) trends. Overall, regional, abundance-weighted trends were negative across the periods and became more negative as the time-series became shorter. At the stock level, the Working Group evaluated the Northwest Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The Northwest Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana, Suriname, Cayenne, and Matura. Declines in Awala-Yalimapo were attributed, in part, due to a beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017. The Northern Caribbean and Western Caribbean stocks also declined over all three periods. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent time period. The Working Group identified anthropogenic sources (fishery bycatch, vessel strikes), habitat loss, and changes in life history parameters as possible drivers of nesting abundance declines (Northwest Atlantic Leatherback Working Group 2018). Fisheries bycatch is a well-documented threat to leatherback sea turtles. The Working Group discussed entanglement in vertical line fisheries off New England and Canada as potentially important monitoring sinks. They also noted that vessels strikes result in mortality annually in feeding habitats off New England. Off nesting beaches in Trinidad and the Guianas, net fisheries take leatherbacks in high numbers (~3,000/year) (Eckert 2013, Lum 2006, Northwest Atlantic Leatherback Working Group 2018).

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Significant declines have been observed at nesting beaches with the greatest historical or current nesting female abundance, most notably in Trinidad and Tobago, Suriname, and French Guiana. Though some nesting aggregations (see status review document for information on specific nesting aggregations) indicated increasing trends, most of the largest ones are declining. The declining trend is considered to be representative of the DPS (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The status review found that fisheries bycatch is the primary threat to the Northwest Atlantic DPS (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

In the vicinity of the action area, leatherback sea turtles nest in the southeastern U.S. From 1989-2020, leatherback nests at core index beaches in Florida have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Leatherback nesting declined from 2014 to 2017. Although slight increases were seen in 2018, 2019, and 2020, nest counts remain low compared to the numbers documented from 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/) (Figure 12). The status review found that the median trend for Florida from 2008-2017 was a decrease of 2.1% annually (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

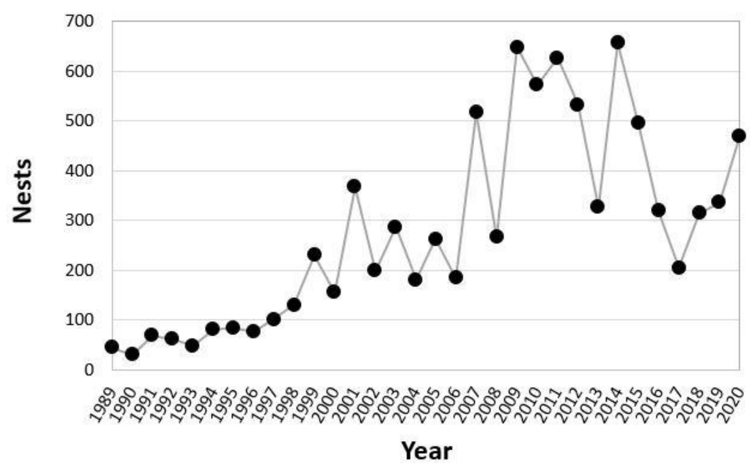

Figure 12. Number of leatherback sea turtle nests counted on core index beaches in Florida from 1989-2020. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/.

For the Southwest Atlantic DPS, the status review estimates the total index of nesting female abundance at approximately 27 females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). This is similar to the IUCN Red List assessment that estimated 35 mature individuals (male and female) using nesting data since 2010. Nesting has increased since 2010 overall, though the 2014-2017 estimates were lower than the previous three years. The trend is increasing, though variable (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The Southeast Atlantic DPS has an index of nesting female abundance of 9,198 females and demonstrates a declining nest trend at the largest nesting aggregation (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The Southeast Atlantic DPS exhibits a declining nest trend (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris *et al.* 2017, Santidrián-Tomillo *et al.* 2017, Santidrián-Tomillo *et al.* 2007, Sarti Martínez *et al.* 2007, Tapilatu *et al.* 2013). For an IUCN Red List evaluation, datasets for nesting at all index beaches for the West Pacific population were compiled (Tiwari *et al.* 2013). This assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari *et al.* 2013). Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation declined at a rate of almost 6% per year from 1984 to 2011 (Tapilatu *et al.* 2013). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific DPS at 1,277 females, and the DPS exhibits low hatchling success (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The total index of nesting female abundance for the East Pacific DPS is 755 nesting females. It has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace *et al.* 2013). The low productivity parameters, drastic reductions in nesting female abundance, and current declines in nesting place the DPS at risk (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013). A five-year status review in 2013 found that, in the southwest Indian Ocean, populations in South Africa are stable (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013). More recently, the 2020 status review estimated that the total index of nesting female abundance for the Southwest Indian DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. There has been a global decline overall. For all DPSs, including the Northwest Atlantic DPS, fisheries bycatch is the primary threat to the species (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). Leatherback sea turtle nesting in the Northwest Atlantic showed an overall negative trend through 2017, with the most notable decrease occurring during the most recent time frame of 2008 to 2017 (Northwest Atlantic Leatherback Working Group 2018). Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. Therefore, the leatherback status review in 2020 concluded that the Northwest Atlantic DPS exhibits an overall decreasing trend in annual nesting activity (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). Threats to leatherback sea turtles include loss of nesting habitat, fisheries bycatch, vessel strikes, harvest of eggs, and marine debris, among others (Northwest Atlantic Leatherback Working Group 2018). Because of the threats, once large nesting areas in the Indian and Pacific Oceans are now functionally extinct (Tiwari *et al.* 2013) and there have been range-wide reductions in population abundance. The species' resilience to additional perturbation both within the Northwest Atlantic and worldwide is low.

Critical Habitat
Critical habitat has been designated for leatherback sea turtles in the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710, March 23, 1979) and along the U.S. West Coast (77 FR 4170, January 26, 2012), both of which are outside the action area.

Recovery Goals
There are separate plans for the U.S. Caribbean, Gulf of Mexico, and Atlantic (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992) and the U.S. Pacific (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1998a) populations of leatherback sea turtles. Neither plan has been recently updated. As with other sea turtle species, the recovery plans for leatherbacks includes criteria for considering delisting. These criteria relate to increases in the populations, nesting trends, nesting beach and habitat protection, and implementation of priority actions. Criteria for delisting in the recovery plan for the U.S. Caribbean, Gulf of Mexico, and Atlantic are described here.

Delisting criteria:

1. Adult female population increases for 25 years after publication of the recovery plan, as evidenced by a statistically significant trend in nest numbers at Culebra, Puerto Rico, St. Croix, USVI, and the east coast of Florida.
2. Nesting habitat encompassing at least 75% of nesting activity in the USVI, Puerto Rico, and Florida is in public ownership.
3. All priority one tasks have been successfully implemented (see the recovery plan for a list of priority one tasks).

Major recovery actions in the U.S. Caribbean, Gulf of Mexico and Atlantic include actions to:

1. Protect and manage terrestrial and marine habitats.
2. Protect and manage the population.
3. Inform and educate the public.
4. Develop and implement international agreements.

The Pacific leatherback sea turtle is a NOAA Species in the Spotlight. The Species in the Spotlight program identifies those species most-at risk of extinction. A five-year action plan has been developed for these species to identify immediate, targeted efforts vital to stabilize the population and prevent extinction. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan (NMFS 2016)

1. Reduce fisheries interactions.
2. Improve nesting beach protection and increase reproductive output.
3. International cooperation.
4. Monitoring and research.
5. Public engagement.

4.2.1.3 Kemp's ridley sea turtle

The range of Kemp's ridley sea turtles extends from the Gulf of Mexico to the U.S. Atlantic coast (Figure 13). They have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomás and Raga 2008). They are the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell. The species was first listed under the Endangered Species Conservation Act (35 FR 18319, December 2, 1970) in 1970. The species has been listed as endangered under the ESA since 1973.

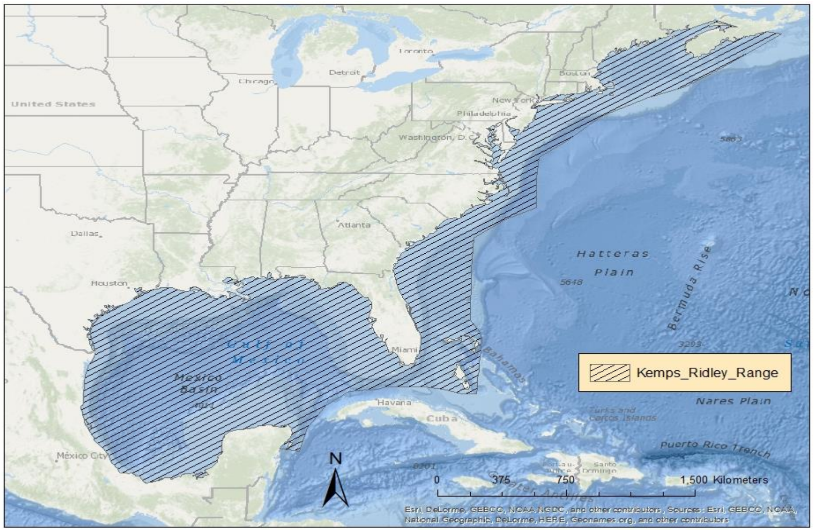

Figure 13. Range of the endangered Kemp's ridley sea turtle.

We used information available in the revised recovery plan (NMFS (National Marine Fisheries Service) *et al.* 2011), the Five-Year Review (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015), and published literature to summarize the life history, population dynamics and status of the species, as follows.

Life History

Kemp's ridley nesting is essentially limited to the western Gulf of Mexico. Approximately 97% of the global population's nesting activity occurs on a 146-kilometer stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the U.S., nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015). Nesting occurs from April to July in large arribadas (synchronized large-scale nesting). The average remigration interval is two years, although intervals of one and three years are not uncommon (NMFS (National Marine Fisheries Service) *et al.* 2011, TEWG (Marine Turtle Expert Working Group) 1998, 2000). Females lay an average of 2.5 clutches per season (NMFS (National Marine Fisheries Service) *et al.* 2011). The annual average clutch size is 95 to 112 eggs per nest (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015). The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats (Epperly *et al.* 2013, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015, Snover *et al.* 2007). Modeling indicates that oceanic-stage Kemp's ridley sea turtles are likely distributed throughout the Gulf of Mexico into the Northwest Atlantic (Putman *et al.* 2013). Kemp's ridleys nearing the age when recruitment to nearshore waters occurs are more likely to be distributed in the northern Gulf of Mexico, eastern Gulf of Mexico, and the western Atlantic (Putman *et al.* 2013).

Several studies, including those of captive turtles, recaptured turtles of known age, mark-recapture data, and skeletochronology, have estimated the average age at sexual maturity for Kemp's ridleys between 5 to 12 years (captive only) (Bjorndal *et al.* 2014), 10 to 16 years(Chaloupka and Zug 1997, Schmid and Witzell 1997, Schmid and Woodhead 2000, Zug *et al.* 1997), 9.9 to 16.7 years (Snover *et al.* 2007), 10 and 18 years (Shaver and Wibbels 2007), 6.8 to 21.8 years (mean 12.9 years) (Avens *et al.* 2017).

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. In addition, the NEFSC caught a juvenile Kemp's ridley during a recent research project in deep water south of Georges Bank (NEFSC, unpublished data). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter. As adults, many Kemp's ridleys remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS (National Marine Fisheries Service) *et al.* 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep (Seney and Landry 2008, Shaver *et al.* 2005, Shaver and Rubio 2008), although they can also be found in deeper offshore waters. As larger juveniles and adults, Kemp's ridleys forage on swimming crabs, fish, mollusks, and tunicates (NMFS (National Marine Fisheries Service) *et al.* 2011).

Population Dynamics
Of all the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased at 15% annually (Heppell *et al.* 2005). However, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (Caillouet *et al.* 2018, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015). In 2019, there were 11,090 nests, a 37.61% decrease from 2018 and a 54.89% decrease from 2017, which had the highest number (24,587) of nests (Figure 14; unpublished data). The reason for this recent decline is uncertain.

Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of two years, and a sex ratio of 3.17 females:1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS (National Marine Fisheries Service) *et al.* 2011). If this holds true than rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS (National Marine Fisheries Service) *et al.* 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley sea turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton *et al.* 2006).

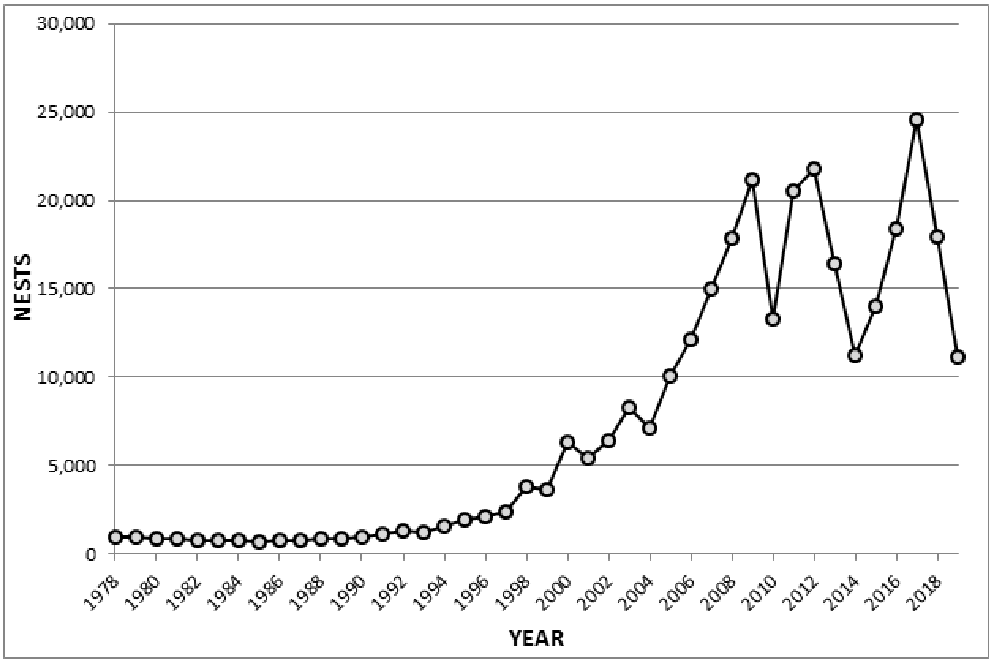

Figure 14. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019).

Status

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances in Mexico prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. Nesting beaches in Texas have been re-established. Fishery interactions are the main threat to the species. Other threats include habitat destruction, oil spills, dredging, disease, cold stunning, and climate change. The current population trend is uncertain. While the population has increased, recent nesting numbers have been variable. In addition, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

Critical Habitat

Critical habitat has not been designated for Kemp's ridley sea turtles.

Recovery Goals

As with other recovery plans, the goal of the Kemp's ridley recovery plan is to conserve and protect the species so that the listing is no longer necessary. The recovery criteria relate to the number of nesting females, hatchling recruitment, habitat protection, social and/or economic initiatives compatible with conservation, reduction of predation, TED or other protective measures in trawl gear, and improved information available to ensure recovery. The recovery plan includes the complete downlisting/delisting criteria (NMFS (National Marine Fisheries Service) *et al.* 2011). These criteria, which are related to demographic and listing factor criteria, are summarized here.

Downlisting criteria include:

1. A population of at least 10,000 nesting females in a season distributed at primary nesting beaches.
2. Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico.
3. Listing factor criteria related to long-term protection of habitat at two of the primary nesting beaches; initiation of social and/or economic community initiatives; reduction of nest predation; maintenance and enforcement of TED regulations; and identification and review of data on foraging areas, interesting habitats, mating areas, and adult migration routes to provide information to ensure recovery.

Delisting criteria include:

1. Average population of at least 40,000 nesting females per season over a six-year period distributed among nesting beaches.
2. Average annual recruitment of hatchlings over a 6-year period sufficient to maintain a population of at least 40,000 nesting females per nesting season.
3. Listing factor criteria related to maintaining long-term habitat protection at nesting beaches of Tamaulipas and Texas; maintaining and expanding community socioeconomic programs; reducing nest predation through protective measures; implementing specific, comprehensive legislation/regulations to ensure post-delisting protection, as appropriate; establishing a network on in-water sites to monitor population and implementing surveys; initiating monitoring programs in commercial and recreational fisheries have been initiated and implementing measures to minimize mortality in fisheries; ensuring all other significant anthropogenic mortalities have been sufficiently addressed to ensure recruitment to maintain population level criterion; and continuing Sea Turtle Stranding and Salvage Network (STSSN) research and data collection to monitor the effectiveness of protection and restoration activities.

Major actions needed to meet the recovery goals include:

1. Protect and manage terrestrial and marine habitats and Kemp's ridley populations.
2. Maintain the STSSN.
3. Manage captive stocks.
4. Develop local, state, national government and community partnerships.
5. Educate the public.

6. Maintain and expand legal protections, promote awareness of these, and increase enforcement.
7. Implement international agreements.

4.2.1.4 Green sea turtle – North Atlantic DPS

The green sea turtle has a circumglobal distribution, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters. They commonly inhabit nearshore and inshore waters. It is the largest of the hard-shelled sea turtles, growing to a weight of approximately 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (one meter). The species was listed under the ESA on July 28, 1978 (43 FR 32800) as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green sea turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 15) and is listed as threatened. Green sea turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa.

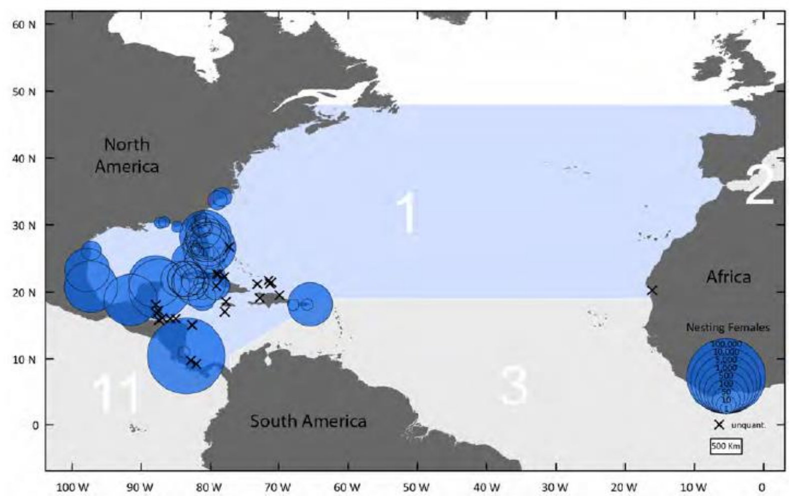

Figure 15. Geographic range of the North Atlantic DPS of green sea turtles (1), with location and abundance of nesting females (Seminoff *et al.* 2015).

We used information available in the 2015 Status Review (Seminoff *et al.* 2015), relevant literature, and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

Life history

Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), the U.S. (Florida), and Cuba (Figure 15. Geographic range of the North Atlantic DPS of green sea turtles (1), with location and abundance of nesting femalesFigure 15) support nesting concentrations of particular interest in the

North Atlantic DPS (Seminoff *et al.* 2015). The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff *et al.* 2015). In the southeastern U.S., females generally nest between May and September (Seminoff *et al.* 2015, Witherington *et al.* 2006). Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest (Hirth 1997, Seminoff *et al.* 2015). The remigration interval (period between nesting seasons) is two to five years (Hirth 1997, Seminoff *et al.* 2015). Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during the summer months.

Green sea turtles are long-lived animals. Size and age at sexual maturity have been estimated using several methods, including mark-recapture, skeletochronology, and marked, known-aged individuals. Skeletochronology analyzes growth marks in bones to obtain growth rates and age at sexual maturity estimates. Estimates vary widely among studies and populations, and methods continue to be developed and refined (Avens and Snover 2013). Early mark-recapture studies in Florida estimated the age at sexual maturity 18-30 years (Frazer and Ehrhart 1985, Goshe *et al.* 2010, Mendonça 1981). More recent estimates of age at sexual maturity are as high as 35-50 years (Avens and Snover 2013, Goshe *et al.* 2010), with lower ranges reported from known age turtles (15-19 years) from the Cayman Islands (Bell *et al.* 2005) and Caribbean Mexico (12-20 years) (Zurita *et al.* 2012). A study of green sea turtles that use waters of the southeastern U.S. as developmental habitat found the age at sexual maturity likely ranges from 30-44 years (Goshe *et al.* 2010). Green sea turtles in the Northwestern Atlantic mature at 85-100+ centimeters SCL (Avens and Snover 2013).

Adult green sea turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adults feed primarily on seagrasses and algae, although they also eat other invertebrate prey (Seminoff *et al.* 2015).

Population dynamics

The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico, and Costa Rica (Seminoff *et al.* 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin *et al.* 2016).

Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites (using data through 2012), and available data indicated an increasing trend in nesting (Seminoff *et al.* 2015). Counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. The status review for green sea turtles assessed population trends for seven nesting sites with more than ten years of data collection in the North Atlantic DPS. The results were variable with some sites showing no trend and others increasing.

However, all major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff *et al.* 2015)).

More recent data is available for the southeastern U.S. The FWRI monitors sea turtle nesting through the Statewide Nesting Beach Survey (SNBS) and Index Nesting Beach Survey (INBS). Since 1979, the SNBS had surveyed approximately 215 beaches to collect information on the distribution, seasonality, and abundance of sea turtle nesting in Florida. Since 1989, the INBS has been conducted on a subset of SNBS beaches to monitor trends through consistent effort and specialized training of surveyors. The INBS data uses a standardized data-collection protocol to allow for comparisons between years and are presented for green, loggerhead, and leatherback sea turtles. The index counts represent 27 core index beaches. The index nest counts represent approximately 67% of known green turtle nesting in Florida (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

Nest counts at Florida's core index beaches have ranged from less than 300 to almost 41,000 in 2019. Overall, the nest numbers show a mostly biennial pattern of fluctuation (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/; Figure 16). It should also be noted that green sea turtle nest counts have increased eightyfold since standardized nest counts began in 1989 – a trend that differs dramatically from that of the loggerheads that nest on the same beaches. Green sea turtles set record highs for nesting at Florida core index beaches in 2011, 2013, 2015, 2017, and 2019. In 2020, green sea turtle nest counts on the 27 core index beaches reached more than 20,000 nests recorded, which was also high considering the above-mentioned cycles (FFWCC 2021). This recent nesting data over the past decade suggests a potentially strong increasing trend in nesting, although similar to loggerheads, using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation.

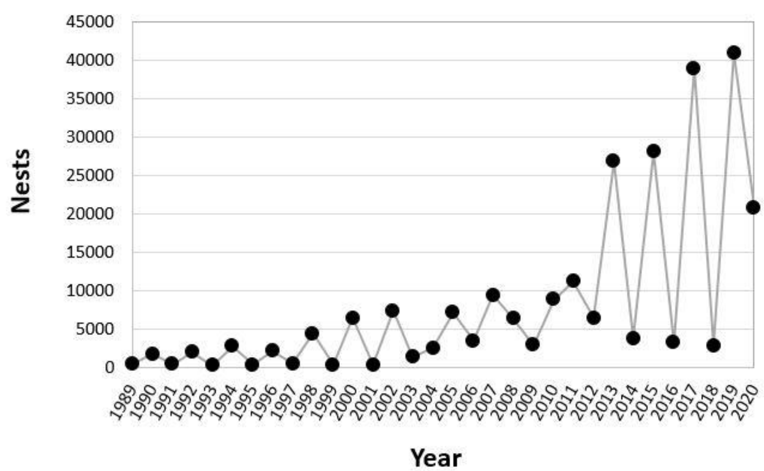

Figure 16. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2020. Source: https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/.

Status
Historically, green sea turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation which is between 30 and 40 years (Seminoff *et al.* 2015). While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Critical Habitat
Critical habitat in effect for the North Atlantic DPS green sea turtles surrounds Culebra Island, Puerto Rico (66 FR 20058, April 6, 2016), which is outside the action area.

Recovery Goals
The recovery plan for green sea turtles has not been recently updated. In the plan, the recovery goal for the U.S. population of green sea turtles is delist the species once the recovery criteria are met (NMFS and USFWS 1991). The recovery plan includes criteria for delisting related to nesting activity, nesting habitat protection, and reduction in mortality.

Delisting can be considered if over a period of 25 years:
1. Florida nesting has increased to an average of 5,000 nests per year for at least six years.
2. At least 25% (105 kilometers) of available nesting beaches is in public ownership and encompasses greater than 50% of nesting activity.
3. Stage class mortality reduction is reflected in higher abundance counts on foraging grounds.
4. All priority one tasks have been successfully implemented (NMFS and USFWS 1991).

Major actions needed to help meet the recovery goals include:
1. Providing long-term protection to important nesting beaches.
2. Ensuring at least a 60% hatch rate success on major nesting beaches.
3. Implementing effective lighting ordinances/plans on nesting beaches.
4. Determining distribution and seasonal movements of all life stages in the marine environment.
5. Minimizing commercial fishing mortality.
6. Reducing threat to the population and foraging habitat from marine pollution.

4.2.1.5 Other factors outside the action area affecting the status of sea turtles

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. While the spill occurred outside the action area, it does impact the same sea turtle populations occur in the action area. Therefore, we are considering it in the status of the species. This extensive oiling event contaminated important sea turtle foraging, migratory, and breeding habitats used by different life stages at the surface, in the water column, on the ocean bottom, and on beaches throughout the northern Gulf of Mexico. Sea turtles were exposed to oil when in contaminated water or habitats; by breathing oil droplets, oil vapors, and smoke; by ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos.

Response activities and shoreline oiling also directly injured sea turtles, disrupting and deterring sea turtle nesting in the Gulf (DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment) Trustees 2016).

During direct at-sea capture events, more than 900 sea turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the sea turtles captured during these operations, greater than 80% were visibly oiled (DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment) Trustees 2016). Most of the rescued sea turtles were taken to rehabilitation facilities; more than 90% of the sea turtles admitted to rehabilitation centers eventually recovered and were released (Stacy 2012, Stacy *et al.* 2015). Recovery efforts also included relocating nearly 275 sea turtle nests from the northern Gulf to the Florida Panhandle, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. More than 28,000 eggs were moved to an incubation facility in Cape Canaveral, Florida, where they were incubated until emergence and release. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95% of which were loggerheads (https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtles-dolphins-and-whales-10-years-after-deepwater-horizon-oil).

Direct observations of the effects of oil on sea turtles obtained by at-sea captures, sightings, and strandings represent a fraction of the scope of the injury. As such, the DWH NRDA Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse effects of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, greens, loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill. Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and greens) were also injured by response activities (DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment) Trustees 2016). Despite uncertainties and some unquantified injuries to sea turtles (e.g., injury to leatherbacks, unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities. Other impacts assessed include reproductive failure and adverse health effects. Chapter 4 of the NRDA report includes details of the assessment and results (DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment) Trustees 2016).

In addition, Wallace et al. (2017) later determined through a modeling approach that the highest probabilities of heavy oil exposure were limited to areas nearest the wellhead, and the probability of heavy oiling decreased with increasing distance from the wellhead. They also determined that the estimated distribution of heavily oiled neritic turtles was similar to the estimated distribution of heavily oiled oceanic turtles (Wallace *et al.* 2017). This modeling approach produced reasonable estimates of heavy oiling probability for both sea turtles and surface habitats that were not directly observed during the NRDA response and survey efforts. A toxicological estimation of mortality of oceanic sea turtles oiled during the spill concluded that, overall, approximately 30% of all oceanic sea turtles in the region affected by the spill that were not heavily oiled would have died from ingestion of oil (Mitchelmore *et al.* 2017).

Response methods used to minimize the extent and harm resulting from a spill can also affect sea turtles. These responses may include collection of oil, in situ burning, use of oil booms, and application of dispersants. Oil removal via skimming or burning can incidentally entrap and kill sea turtles. The effects of dispersants on sea turtles is poorly understood, and there is a lack of empirical studies and controlled experiments (Stacy *et al.* 2019). Exposure over the short-term to a dispersant and a mixture of oil/dispersant affected hydration and weight gain in loggerhead hatchlings (Harms *et al.* 2014). While the effects of dispersants on sea turtles is largely unknown, they remain a concern in sea turtles based on observations in other species (Stacy *et al.* 2019).

Based on these quantifications of sea turtle injuries and mortalities caused by the DWH oil spill, hard-shelled sea turtles from all life stages and all geographic areas were lost from the northern Gulf of Mexico ecosystem. Injuries to leatherback sea turtles could not be quantified (DWH NRDA (Deepwater Horizon Natural Resource Damage Assessment) Trustees 2016). The DWH NRDA Trustees (2016) concluded that the recovery of sea turtles in the northern Gulf of Mexico from injuries and mortalities caused by the DWH oil spill will require decades of sustained efforts to reduce the most critical threats and enhance survival of turtles at multiple life stages. The ultimate population level effects of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

4.2.2 Status of Atlantic Sturgeon

An estuarine-dependent anadromous species, Atlantic sturgeon occupy ocean and estuarine waters, including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASSRT (Atlantic Sturgeon Status Review Team) 2007) (Figure 17). On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (SA) (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered.

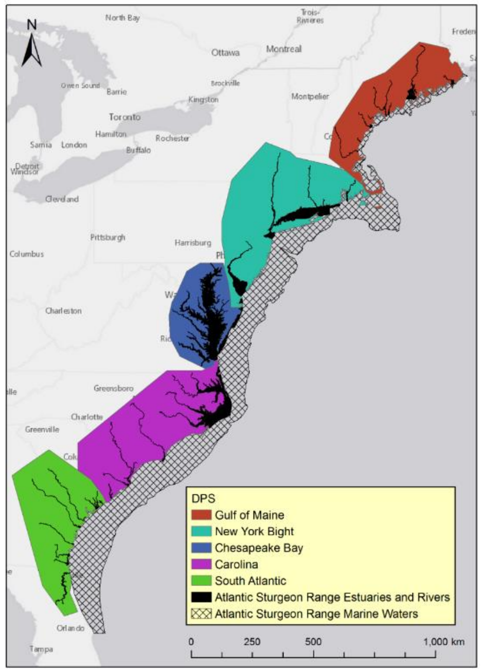

Figure 17. U.S. range of Atlantic sturgeon DPSs.

Information available from the 2007 Atlantic sturgeon status review (ASSRT (Atlantic Sturgeon Status Review Team) 2007), 2017 ASMFC benchmark stock assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), and material supporting the designation of Atlantic sturgeon critical habitat (NMFS (National Marine Fisheries Service) 2017b) were used to summarize the life history, population dynamics, and status of the species.

Life history

Atlantic sturgeon are a late maturing, anadromous species (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Balazik *et al.* 2010, Hilton *et al.* 2016, Sulak and Randall 2002). Sexual maturity is reached between the ages of 5 to 34 years. Sturgeon originating from rivers in lower latitudes (e.g., South Carolina rivers) mature faster than those originating from rivers located in higher latitudes (e.g., Saint Lawrence River) (NMFS (National Marine Fisheries Service) 2017b).

Atlantic sturgeon spawn in freshwater (ASSRT (Atlantic Sturgeon Status Review Team) 2007, NMFS (National Marine Fisheries Service) 2017b) at sites with flowing water and hard bottom substrate (Bain *et al.* 2000, Balazik *et al.* 2012a, Gilbert 1989, Greene *et al.* 2009, Hatin *et al.* 2002, Mohler 2003, Smith and Clugston 1997, Vladykov and Greeley 1963). Water depths of spawning sites are highly variable, but may be up to 27 meters (Bain *et al.* 2000, Crance 1987, Leland 1968, Scott and Crossman 1973). Based on tagging records, Atlantic sturgeon return to their natal rivers to spawn (ASSRT (Atlantic Sturgeon Status Review Team) 2007), with spawning intervals ranging from one to five years in males (Caron *et al.* 2002, Collins *et al.* 2000, Smith 1985) and two to five years in females (Stevenson and Secor 1999, Van Eenennaam *et al.* 1996, Vladykov and Greeley 1963). Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Balazik and Musick 2015, Collins *et al.* 2000), although the majority likely have just one, either in the spring or fall.[5] There is evidence of spring and fall spawning for the South Atlantic DPS (77 FR 5914, February 6, 2012) (Collins *et al.* 2000, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1998b), spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS (National Marine Fisheries Service) 2017b), and fall spawning for the Chesapeake and Carolina DPSs (Balazik *et al.* 2012b, Smith *et al.* 1984). While spawning has not been confirmed in the James River (Chesapeake Bay DPS), telemetry and empirical data suggest that there may be two potential spawning runs: a spring run from late March to early May, and a fall run around September after an extended staging period in the lower river (Balazik *et al.* 2012b, Balazik and Musick 2015).

Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012b, Breece *et al.* 2013, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2002, Ingram *et al.* 2019, Smith 1985, Smith *et al.* 1982). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Bain 1997, Bain *et al.* 2000, Balazik *et al.* 2012b, Breece *et al.* 2013, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2002, NMFS (National Marine Fisheries Service) 2017b, Smith 1985, Smith *et al.* 1982). Atlantic sturgeon deposit eggs on hard bottom substrate. They hatch into the yolk sac larval stage approximately 94 to 140 hours after deposition (Mohler 2003, Murawski and Pacheco 1977, Smith *et al.* 1980, Van Den Avyle 1984, Vladykov and Greeley 1963). Once the yolk sac is absorbed (eight to twelve days post-hatching), sturgeon are larvae. Shortly after, they become young of year and then juveniles. The juvenile stage can last months to years in the brackish waters of the natal estuary (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Calvo *et al.* 2010, Collins *et al.* 2000, Dadswell 2006, Dovel and Berggren 1983, Greene *et al.* 2009, Hatin *et al.* 2007, Holland and Yelverton 1973, Kynard and Horgan 2002, Mohler 2003, Schueller and Peterson 2010, Secor *et al.* 2000, Waldman *et al.* 1996). Upon reaching the sub-adult phase, individuals enter the marine environment, mixing with adults and sub-adults from other river systems (Bain 1997, Dovel and Berggren 1983, Hatin *et al.* 2007, McCord *et al.* 2007, NMFS (National Marine Fisheries Service) 2017b). Once sub-adult Atlantic sturgeon have reached maturity (i.e., adult stage), they will remain in marine or estuarine waters, only returning far upstream to the spawning areas when they are ready to spawn (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Bain 1997, Breece *et al.* 2016, Dunton *et al.* 2012, Dunton *et al.* 2015, Savoy and Pacileo 2003).

The life history of Atlantic sturgeon can be divided up into seven general categories as described in Table 6 below (adapted from ASSRT 2007).

[5] Although referred to as spring spawning and fall spawning, the actual time of Atlantic sturgeon spawning may not occur during the astronomical spring or fall season (Balazik and Musick 2015).

Table 6. Descriptions of Atlantic sturgeon life history stages.

Age Class	Size	Duration	Description
Egg	~2mm – 3 mm diameter (Van Eenannnam *et al.* 1996, p. 773)	Hatching occurs ~3-6 days after egg deposition and fertilization (ASSRT 2007, p. 4)	Fertilized or unfertilized
Yolk-sac larvae (YSL)	~6mm – 14 mm (Bath *et al.* 1981, pp. 714-715)	8-12 days post hatch (ASSRT 2007, p.4)	Negative photo-taxic, nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14mm – 37mm (Bath *et al.* 1981, pp. 714-715)	12-40 days post hatch	Free swimming; feeding; Silt/sand bottom, deep channel; fresh water
Young of Year (YOY)	0.3 grams <410mm TL	From 40 days to 1 year	Fish that are > 40 days and < one year; capable of capturing and consuming live food
Juveniles	>410mm and <760mm TL	1 year to time at which first coastal migration is made	Fish that are at least age 1 and are not sexually mature and do not make coastal migrations.
Subadults	>760 mm and <1500 mm TL	From first coastal migration to sexual maturity	Fish that are not sexually mature but make coastal migrations
Adults	>1500 mm TL	Post-maturation	Sexually mature fish

Population dynamics

A population estimate was derived from the NEAMAP trawl surveys (Kocik *et al.* 2013).[6] For this Opinion, as we did in the prior 2012 Opinion, we are relying on the population estimates derived from the NEAMAP swept area biomass assuming a 50% catchability (i.e., net efficiency x availability) rate. We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon, but do not sample all the locations and times where Atlantic sturgeon are present, and

[6] Since fall 2007, NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 18.3 meters (60 feet). Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations.

that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assume that net efficiency and the fraction of the population exposed to the NEAMAP surveys in combination result in a 50% catchability (Kocik *et al.* 2013). The 50% catchability assumption reasonably accounts for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear. As these estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we have determined that these estimates continue to serve as the best available information. Based on the above approach, the overall abundance of Atlantic sturgeon in U.S. Atlantic waters is estimated to be 67,776 fish (see Table in 16 in (Kocik *et al.* 2013)). Based on genetic frequencies of occurrence in the sampled area, this overall population estimate was subsequently partitioned by DPS (Table 7). Given the proportion of adults to sub-adults in the NEFSC observer data (approximate ratio of 1:3), we have also estimated the number of adults and sub-adults originating from each DPS. However, this cannot be considered an estimate of the total number of sub-adults because it only considers those sub-adults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.

Table 7. Summary of calculated population estimates based upon the NEAMAP survey swept area model assuming 50% efficiency.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Sub-adults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada	678	170	509

It is important to note, the NEAMAP-based estimates do not include young-of-the-year (YOY) fish and juveniles in the rivers; however, those segments of the Atlantic sturgeon populations are at minimal risk from the proposed action since they are rare to absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of sub-adult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. However, the estimated number of sub-adults in marine waters is a minimum count because it only considers those sub-adults that are captured in a portion of the action area and are present in the marine environment, which is only a fraction of the total number of sub-adults. In regards to adult Atlantic sturgeon, the estimated population in marine waters is also a minimum count as the NEAMAP surveys sample only a portion of the action area, and therefore a portion of the Atlantic sturgeon's range.

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The ASMFC (2017) stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model that would not converge. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Bowen and Avise 1990, O'Leary *et al.* 2014, Ong *et al.* 1996, Waldman *et al.* 1996, Waldman and Wirgin 1998). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Fritts *et al.* 2016, Savoy *et al.* 2017, Wirgin *et al.* 2002) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

The range of all five listed DPSs extends from Canada through Cape Canaveral, Florida. All five DPSs use the action area. Based on a recent genetic mixed stock analysis (Kazyak *et al.* 2020), we expect Atlantic sturgeon throughout the action area originate from the five DPSs at the following frequencies: Gulf of Maine 8.7%; New York Bight 71.4%; Chesapeake Bay 10.7%; Carolina 2.6%; and South Atlantic 5.6%. Approximately 1.0% of the Atlantic sturgeon throughout the action area are expected to originate from Canadian rivers or management units. The authors of this recent analysis used 12 microsatellite markers to characterize the stock composition of 1,704 Atlantic sturgeon encountered across the U.S. Atlantic coast dating back to 1980. The primary method to determine the origin of Atlantic sturgeon when they are encountered away from natal habitats is through the use of genetic assignment testing, as was done in Kazyak et al. (2020). However, one caveat with genetic assignment testing is that not all populations have been discovered and not all discovered populations were used for this assessment. Assignment testing can only assign an individual to a known or defined category. Even if there is very little similar with the best match, that is where that sample is assigned.

Depending on life stage, sturgeon may be present in marine and estuarine ecosystems. The action area for this Opinion occurs in marine waters; therefore, this section will focus only on the distribution of Atlantic sturgeon life stages (sub-adult and adult) in marine waters; it will not discuss the distribution of Atlantic sturgeon life stages (eggs, larvae, juvenile, sub-adult, adult) in freshwater ecosystems, specifically, their movements into/out of natal river systems. For more information on Atlantic sturgeon distribution in freshwater ecosystems, refer to ASSRT (2007); 77 FR 5880 (February 6, 2012); 77 FR 5914 (February 6, 2012); NMFS (2017); and ASMFC (2017).

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range. Results from genetic studies show that, regardless of location, multiple DPSs can be found at any one location along the Northwest Atlantic coast, although the Hudson River population from the New York Bight DPS dominates (ASMFC (Atlantic States Marine Fisheries Commission) 2017, ASSRT (Atlantic Sturgeon Status Review Team) 2007, Dadswell 2006, Dovel and Berggren 1983, Dunton *et al.* 2012, Dunton *et al.* 2015, Dunton *et al.* 2010, Erickson *et al.* 2011, Kynard *et al.* 2000, Laney *et al.* 2007, O'Leary *et al.* 2014, Stein *et al.* 2004b, Waldman *et al.* 2013, Wirgin *et al.* 2015a, Wirgin *et al.* 2015b, Wirgin *et al.* 2012).

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 50 meter depth contour (Dunton *et al.* 2012, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Stein *et al.* 2004a, b, Waldman *et al.* 2013, Wirgin *et al.* 2015a, Wirgin *et al.* 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 75 meters) continental shelf waters have been documented (Colette and Klein-MacPhee 2002, Collins and Smith 1997, Erickson *et al.* 2011, Stein *et al.* 2004b, Timoshkin 1968). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton *et al.* 2010, Erickson *et al.* 2011, Hilton *et al.* 2016, Oliver *et al.* 2013, Post *et al.* 2014, Wippelhauser 2012). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 20 meters, during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 20 meters (Erickson *et al.* 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina, Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 25 meters (Bain *et al.* 2000, Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, O'Leary *et al.* 2014, Oliver *et al.* 2013, Savoy and Pacileo 2003, Stein *et al.* 2004b, Waldman *et al.* 2013, Wippelhauser 2012, Wippelhauser and Squiers 2015). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refuge, wintering sites, or marine foraging areas (Dunton *et al.* 2010, Erickson *et al.* 2011, Stein *et al.* 2004b).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT (Atlantic Sturgeon Status Review Team) 2007). They are currently present in 36 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT (Atlantic Sturgeon Status Review Team) 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or YOY observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC (Atlantic States Marine Fisheries Commission) 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid-1990s. Based on management recommendations in the ISFMP, adopted by the ASMFC in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from most coastal states (ASMFC (Atlantic States Marine Fisheries Commission) 1998b). In 1998, the ASMFC placed a 20-40 year moratorium on all Atlantic sturgeon fisheries until the spawning stocked could be restored to a level where 20 subsequent year classes of adult females were protected (ASMFC (Atlantic States Marine Fisheries Commission) 1998a, b). In 1999, NMFS closed the U.S. EEZ to Atlantic sturgeon retention, pursuant to the ACA (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this.

The most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

In support of the above, the ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC (Atlantic States Marine Fisheries Commission) 2017). Based on historic removals and estimated effective population size, the 2017 stock assessment concluded that all five Atlantic sturgeon DPSs are depleted relative to historical levels (Table 8). However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC (Atlantic States Marine Fisheries Commission) 2017). The 2017 stock assessment also concluded that a variety of factors (e.g., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

Table 8. Stock status determination for the coastwide stock and DPSs (from the ASMFC's Atlantic Sturgeon Stock Assessment Overview, October 2017).

	Mortality Status	Biomass/Abundance Status	
Population	Probability that $Z > Z_{50\%EPR}$ 80%	Relative to Historical Levels	Average probability of terminal year of indices > 1998* value
Coastwide	7%	Depleted	95%
Gulf of Maine	74%	Depleted	51%
New York Bight	31%	Depleted	75%
Chesapeake Bay	30%	Depleted	36%
Carolina	75%	Depleted	67%
South Atlantic	40%	Depleted	Unknown (no suitable indices)

* **For indices that started after 1998, the first year of the index was used as the reference value. EPR= Eggs Per Recruit.**

Despite the depleted status, the ASMFC assessment did include signs that the coastwide index is above the 1998 value (95% probability). The Gulf of Maine, New York Bight, and Carolina DPS indices also all had a greater than 50% chance of being above their 1998 value; however, the index from the Chesapeake Bay DPS (highlighted red) only had a 36% chance of being above the 1998 value. There were no representative indices for the South Atlantic DPS. Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. The New York Bight, Chesapeake Bay, and South Atlantic DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The Gulf of Maine and Carolina DPSs (highlighted red) had 74%-75% probability of being above the mortality threshold (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

Critical Habitat
Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern U.S. These areas are outside the action area.

Recovery Goals
Recovery Plans have not yet been drafted for any of the Atlantic sturgeon DPSs. A recovery outline (see https://www.fisheries.noaa.gov/resource/document/recovery-outline-atlantic-sturgeon-distinct-population-segments) has been developed as interim guidance to direct recovery efforts, including recovery planning, until a full recovery plan is approved.

5.0 ENVIRONMENTAL BASELINE

The environmental baseline for this Opinion refers to the condition of ESA-listed species and designated critical habitats in the action area, without the consequences that are caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, 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 impacts of state or private actions which are contemporaneous with the consultation in process. The consequences to ESA-listed species or designated critical habitats from ongoing agency activities or existing agency facilities that are not within that agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The *Environmental Baseline* includes the effects of several activities that may affect the survival and recovery of sea turtles (NWA DPS loggerheads, leatherbacks, Kemp's ridleys, and North Atlantic DPS greens) and Atlantic sturgeon DPSs in the action area. The activities that shape the *Environmental Baseline* of this consultation generally include: federal fisheries management plans; aquaculture; dredging, sand mining, and beach nourishment activities; research and other permitted activities; federal vessel operations; military operations; offshore oil and gas; offshore energy development; non-federally regulated fisheries; maritime industry; pollution; coastal development; and recovery activities associated with reducing impacts to listed species.

The overall impacts that each federal, state, and private action or other human activities have on ESA-listed sea turtles and Atlantic sturgeon is not fully known. For actions outside the action area, the impacts of human activities on these species are discussed and incorporated into the status of each species considered in this Opinion (sections 4.2.1 and 4.2.2). Sections 4.2.1 and 4.2.2 also recognize the benefits of recovery activities already being implemented for these species. In some cases, the benefits of a recovery action may not be evident in the status of the respective species for years or even decades, given the relatively late age at which some species reach maturity (e.g., sea turtles) and depending on the age class(es) affected. This section characterizes actions within the action area and their impacts on ESA-listed species.

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

NMFS has conducted a number of section 7 consultations to address the effects of federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways to avoid and reduce impacts of the action on listed species.

As described in section 2.0, we have also previously consulted on the authorization of the scallop fishery. Gears used in the fishery (i.e., dredges and bottom trawls) are known to affect ESA-listed species, with some interactions causing injury and death. Therefore, the *Environmental Baseline* for this action also includes the effects of the past authorization of this fishery.

5.1.1 Authorization of Fisheries through Fishery Management Plans

In the Northwest Atlantic, NMFS GARFO manages federal fisheries from Maine to Cape Hatteras, North Carolina; however, the management areas for some of these fisheries range from Maine through Virginia, while others extend as far south as Key West, Florida. The NMFS Southeast Regional Office (SERO) manages federal fisheries from Cape Hatteras, North Carolina to Texas, including Puerto Rico and the U.S. Virgin Islands. Fisheries managed by NMFS GARFO and SERO partially overlap in some parts of the action area.

Both regions have conducted ESA section 7 consultation on all federal fisheries authorized under an FMP or ISFMP. NMFS SERO has formally consulted on the following fisheries: (1) coastal migratory pelagics (NMFS (National Marine Fisheries Service) 2015, 2017a); (2) snapper/grouper (NMFS (National Marine Fisheries Service) 2015); (3) dolphin/wahoo (NMFS 2003); (4) Southeast shrimp trawl fisheries (NMFS 2021a); (5) Atlantic highly migratory species, excluding pelagic longline (NMFS (National Marine Fisheries Service) 2020a)and (6) pelagic longline Atlantic highly migratory species (NMFS (National Marine Fisheries Service) 2020b). NMFS GARFO has formally consulted on the Atlantic sea scallop fishery as well as ten batched fisheries that primarily use bottom trawl, gillnet, and pot/trap gear including Northeast multispecies, monkfish, spiny dogfish, Atlantic bluefish, Northeast skate complex, Atlantic mackerel/squid/butterfish, summer flounder/scup/black sea bass, American lobster, Jonah crab, and Atlantic deep-sea red crab.

In these past Opinions, only the consultations on the Atlantic highly migratory species, excluding pelagic longline (NMFS (National Marine Fisheries Service) 2020a), and the ten batched fisheries concluded that there was a potential for collisions between fishing vessels and an ESA-listed species (specifically, sea turtles). Any effects to their prey and/or habitat were found to be insignificant and discountable. We have also determined that the Atlantic herring, Atlantic surf clam and ocean quahog, and golden and blueline tilefish fisheries are not likely to adversely affect any ESA-listed species or their designated critical habitats (NMFS 2010, 2017c, 2020b).

Impacts to Sea Turtles

Each of the most recent NMFS GARFO and SERO fishery consultations noted above consider adverse effects loggerhead, leatherback, Kemp's ridley, and/or green sea turtles. In each of the fishery Opinions, we concluded that the ongoing action was likely to adversely affect but was not likely to jeopardize the continued existence of any sea turtle species. Each of these Opinions included an ITS exempting a certain amount of total and lethal/non-lethal take resulting from interactions with the fisheries. These ITSs are summarized in Table 9.

Table 9. Most recent Opinions prepared by NMFS GARFO and SERO for federally managed fisheries in the action area and their respective ITSs for sea turtles.

	Date	Loggerhead (NWA DPS)	Kemp's ridley	Green (North Atlantic DPS)	Leatherback
GARFO FMPs					
Atlantic sea scallop	July 12, 2012 (ITS amended November 27, 2018)	322 (92 lethal) over a 2 year period in dredges; 700 (330 lethal) over a 5 year period in trawls	3 (2 lethal) annually in dredges and trawls combined	2 (both lethal) annually in dredges and trawls combined	2 (both lethal) annually in dredges and trawls combined
American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/ Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and Omnibus EFH Amendment 2 (Batched Fisheries)	May 27, 2021	1,995 (1,289 lethal) over a 5 year period in trawl, gillnet, and pot/trap gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	292 (214 lethal) over a 5 year period in trawl and gillnet gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	42 (24 lethal) over a 5 year period in trawl and gillnet gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes	142 (93 lethal) over a 5 year period in trawl, gillnet, and pot/trap gear; up to 3 (3 lethal) over a 5 year period due to vessel strikes
SERO FMPs					
Coastal migratory pelagics*	June 18, 2015, later amended 2017	27 over 3 years (7 lethal)	8 over 3 years (2 lethal)	31 over 3 years (9 lethal)	1 over 3 years (1 lethal)
South Atlantic snapper-grouper	December 1, 2016	629 (208 lethal) over 3 years	180 (59 lethal) over 3 years	111 (42 lethal) over 3 years	6 (5 lethal) over 3 years
Southeastern U.S. Shrimp Fisheries and Sea Turtle Conservation Regulations	April 26, 2021	72,670 (1,700 lethal) over a 5 year period	84,495 (8,505 lethal) over a 5 year period	21,214 (1,700 lethal) over a 5 year period	130 (5 lethal) over a 5 year period
HMS fisheries, excluding pelagic longline	January 10, 2020	91 (51 lethal) over 3 years	22 (11 lethal) over 3 years	46 (21 lethal) over 3 years	7 (3 lethal) over 3 years
HMS, pelagic longline	May 15, 2020	1080 (280 lethal) over 3 years	21 (8 lethal) combination of Kemp's ridley, green (includes NA and SA DPS), hawksbill, or olive ridley over 3 years		996 (275 lethal) over 3 years
South-Atlantic dolphin-wahoo	August 27, 2003	12 (2 lethal) annually	3 (1 lethal) combination of Kemp's ridley, green, or hawksbill annually		12 (1 lethal) annually

* The coastal migratory pelagic consultation states a total of 31 green sea turtle takes of both DPSs combined is expected, but no more than 30 from the North Atlantic DPS and no more than two from the South Atlantic DPS

The NEFSC has estimated the take of sea turtles in gillnet, dredge, and trawl gear in the Greater Atlantic Region (Table 10). When available, these estimates were considered in developing the ITSs.

Table 10. Estimates of average annual sea turtle interactions in fishing gear. Numbers in parentheses are adult equivalents.

Gear	Years	Area	Estimated Interactions (adult equivalents)	Mortalities (adult equivalents)	Source
Sea Scallop Dredge	2015-2019	Mid-Atlantic	Loggerhead: 155 (31)	Loggerhead: 53 (11)	Murray (2020a)
Bottom Trawl	2014-2018	Mid-Atlantic and Georges Bank	Loggerhead: 116.6 (36.4) Kemp's ridley:9.2 Green: 3.2 Leatherbacks: 5.2	Loggerhead: 54.4 (17.4) Kemp's ridley: 4.6 Green: 1.6 Leatherbacks:2.6	Murray (2020b)
Sink Gillnet	2012-2016	Mid-Atlantic	Loggerhead: 141 (3.8) Kemp's ridley: 29 Leatherbacks: 5.4 Unid. hardshell: 22.4	Loggerhead: 111.4 Kemp's ridley: 23 Leatherbacks: 4.2 Unid. hardshell: 17.6	Murray (2018)

Impacts to Atlantic sturgeon

Commercial fisheries that operate in the action area for this consultation capture and kill Atlantic sturgeon originating from each of the five listed DPSs. Given this, consultations on fisheries in the Greater Atlantic and Southeast Regions consider the take of Atlantic sturgeon (Table 11).

Table 11. Most recent Opinions prepared by NMFS GARFO and SERO for federally managed fisheries in the action area that result in takes of the five DPSs of Atlantic sturgeon and their respective ITSs.

	Date	**Gulf of Maine DPS**	**New York Bight DPS**	**Chesapeake Bay DPS**	**Carolina DPS**	**South Atlantic DPS**
<u>GARFO FMPs</u>						
American Lobster, Atlantic Bluefish, Atlantic Deep-Sea Red Crab, Mackerel/Squid/Butterfish, Monkfish, Northeast Multispecies, Northeast Skate Complex, Spiny Dogfish, Summer Flounder/Scup/Black Sea Bass, and Jonah Crab Fisheries and Omnibus EFH Amendment 2 (Batched Fisheries)	May 27, 2021	615 (75 lethal) over a 5 year period in trawl and gillnet gear	5,020 (590 lethal) over a 5 year period	755 (85 lethal) over a 5 year period	180 (20 lethal) over a 5 year period	395 (45 lethal) over a 5 year period

Atlantic sea scallop	July 12, 2012 (ITS amended November 27, 2018)	One take annually in scallop trawl gear from any of the five DPSs (one lethal take every 20 years from any of the five DPSs)				
SERO FMPs						
Coastal migratory pelagics	June 18, 2015	2 (12)* every 3 years; 0 lethal	4 (12)* every 3 years; 0 lethal	3 (12)* every 3 years; 0 lethal	4 (12)* every 3 years; 0 lethal	10 (12)* every 3 years; 0 lethal
Southeastern U.S. Shrimp Fisheries and Sea Turtle Conservation Regulations	April 26, 2021	2 (0 lethal) over a 5 year period	7 (2 lethal) over a 5 year period	19 (4 lethal) over a 5 year period	66 (15 lethal) over a 5 year period	103 (24 lethal) over a 5 year period
HMS fisheries, excluding pelagic longline	January 10, 2020	34 (8 lethal) every 3 years	170 (36 lethal) every 3 years	40 (9 lethal) every 3 years	10 (5 lethal) every 3 years	75 (19 lethal) every 3 years

* The coastal migratory pelagics Opinion estimates a total take of 12 Atlantic sturgeon across all five DPSs. The Opinion considered the percent each DPS, presented as a range, is expected to be in the action area. To be conservative, the Opinion considered the high end of the range in apportioning take between DPSs, which is the number before each parenthesis (i.e., the number before the parenthesis is the maximum number of individuals per DPS that may be taken that would not trigger reinitiation). However, in total, no more than 12 Atlantic sturgeon are anticipated to be taken in the fishery every three years (NMFS (National Marine Fisheries Service) 2015, 2017a).

In a review of bycatch rates on fishing trips from 1989 to 2000, Atlantic sturgeon were recorded in both gillnet and trawl gears, and bycatch rates varied by gear type and target species. Bycatch was highest for sink gillnets in specific areas of the coast. Mortality was higher in sink gillnets than trawls (Stein et al. 2004a). More recent analyses were completed in 2011 and 2016.

In 2011, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in federally managed commercial sink gillnet and otter trawl fisheries from Maine through Virginia. This estimate indicated that from 2006-2010, an annual average of 3,118 Atlantic sturgeon were captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets was estimated at approximately 20% and the mortality rate in otter trawls was estimated at 5%. Based on this estimate, 391 Atlantic sturgeon were estimated to be killed annually in federal fisheries prosecuted in the Greater Atlantic Region (Miller and Shepard 2011).

An updated, although unpublished, Atlantic sturgeon bycatch estimate in Northeast sink gillnet and otter trawl fisheries for 2011-2015 was prepared by the NEFSC in 2016. Using this information, the authors of the recent Atlantic Sturgeon Benchmark Stock Assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017) estimated that 1,139 fish (295 lethal; 25%) were caught in gillnet fisheries and 1,062 fish (41 lethal; 4%) were caught in otter trawl fisheries each year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 for trawls) are substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 for trawls) (ASMFC (Atlantic States Marine Fisheries Commission) 2017). It should be noted that the models used in 2011 and 2016 differed. The 2011 analysis used a generalized linear model. In this model, the species mix considered was comprised of those species currently managed under a federal FMP. In the model used in the 2017 ASMFC stock assessment, the species considered as covariates were those species caught most on observed hauls encountering Atlantic sturgeon (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

5.1.2 Aquaculture

Aquaculture has the potential to impact ESA-listed species through entanglement and/or other interaction with aquaculture gear (e.g., buoys, nets, and vertical lines), introduction or transfer of pathogens, increased vessel traffic and noise, impacts to habitat and benthic organisms, and water quality (Clement 2013, Lloyd 2003, Price and Morris 2013, Price *et al.* 2017). Current data suggest that documented interactions and entanglements of ESA-listed sea turtles with aquaculture gear are rare (Price *et al.* 2017). However, this information includes documented interactions only and may not be reflective of actual interaction. There are also concerns about interactions between Atlantic sturgeon and aquaculture with respect to, among others, entanglements, changes to water features related to migration and residency, and habitat conversion. Aquaculture projects have the potential to modify critical habitat through impacts to water quality and habitat conversion. Some components of aquaculture gear and gear used in commercial fisheries are similar; therefore, information on interactions in the similar gear may provide information on the risk aquaculture poses. There are several reports of sea turtles in the North Atlantic entangled in aquaculture gear (Price *et al.* 2017), including one entanglement within the action area.

In the U.S., marine aquaculture production increased an average of 3.3% per year from 2009-2014; however, globally, the U.S. remains a relatively minor aquaculture producer. Farmed items in the Atlantic include finfish (e.g. Atlantic salmon, steelhead trout), shellfish (e.g. American and European oyster, quahog, blue mussels, softshell clams, sea and bay scallops, and quahogs), and sea vegetables (e.g., sugar kelp). Trials with other species, such as cod and halibut have occurred previously and there is known interest to farm other marine fish species in the future, such as sea trout and black sea bass. Hatchery-raised species are also used to support important commercial and recreational fisheries, as well as for habitat and endangered species restoration. Aquacultured products are grown for medical research, pharmaceuticals, food additives, ornamentals, and aquarium commerce.

The 2018 Census on Aquaculture collected national data about the industry (USDA 2019). In this survey, aquaculture is the farming of aquatic organisms, including baitfish, crustaceans, food fish, mollusks, ornamental fish, sport/game fish, and other products. It includes algae and sea vegetables but does not include other aquatic plants. The 2018 Census reports 774 saltwater farms and 51,674 acres of saltwater aquaculture from Maine through Florida. It should be noted that this includes the west coast of Florida, and that for some states (Delaware, New Jersey), the acreage is not reported to preserve confidentiality (USDA 2019). In addition, the farms reported may be in estuaries that are outside the action area.

Aquaculture in the Greater Atlantic Region is, at present, primarily in state waters. Currently, there is one U.S. Army Corps of Engineers (USACE) permit for a pilot scale blue mussel aquaculture operation in federal waters of the Atlantic coast (i.e., between 3 and 200 nautical miles offshore). This project is located eight miles off Rockport, Massachusetts, and has placed three longlines in the water. The permittee submitted an application to USACE in December 2019 to expand the operation to a total of 20 longlines, but at the time of this consultation has not yet submitted a completed Biological Assessment to initiate the section 7 consultation process.

As provided in Table 12, there are four categories of aquaculture gear used in the Greater Atlantic Region: floating gear, net pen, shell on bottom, and cage on bottom. Based on ESA section 7 consultations conducted in the Greater Atlantic Region between 2015 and January of 2019,[7] we compiled a list of states that have aquaculture farms, and, per state, the number and type of aquaculture gear used (Table 13). One case in 2014 was also included due to its offshore locations.

The species grown in various gear types include shellfish, finfish, and seaweeds (Table 12). Floating gear includes surface longlines, submerged longlines, and a floating upweller system. Aquaculture longlines are not the same as longline gear used in fisheries. In aquaculture, surface longlines consist of horizontal longline suspended on/near the surface of the water with buoy lines or poles at each end. Various types of cages or flip bags may be used to keep organisms inside an enclosed space. In deeper and higher energy locations, submerged longline are used. Their design consists of horizontal longlines suspended below the surface with moorings/marker buoys at each end. Some may have another mooring in the middle of their run. The longlines are suspended below the water surface and use a series of buoys to maintain the depth. This gear category also includes a floating upweller system (FLUPSY). This system is a dock or pier with tanks used to grow shellfish in open water while protecting them from predation. The FLUPSY has a motor that pulls water through the bottom of the tanks. As the water moves through the system, it provides a continuous food supply to the shellfish by transporting algae.

Net pens are a type of enclosure culture and involve holding organisms captive within an enclosed space while maintaining a free exchange of water. They are enclosed on the bottom and sides by wooden, mesh or net screens. These types of gear are in direct contact with the surrounding environment. Shell on bottom refers to a technique used to grow shellfish, such as oysters, on the bottom of the ocean floor without cages. Shell on bottom also includes cases used for oyster bed restoration and maintenance, artificial oyster reefs creation, and spat collector installation. Cage on bottom also refers to a technique used to grow shells on the bottom of the ocean floor where cages are used.

Table 12.5 Examples of organisms grown for each aquaculture gear type.

Gear type	Examples of grown organisms
Floating gear	Kelp, mussels, oysters, scallops
Net pens	Fish (e.g., Atlantic salmon)
Shell on bottom	Oysters, clams, mussels
Cage on bottom	Oysters, clams

[7] Counts include experimental and/or gear that are no longer deployed.

Aquaculture sites may use a combination of gear categories, referred to here as multimode. For instance, both cage on bottom and floating gear were used to grow oysters in the waters near Maryland, so this case was included in this "Multimode" category.

Table 13. Aquaculture Gear in the Greater Atlantic Region.

State	Type of Aquaculture Gear					Total
	Floating Gear	Net Pen	Shell on bottom	Cage on bottom	Multimode	
ME	1	1	2	1	0	5
MA	10	0	1	3	0	15
CT	9	0	3	10	0	22
RI	1	0	0	1	1	3
NY	1	0	3	3	0	7
NJ	3	0	0	8	11	22
MD	7	0	115	33	8	163
VA	2	0	59	1	1	63
Total	34	1	183	60	21	299

5.1.3 Dredging, Sand Mining, and Beach Nourishment Activities

The construction and maintenance of federal navigation channels and sand mining ("borrow") areas to aid in beach nourishment activities may result in the take of sea turtles and Atlantic sturgeon. There are several navigational dredge types used in the action area. A hopper dredge uses pumps to force water and sediment up the dragarm and into the hopper. Hopper dredges may be equipped with screens for unexploded ordinance on the intake (UXO screens). Cutterhead dredges have a rotating cutter apparatus surrounding the intake of a suction pipe and may be hydraulic or mechanical. Bucket and clamshell dredges are mechanical devices that use buckets to excavate dredge materials (NMFS (National Marine Fisheries Service) 2019b). Most dredging and dredged material placement projects in the action area are authorized or carried out by the USACE. These projects are under the jurisdiction of districts within the North Atlantic and South Atlantic Divisions.

Due to their design and operation, hopper dredges are the most likely to adversely affect ESA-listed species in the action area. Hard-shelled sea turtles may be injured or killed by hopper dredges when the draghead is placed, impinged on the screen, or entrained in the draghead. It is also possible that sea turtles may become entrained in other intake ports of these dredges. Adverse effects to sea turtles from cutterhead, bucket, and clamshell dredges are extremely unlikely. Atlantic sturgeon, on the other hand, may become entrained during hopper or cutterhead dredging or captured by clamshell or bucket dredges. Sediment suspension, blasting, and relocation trawling associated with dredging projects may also impact these species (NMFS (National Marine Fisheries Service) 2019b). Relocation trawling may be undertaken to move sea turtles and Atlantic sturgeon out of the area being dredged and placing them in an area outside the dredge area. Although done primarily to benefit sea turtles and Atlantic sturgeon, relocation trawling interactions and captures are still considered takes as part of the proposed actions.

NMFS has completed ESA section 7 consultations with the USACE, NASA, and the U.S. Navy to consider the effects of these dredging, sand mining, and nourishment projects on ESA-listed species in the Northeast and Mid-Atlantic (NMFS 2006, 2012a, b, c, 2014, 2018d, 2019, 2020a, NMFS (National Marine Fisheries Service) 2014, 2019b). Takes of sea turtles and Atlantic sturgeon during relocation trawling activities are also included in the consultations and are described below.

A regional biological opinion on the USACE's dredging and material placement activities in the South Atlantic was completed in 2020, and includes activities from North Carolina to Texas. This South Atlantic Regional Biological Opinion (SARBO) (March 27, 2020) concluded that the proposed actions would adversely affect, but not likely jeopardize the continued existence of sea turtles or Atlantic sturgeon. Anticipated take of these species are included in the table below.

Aside from commercial fishing and fisheries research activities, these dredging projects represent one of the largest sources of incidental take for sea turtles and Atlantic sturgeon in the action area, and, potentially, one of the largest sources of lethal take. Active Opinions covering dredging, beach nourishment, and shoreline restoration/stabilization projects in the action area and the associated ITSs for sea turtles and Atlantic sturgeon are presented below (Table 14).

Table 14. NMFS formal consultations on dredging and disposal projects that occur in the action area and the anticipated take of ESA-listed species. Unless otherwise noted, the anticipated takes are over the life of the project.

Project	Date of Opinion	NWA DPS Loggerhead	Kemp's ridley	North Atlantic DPS Green	Leatherback	Atlantic Sturgeon	Life of Project
USACE Maintenance Dredging at Bath Iron Works, Maine	9/20/2020					3 GOM DPS juveniles, subadults, or adults (3 lethal)	2019-2029
USACE New York Coastal Storm Risk Management – Beach Nourishment Projects	9/3/2020	Non-lethal: 35 (trawling); Lethal: 3 (hopper dredge entrainment)	Non-lethal: 7 (trawling); Lethal: 1 (hopper dredge entrainment)		Non-lethal: 14 (trawling)	Non-lethal: 1,533 adults or subadults (trawling); Lethal: 3 subadults (hopper dredge entrainment), 82 adults or subadults (trawling) across all 5 listed DPSs	2020-2039
USACE Deepening and Maintenance of the Delaware River Federal Navigation Channel	11/22/2019	37 (37 lethal)	3 (3 lethal)			1763 non-lethal NYB DPS (relocation trawling and tagging); 8 lethal GOM DPS, 67 lethal NYB DPS, 21 lethal CB DPS, and 20 lethal SA DPS (dredging) 1.3% of each year class post yolk-sac larvae NYB DPS	2020-2070
U.S. Navy; USACE Maintenance Dredging of the Kennebec River FNP	10/25/2019					5 GOM DPS juveniles, subadults, or adults (5 lethal)	2019-2029
USACE Atlantic Coast of Maryland Shoreline Protection Project	11/30/2006	22 (22 lethal)	2 (2 lethal)				2008-2044
NASA Wallops Island Shoreline Restoration/ Infrastructure Protection Program	8/3/2012	9 (9 lethal) of which no more than 1 (1 lethal) may be a Kemp's ridley				2 (2 lethal) GOM, NYB, CB, Carolina, or SA DPS	2012-2062
USACE Sea Bright Offshore Borrow Area Beach Nourishment	3/7/2014	8 (8 lethal) combination of loggerheads and Kemp's ridleys (but no more than 3 Kemp's ridleys total)				2 NYB DPS and 1 CB, GOM, Carolina, or SA DPS (Elberon to Loch Arbour, all lethal); 2 of any DPS (Port Monmouth and Union Beach, all lethal)	50 years

<table>
<tr><td>USACE New Jersey and Delaware Beach Nourishment Program</td><td>6/26/2014</td><td>29 (29 lethal)</td><td>2 (2 lethal)</td><td>1 (1 lethal)</td><td></td><td>1 GOM DPS (1 lethal);
9 NYB DPS (9 lethal);
3 CB DPS (3 lethal);
3 SA DPS (3 lethal)</td><td>2014-2064</td></tr>
<tr><td rowspan="2">USACE Dredging of Chesapeake Bay Entrance Channels and Beach Nourishment</td><td rowspan="2">10/15/2018</td><td>1,722 (785 lethal)</td><td>352 (77 lethal)</td><td>58 (20 lethal)</td><td></td><td>100 (24 lethal) GOM DPS;
350 (94 lethal) NYB DPS;
100 (34 lethal) CB DPS;
50 (13 lethal) Carolina DPS;
150 (40 lethal) SA DPS</td><td rowspan="2">50 years</td></tr>
<tr><td colspan="4">Relocation Trawling: 1,250 (50 lethal) total;
of these, up to 937 captures (37 lethal) of loggerheads,
275 captures (11 lethal) of Kemp’s ridleys, and
37 captures (2 lethal) of green sea turtles</td><td>Relocation Trawling: 700 (0 lethal) total; Of these, ≤ 100 GOM, ≤ 350 NYB DPS, ≤ 100 CB DPS; ≤50 Carolina DPS; ≤150 SA DPS</td></tr>
<tr><td>USACE SARBO</td><td>3/27/2020</td><td>5,484 (214 lethal) and 65 lost egg clutches over 3 years</td><td>1,456 (116 lethal) and 1 lost egg clutch over 3 years</td><td>860 (118 lethal) and 3 lost egg clutches over 3 years</td><td>369 (4 lethal) and 6 lost egg clutches over 3 years</td><td>2 (1 lethal) GOM DPS;
39 (5 lethal) NYB DPS;
105 (14 lethal) CB DPS;
366 (47 lethal) Carolina DPS;
572 (73 lethal) SA DPS
over 3 years</td><td></td></tr>
</table>

5.1.4 Research and Other Permitted Activities

Within the action area, NMFS has completed section 7 consultation on research (either conducted or funded by federal agencies) and other federally-permitted activities that may adversely affect ESA-listed sea turtles and Atlantic sturgeon. Below, a description of recently completed section 7 consultations on research and other permitted activities is provided.

NEFSC Fisheries and Ecosystem Research

NEFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in coastal, estuarine, and marine waters of the U.S. Atlantic Ocean from Maine to Florida. A number of cooperative research projects also occur within the action area each year. The cooperative research projects are designed to address emerging needs of the fishing industry, for information about particular species, or for modifications to fishing gear to address conservation concerns. Grant programs that fund cooperative research along the U.S. Atlantic coast include the Cooperative Research Partners Program, Northeast Consortium Cooperative Research Program, Commercial Fisheries Research Foundation, and the Research Set-Aside (RSA) Program. A major research initiative is the Northeast Area Monitoring and Assessment Program (NEAMAP) nearshore trawl surveys. These fishery surveys are conducted every spring and fall by the Virginia Institute of Marine Science (VIMS) in shallow (up to 120 feet), nearshore waters from Cape Hatteras, North Carolina to Montauk, New York. Those surveys are similar in design and are meant to complement the annual NEFSC spring and fall bottom trawl surveys, which are conducted in deeper waters of the U.S. Atlantic.

NEFSC-conducted or funded fisheries and ecosystem surveys that are known to interact with sea turtles and Atlantic sturgeon include those that utilize bottom trawl, gillnet, and longline gear. Sea turtles have been caught in the following NEFSC survey programs: Cooperative Atlantic States Shark Pupping and Nursery (COASTSPAN) gillnet and longline surveys, Spring and Fall NEFSC Bottom Trawl Surveys, Spring and Fall NEAMAP trawl surveys, and Apex Predators longline surveys. Atlantic sturgeon have been caught during the NEFSC bottom trawl surveys and the spring and fall NEAMAP bottom trawl surveys. A few short-term cooperative research projects have also captured Atlantic sturgeon.

In June 2016, NMFS completed a programmatic Opinion (NMFS (National Marine Fisheries Service) 2016) on all fisheries and ecosystem research activities to be conducted and funded by the NEFSC from June 2016 to June 2021. Based on the information presented in the Opinion, we anticipate that these fisheries and ecosystem research projects, over the five-year period, will result in the capture of:

- up to 85 NWA DPS of loggerhead sea turtles (ten lethal);
- up to 95 Kemp's ridley sea turtles (15 lethal);
- up to 10 North Atlantic DPS of green sea turtles (non-lethal);
- up to 10 leatherback sea turtles (five lethal); and
- up to 595 Atlantic sturgeon (30 lethal)
    - up to 308 from the NYB DPS (15 lethal),

- up to 130 from the SA DPS (seven lethal),
- up to 70 from the CB DPS (four lethal),
- up to 60 from the GOM DPS (three lethal),
- up to 14 from the Carolina DPS (one lethal), and
- up to 13 Canadian origin (non-listed).

U.S. FWS Funded State Fisheries Surveys
Under the Dingell-Johnson Sport Fish Restoration Grant program and State Wildlife Grant programs, the U.S. FWS Region 5 provides an annual apportionment of funds to 13 Northeast states and the District of Columbia. Vermont and West Virginia are the only two Northeast states that do not use these funds to conduct surveys in marine, estuarine, or riverine waters where ESA-listed species under NMFS jurisdiction are present. The 11 other states (Maine, New Hampshire, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia) and the District of Columbia are anticipated to carry out a total of 113 studies, mostly on an annual basis, under these grant programs. There are several broad categories of fisheries surveys including: hook and line; long line; beach seine; haul seine; bottom trawl; surface trawl; fishway trap; fish lift; boat, backpack, and/or barge electrofishing; fyke net; dip net; gill net; push net; hoop net; trap net; cast net; plankton net; pound net; and fish and/or eel pot/trap. These surveys occur in rivers, bays, estuaries, and nearshore ocean waters of those 11 states and the District of Columbia.

We completed an Opinion on this grant program in October 2018. It bundled together twelve independent actions carried out by the U.S. FWS (i.e., awarding of each grant fund to each state or district is an independent action) and provided an ITS by activity and a summary by state. Overall, we anticipate that the surveys described in the Opinion, which will be carried out by the states from 2018 to 2022 will result in the capture of:

- Up to 37 sea turtles; and
- Up to 427 Atlantic sturgeon (including two in beach/haul seine studies, 266 in bottom trawl studies, 158 in gill net studies, and one interaction during electrofishing activities).

The only mortalities that we anticipate to occur are six Atlantic sturgeon (originating from any of the five DPSs) during gillnet surveys carried out by New York, New Jersey, Maryland, and Virginia.

Section 10(a)(1)(A) Permits
NMFS has issued research permits under section 10(a)(1)(A) of the ESA, which authorizes activities for scientific purposes or to enhance the propagation or survival of the affected species. The permitted activities do not operate to the disadvantage of the species and are consistent with the purposes of the ESA, as outlined in section 2 of the Act. Active section 10(a)(1)(A) permits for sea turtles and Atlantic sturgeon are provided in Tables 14 and 15, respectively. No section 10 permits authorizing serious injury or mortality of marine mammals are currently active.

We searched for research permits on the NMFS online application system for Authorization and Permits for Protected Species. The search criteria used confined our search to active permits that include take of sea turtles and Atlantic sturgeon within the Atlantic Ocean. Search criteria also limited the search to research states from Maine to North Carolina. However, many research activities include both the Gulf of Mexico and the Atlantic Ocean, and the requested take did not always specify the waters where take would occur. Thus, some of the requested sea turtle take in Table 15 below includes take for activities outside the action area (i.e., off the Southeast U.S. or in the Gulf of Mexico).

The requested take reported in Tables 15 and 16 only includes take authorized under section 10(a)(1)(A) of the ESA. Permits related to stranding and salvage programs are described in that section. In addition, several research projects included take authorized under other authorities (e.g., under section 7 of the ESA). These takes are included elsewhere in this Opinion and, therefore, are not included here to avoid double counting of take provided under the ESA.

Table 15. Active section 10(a)(1)(A) permits authorizing take of sea turtles for scientific research.

Permittee	File #	Project	Area	Sea Turtle Takes	Research Timeframe
NMFS Southeast Fisheries Center	16733	Demographic and life history studies of sea turtle populations in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries.	Atlantic Ocean DE,MD,NC, NJ,NY,VA	Sample annually 925 loggerheads, 560 greens, 455 Kemp's ridleys, 65 hawksbills, 60 leatherbacks, 10 olive ridleys, and 24 unidentified/hybrid hardshells. In addition, we plan to observe during aerial, vessel, and acoustic surveys annually 2620 loggerheads, 565 greens, 615 Kemp's ridleys, 287 hawksbills, 665 leatherbacks, 37 olive ridleys, and 2170 unidentified hardshells.	5 years, 08/13/2013 to 08/13/2019
NMFS Northeast Fisheries Science Center	17225	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	U.S. locations including offshore waters	Over the course of the permit: Northern area (NH to NC): 8 green, 8 Kemp’s, 8 leatherbacks, 26 loggerheads; no lethal (capture covered under other authorities) over the course of the permit Southern area (SC to GA): 10 green, 8 hawksbill, 62 Kemp’s, 8 leatherback, 148 loggerhead. Unintentional (incidental) mortality: 6 unidentified	5 years, 01/01/2017 to 12/31/2021

Coonamessett Farm Foundation, Inc.	18526	Understanding Impact of the Sea Scallop Fishery on Loggerhead Sea Turtles through Satellite Tagging	Western Atlantic waters / Mid-Atlantic Bight from Cape Hatteras, North to NY LIS; and from coastal waters to the shelf break	A maximum of 200 loggerhead (20 captured and sonic tagged/80 approached unsuccessfully and 100 observed and tracked with ROV). Non-Target species: 2 Kemps ridley, green (captured and sonic tagged); 8 Kemp's ridley, green, leatherback, and/or unidentified (approached unsuccessfully); and 20 Kemp's ridley, green, leatherback, and unidentified (observed and tracked with ROV) sea turtles are requested per year.	5 years, 05/27/2015 to 05/31/2020
Robert DiGiovanni Jr, Atlantic Marine Conservation Society	20294	Marine mammal and sea turtle surveys to assess seasonal abundance and distribution in the Mid-Atlantic region.	Atlantic Ocean / Focal area: New York Bight and surrounding waters; Research can occur off MA,RI, CT, NY, NJ, DE, MD, VA and NC	Aerial Surveys: 125 Kemp's ridley, leatherback 85, 450 loggerhead, 450 unidentified.	5 years, 06/02/2017 to 06/01/2022
NMFS Southeast Fisheries Center (SEFSC)	20339	Application for a scientific research and enhancement permit under the ESA; development and testing of gear aboard commercial fishing vessels.	Project A: Turtle Excluder Device (TED) Evaluations in Atlantic and Gulf of Mexico Trawl Fisheries Project B research will occur solely within longline commercial fisheries where the incidental capture is already authorized by an existing ESA Section 7 biological opinion.	Project A, annual take numbers: 220 (70 of these to include capture) loggerheads, 105 (25 of these captures) Kemp's ridleys, 85 (20 of these captures) leatherbacks, 50 (15 of these captures) greens, 30 (10 of these captures) hawksbills, 30 (10 of these captures) olive ridleys, and 75 (25 of these captures) unidentified/hybrid turtles. A subset of these animals will be captured during trawl research authorized under this permit as noted in the parentheses; the rest of the turtles will be captured within fisheries managed by federal authority. Project B, annual take numbers: 30 loggerheads, 10 Kemp's ridleys, 30 leatherbacks, 10 greens, 10 hawksbills, 10 olive ridleys, and 10 unidentified/hybrid turtles. Total over 5 yrs., unintentional mortality: 2 green, 1 hawksbill, 2 Kemp's, 1 leatherback, 3 loggerhead, and 1 olive.	5 years, 05/23/2017 to 05/31/2022

Virginia Aquarium and Marine Science Center	20561	2018 Renewal Request for Virginia Aquarium Sea Turtle Research Permit	Atlantic Ocean, Long Island Sound, Delaware Bay, Chesapeake Bay, North Carolina Sounds / Estuarine and ocean waters from shore to the continental shelf off of NY, NJ, DE, MD, VA and northern NC including inshore brackish waters of bays, sounds and river mouths.	Up to 72 turtles annually (25 green, 22 Kemp's ridley, 25 loggerhead) would be captured, sampled, and tagged. Up to one leatherback sea turtle may be opportunistically captured, sampled, and tagged. 18 turtles will be captured under other authority annually (5 green, 8 Kemp's, and 5 loggerhead)	10 years, 08/24/2018 to 09/30/2027
NMFS Northeast Fisheries Science Center (NEFSC)	21233	Demographic and life history studies of sea turtle populations in the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, and tributaries	Project: 1) Cape Lookout Bight, NC 2) Gulf Stream Surveys, NC 3) North Carolina In-water Studies 4) Leatherback Studies, GOM and Atlantic 5) Biscayne National Park and Chassahowitzka National Wildlife Refuge 6) Florida Keys National Marine Sanctuary 7) Trawl captures in Gulf of Mexico 8) Programmatic In-water Studies	Project 1, 2, and 3: 555 loggerheads, 390 greens, 18 leatherbacks, 360 Kemp's ridleys, 21 hawksbills, 11 olive ridleys, and 18 unidentified hardshell/hybrids Project 4: 50 total leatherbacks captured and satellite tagged per year (25 GOM, 25 Atlantic). And, up to 50 leatherbacks may be observed/pursued during vessel surveys but not captured during unsuccessful capture attempts. Up to 50 leatherbacks may be observed/pursued during aerial surveys but not captured. Possibly up to 25 leatherbacks captured under other authority (e.g., Pelagic Longline Fishery bycatch) Project 5: Up to 140 green turtles, 22 hawksbills, 85 Kemp's ridley and 115 loggerheads will be captured and processed and released in Biscayne National Park or Chassahowitzka annually. Up to 100 green, 50 loggerhead, and 20 Kemp's ridley turtles could be pursued without capture during vessel surveys and capture efforts annually. Project 6: Up to 60 greens, 35 hawksbills, 15 Kemp's ridleys and 30 loggerheads will be captured, processed, and released in the Florida Keys annually. Up to 5 hawksbills could be pursued without capture during survey and capture efforts. Project 7: Capture annually with trawl gear in the Gulf of Mexico 10 greens, 2 hawksbills, 10 Kemp's ridleys, 10 loggerheads, and 2 leatherbacks.	10 years, 08/07/2018 to 09/30/2027

				Project 8: Up to 60 green turtles, 25 hawksbills, 60 Kemp's ridley, and 60 loggerheads will be captured, processed, and released annually. Up to 25 green turtles, 10 hawksbills, 25 Kemp's ridley, 25 leatherbacks, and 50 loggerheads will be processed and released after being legally captured under another authority (e.g., commercial fisheries, other Section 10 permits) annually. All: unintentional lethal take over the life of the permit (all capturing and processing) of 2 loggerheads, 2 Kemp's ridleys, 2 greens, 1 leatherback, 1 olive ridley, and 1 hawksbill	

Table 16. Active section 10(a)(1)(A) permits authorizing take of Atlantic sturgeon for scientific research.

Permittee	File #	Project	Area	Atlantic Sturgeon Takes	Research Timeframe
NMFS Northeast Fisheries Science Center	17225	Conservation engineering to reduce sea turtle and Atlantic sturgeon bycatch in fisheries in the Northeast Region	Western Atlantic waters (Massachusetts through Georgia, including inside COLREGs lines).	Northern area (NH to NC): Non-lethal – 223 sub-adult/adult (capture under other authority) over the course of the permit Southern area (SC to GA): Non-lethal: 204 juvenile/sub-adult/adult over the course of the study Unintentional (incidental) mortality: 6 juvenile/sub-adult/adult over the course of the permit	5 years, 01/01/2017 to 12/31/2021
Connecticut Department of Energy and Environmental Protection, Marine Fisheries	19641	Application to conduct scientific research and monitoring of Shortnose Sturgeon (*Acipenser brevirostrum*) and Atlantic Sturgeon (*A. oxyrinchus oxyrinchus*) in Connecticut Waters and Long Island Sound.	All Connecticut waters	Non-lethal - 300 adult, sub-adult and juvenile annually Unintentional (incidental) mortality: 1 adult/ sub-adult and 1 juvenile annually	10 years, 06/20/2016 to 03/31/2027
University of Maine	20347	Sturgeon of the Gulf of Maine	Gulf of Maine	100 (1 lethal) adults and sub-adults annually 20 (1 lethal) juveniles annually	10 years; 3/31/2017-3/31/2027

Stony Brook University	20351	Atlantic and Shortnose Sturgeon Population Dynamics and Life History in New York and Coastal Marine an Riverine Waters	New York (Long Island Sound), New Jersey, Delaware	685 (up to 30 lethal) juveniles, sub-adults, adults annually	10 years; 02/27/2016-03/31/2027
Delaware State University	20548	Reproduction, habitat use, and inter-basin exchange of Atlantic and Shortnose Sturgeons in the mid-Atlantic	Coastal New York, New Jersey, Delaware	600 (up to 1 lethal) juvenile, sub-adult, and adult annually	10 years; 03/31/2017-03/31/2027
NMFS, Office of Protected Resources	19642	Characterizing juvenile, sub-adult, and adult life stages of endangered Atlantic and Shortnose Sturgeon in the York, Rappahannock, Potomac, and Susquehanna Rivers, their tributaries, the Chesapeake Bay, and the Atlantic Coast.	Atlantic Ocean	200 non-lethal; any life stage (capture under other authority over the course of the permit	5 years; 07/01/2016-06/30/2021

Section 10(a)(1)(B) Permits

Section 10(a)(1)(B) of the ESA authorizes NMFS, under some circumstances, to permit non-federal parties to take otherwise prohibited fish and wildlife if such taking is "incidental to, and not the purpose of carrying out otherwise lawful activities" (50 CFR 217-222). As a condition for issuance of a permit, the permit applicant must develop a conservation plan that minimizes negative impacts to the species. There are currently two active section 10(a)(1)(B) permits in the action area (Table 17). Active permits and permit applications are posted online for all species as they become available at https://www.fisheries.noaa.gov/national/endangered-species-conservation/incidental-take-permits.

Table 17. Active Section 10(a)(1)(B) permits.

Permittee	File #	Project	Area	Annual Endangered Species Takes	Dates
North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries	18102	Inshore anchored gillnet shallow water fishery	State waters of North Carolina: Management unit A - Albemarle, Currituck, Croatan, Roanoke B - Pamlico Sound and the northern portion of Core Sound C - Pamlico, Pungo, Bay, and Neuse river drainages D - southern Core Sound, Back Sound, Bogue	Large and small mesh fisheries combined Atlantic sturgeon Carolina DPS Total Lethal: 138 per year Total Non-lethal: 2,124 per year Unit A: 110 lethal and 2,063 non-lethal per year Unit B: 11 lethal and 27 non-lethal per year Unit C: 9 lethal and 10 non-lethal per year Unit D: 4 lethal and 12 non-lethal per year	2014-2024

			Sound, North River, and Newport River E - Atlantic Intracoastal Waterway and adjacent sounds and the New, Cape Fear, Lockwood Folly, White Oak, and Shallotte rivers	Unit E: 4 lethal and 12 non-lethal per year Atlantic sturgeon other DPS Total Lethal: 31 per year Total Non-lethal: 634 Unit A: 31 lethal and 618 non-lethal Unit B: 0 lethal and 12 non-lethal Unit C: 0 lethal and 4 non-lethal Unit D: no take Unit E: no take	
North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries	16230	Inshore anchored gillnet shallow water fishery	State waters of North Carolina: inshore waters 6 management units	Combined take for small and large mesh gillnets <u>Green sea turtle</u> Lethal: 165 per year Non-lethal: 330 per year Either: 18 per year* <u>Kemp's ridley sea turtle</u> Lethal: 49 per year Non-lethal: 98 per year Either: 12 per year* <u>Leatherback sea turtle</u> Lethal: n/a Non-lethal: n/a Either: 8 per year* <u>Loggerhead sea turtle</u> Lethal: n/a Non-lethal: n/a Either: 24 per year* <u>Any species</u> Lethal: n/a Non-lethal: n/a Either: 8 per year* * Observed take, rest are estimated take based on observed take. N/A if not enough observed take occurred to provide an estimate.	2013-2023

5.1.5 Operations of Vessels Carrying Out Federal Actions

Potential sources of adverse effects to sea turtles and Atlantic sturgeon from federal vessel operations in the action area include operations of the U.S. Navy, U.S. Coast Guard (USCG), Bureau of Ocean Energy Management (BOEM), Maritime Administration (MARAD), Environmental Protection Agency (EPA), NOAA and USACE vessels. NMFS has previously conducted formal consultations with the Navy and USCG on their vessel-based operations. NMFS has also conducted section 7 consultations with BOEM and MARAD on vessel traffic related to energy projects and has implemented conservation measures. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for federal vessel operations to avoid or minimize adverse effects to listed species.

5.1.6 Military Operations

NMFS has completed consultations on individual Navy and USCG activities (see https://www.fisheries.noaa.gov/national/endangered-species-conservation/biological-opinions). In the U.S. Atlantic, the operation of USCG boats and cutters are estimated to take no more than one individual sea turtle, of any species, per year (NMFS (National Marine Fisheries Service) 1995, 1998).

In 2018, NMFS issued an Opinion on the U.S. Navy Atlantic Fleet's military readiness training and testing activities and the promulgation of regulations for incidental take of marine mammals (NMFS (National Marine Fisheries Service) 2018). The action area includes the Gulf of Mexico and the western Atlantic. NMFS concluded that the action is not likely to jeopardize the continued existence of NWA DPS loggerhead, leatherback, Kemp's ridley, or North Atlantic DPS green sea turtles and Atlantic sturgeon (Gulf of Maine, New York, Chesapeake Bay, Carolina, and South Atlantic DPSs). For this Opinion, NMFS anticipated the following takes from harm due to exposure to impulsive and non-impulsive acoustic stressors annually: 97 NWA DPS loggerhead, 24 leatherback, five Kemp's ridley, and six North Atlantic DPS green sea turtles. In addition, two lethal takes of loggerhead sea turtles were anticipated. Other sea turtle takes from these stressors are expected to be in the form of harassment. Takes from vessel strikes were anticipated to include the lethal take annually of 75 loggerhead, five leatherback 20 Kemp's ridley, and 55 green sea turtles. Eleven loggerhead, three leatherback, five Kemp's ridley, and four green sea turtles were anticipated have non-lethal injuries. For vessel strikes, the Opinion also anticipates the take of no more than six Atlantic sturgeon (up to one from the Gulf of Maine DPS, one from the New York Bight DPS, six from the Chesapeake Bay DPS, six from the Carolina DPS, and one from the South Atlantic DPS) combined from all DPSs over a five-year period. The ITS did not specify the amount or extent of take of ESA-listed fish, but rather used a surrogate expressed as a distance to reach effects in the water column with injury and sub-injury from acoustic stresses. In addition to takes due to acoustic stressors and vessel strikes, take was estimated to occur as a result of small and large ship shock trials. Forty one (41) NWA DPS loggerhead, 17 leatherback, four Kemp's ridley, and two North Atlantic DPS green sea turtles are anticipated to be harmed over the course of the action. In addition, two lethal takes of loggerheads were estimated.

5.1.7 Offshore Oil and Gas

BOEM oversees leasing of Outer Continental Shelf (OCS) energy and mineral resources; this includes administering the leasing program for OCS oil and gas resources. Currently, BOEM is working under the 2017-2022 National OCS Program, but has initiated a process to develop a program for 2019-2024. No lease sales are scheduled for the Atlantic OCS under the current plan. Under the proposed plan, BOEM has divided the Atlantic OCS into four planning areas: North Atlantic, Mid Atlantic, South Atlantic, and Straits of Florida Planning Areas. The action area overlaps with two of the four Planning Areas (North and Mid Atlantic). The draft proposed program for leasing, published in 2018, calls for leasing in the North Atlantic Planning Area in 2021, 2023 and 2025, and in the Mid Atlantic Planning Area in 2020, 2022 and 2024. At this time, the proposed program has not been approved or finalized.

Geophysical and/or geotechnical surveys to identify hydrocarbon resources would occur if leasing is being pursued in the action area. NMFS recently prepared an Opinion that considered the effects of these activities on ESA-listed species in the action area. It estimated the incidental take of NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles. This take was in the form of harassment through behavioral responses and temporary hearing threshold shifts. The Opinion did not anticipate the death of any individual sea turtles exposed to seismic survey activities. The action was also determined to not likely adversely affect any DPS of Atlantic sturgeon (NMFS 2018b). The activities included in the Opinion were scheduled to be completed by November 30, 2019.

5.1.8 Offshore Renewable Energy

BOEM is responsible for overseeing offshore renewable energy development in federal waters pursuant to the 2009 final regulations for the OCS Renewable Energy Program, which was authorized by the Energy Policy Act of 2005 (EPAct). These regulations provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas (i.e., offshore wind and hydrokinetic projects).

Under the renewable energy regulations (30 CFR § 585), the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision making process and occurs over several years with each step having varying impacts to marine and/or terrestrial resources. The process follows these general steps: lease issuance, site assessment plan approval, and construction and operation plan (COP) review/approval including permitting with cooperating agencies. NMFS has carried out programmatic consultations with BOEM to address the effects of issuance of leases and site assessment activities associated with offshore wind energy. These consultations consider effects from of a suite of activities on listed sea turtles, Atlantic sturgeon, and other species. The expected effects of the actions considered result from temporary exposure to acoustic sources (e.g., geophysical survey equipment) that may result in behavioral disturbance of individuals. No take in the form of injury or mortality is anticipated.

As of March 2019, BOEM has issued 15 leases for commercial offshore wind site development along the U.S. Atlantic coast (North Carolina to Massachusetts) and one lease for a research site (off the coast of Virginia) (see https://www.boem.gov/Lease-and-Grant-Information/). A variety of site assessment activities have been completed or are ongoing within the lease blocks, including the use of meteorological buoys or towers at some sites. The effects of these activities on ESA-listed species were considered in the programmatic consultation above. No injury or mortality of any ESA-listed species have been reported to date.

In order for an offshore wind facility on the OCS to be built, BOEM must approve a COP; proposed approval of the COP is the federal action that triggers review under NEPA and ESA section 7 consultation. Generically, effects to be considered include (but are not limited to) noise (pile driving, vessels, surveys), vessel strikes, habitat disturbance/loss, avoidance/displacement from the area, and electromagnetic fields.

In 2014, NMFS conducted a formal consultation on the effects of Deepwater Wind Block Island, LLC's and Deepwater Wind Block Transmission, LLC's proposals to construct and operate the Block Island Wind Farm. No injury of mortality of sea turtles was anticipated. Behavioral disturbance (i.e., harassment) of loggerhead, leatherback, Kemp's ridley, and green sea turtles was anticipated due to exposure to disturbing levels of noise during pile driving. Temporary, short-term behavioral effects due to exposure to underwater noise was also anticipated for Atlantic sturgeon, but NMFS was unable to estimate the number of animals affected.

In 2020, NMFS concluded a formal consultation on the construction, operation, maintenance, and decommissioning of the Vineyard Wind Offshore Energy Project (NMFS 2020c). Vineyard Wind's proposed activity would occur in the northern portion of the 675 square kilometer (166,886 acre) Vineyard Wind Lease Area, also referred to as the wind development area. Under the maximum impact scenario, pile driving during construction is expected to result in harassment of three NWA DPS loggerhead, seven leatherback, one Kemp's ridley, and one North Atlantic DPS green sea turtles. Serious injury or mortality of 17 NWA DPS loggerhead, 18 leatherback, two Kemp's ridley, and two North Atlantic DPS green sea turtles is also anticipated due to vessel strikes. The Opinion also includes estimated levels of take under other scenarios in which the project installs fewer turbines of larger capacity, if such turbines are available, and fewer electrical service platforms (NMFS 2020c).

5.2 Non-federally regulated fisheries

Several fisheries for species not managed by a federal FMP occur in state waters of the action area, as well as fishing by dually permitted vessels (i.e., those possessing both a state and federal permit) when operating under their state permit (NMFS 2021b). In addition, unmanaged fisheries (e.g., hagfish) may occur in federal waters. The amount of gear contributed to the environment by all of these fisheries together is currently unknown. In most cases, there is limited observer coverage of these fisheries, and the extent of interactions with ESA-listed species is difficult to estimate. Sea turtles and Atlantic sturgeon may be vulnerable to capture, injury, and mortality in a number of these fisheries. Captures of loggerhead, leatherback, Kemp's ridley, and green sea turtles (Murray 2008, 2009a, b, 2013, 2015, 2018, 2020, Murray and Orphanides 2013, NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center) 2001, 2009, Warden 2011a, b) and Atlantic sturgeon (ASSRT (Atlantic Sturgeon Status Review Team) 2007, NMFS (National Marine Fisheries Service) 2011) in these fisheries have been reported through state reporting requirements, research studies, VTRs, NMFS NEFSC observer programs, and anecdotal reports.

Sea turtles may interact with fishing gear in state waters. Interactions have been documented with loggerhead, leatherback, Kemp's ridley, and green sea turtles. Gear types used in these fisheries include hook-and-line, gillnet, trawl, pound net and weir, pot/trap, seines, and channel nets. The magnitude and extent of interaction in many of these fisheries is largely unknown. Through the Annual Determination, NMFS identifies U.S. fisheries that are required to take observers upon request. The goals of this coverage is to learn more about interactions in that fishery, evaluate existing measures to prohibit take, and to determine if additional measures may be needed. It is not intended to be a comprehensive list of fisheries with interactions or suspected interactions, but rather those fisheries that NMFS intends to observe over a five-year period (see Table 18 for current listing).

Table 18. Fisheries currently listed under the Annual Determination in the action area and vicinity.

Fishery	Years Eligible to Carry Observers
Southeastern U.S. Atlantic, Gulf of Mexico shrimp trawl	2020-2025
Long Island inshore gillnet	2020-2025
Chesapeake Bay inshore gillnet	2020-2025
Mid-Atlantic gillnet	2018-2022

The available bycatch data for FMP fisheries indicate that sink gillnets and bottom otter trawl gear pose the greatest risk to Atlantic sturgeon (ASMFC (Atlantic States Marine Fisheries Commission) 2017); although, Atlantic sturgeon are also caught by hook and line, fyke nets, pound nets, drift gillnets and crab pots (ASMFC (Atlantic States Marine Fisheries Commission) 2017). It is likely that this vulnerability to these types of gear is similar to federal fisheries, although there is little data available to support this. Information on the number of Atlantic sturgeon captured or killed in non-federal fisheries, which primarily occur in state waters, is extremely limited. An Atlantic sturgeon "reward program" provided commercial fishermen monetary rewards for reporting captures of Atlantic sturgeon in Maryland's Chesapeake Bay from 1996 to 2012 (Mangold *et al.* 2007). The data from this program show that Atlantic sturgeon have been caught in a wide variety of gear types, including hook and line, pound nets, gillnets, crab pots, eel pots, hoop nets, trawls, and fyke nets. Pound nets (58.9%) and gillnets (40.7%) accounted for the vast majority of captures. Of the more than 2,000 Atlantic sturgeon reported in the reward program over 16 years (1996-2012), biologists counted ten individuals that died because of their capture. No information on post-release mortality is available (Mangold *et al.* 2007).

Efforts are currently underway to obtain more information on the number of Atlantic sturgeon and sea turtles captured and killed in state-water fisheries. Atlantic sturgeon are also vulnerable to capture in state-water fisheries occurring in rivers, such as shad fisheries; however, these riverine areas are outside of the action area considered in this Opinion. Where available, specific information on protected species interactions in non-federal fisheries is provided below.

Atlantic croaker fishery

Along the U.S. Atlantic coast, Atlantic croaker are most abundant from the Chesapeake Bay to northern Florida. The Atlantic croaker fishery is managed by the ASMFC. The fishery is prosecuted with bottom trawl and gillnet gear. In 2018, the majority (97%) of commercial landings (in pounds) in came from Virginia (53%) and North Carolina (44%); the majority of recreational landings (in number of fish) were from Virginia (68%) and Florida (13%) (ASMFC 2019). Sea turtle interactions have been documented in this fishery. In previous bycatch estimates where loggerhead bycatch was prorated by managed species landed, croaker was one of the fisheries with a higher number of takes for trawl (Murray 2015) and gillnet gear (Murray 2018). Atlantic sturgeon interactions have also been observed in the Atlantic croaker fishery, but a quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02% from 1989-2000. Bycatch rates were the ratio of sturgeon catch weight to the catch weight of all species landed (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Stein *et al.* 2004a). The ASSRT notes that the estimates can be heavily biased and the error rate large as observer coverage was not equal between fisheries or months of sampling and error (ASSRT (Atlantic Sturgeon Status Review Team) 2007). In addition, fisheries have changed significantly since these estimates and, therefore, they are likely not applicable to contemporary fisheries.

Weakfish fishery

Weakfish are found Nova Scotia to southeastern Florida, but are more common from New York to North Carolina. The weakfish fishery occurs in both state and federal waters. Most commercial landings occur in the fall and winter months (Weakfish Plan Review Team 2019). The dominant commercial gear is gillnets with about 55% of commercial landings. There has been a shift in the dominant source of landings from trawls in the 1950s to 1980s to gillnets from the 1990s to present (Weakfish Plan Review Team 2019). Other gears include pound nets, haul seines, and beach seines (ASMFC (Atlantic States Marine Fisheries Commission) 2016). North Carolina (34%), New York (23%), and Virginia (22%) had the largest share of the harvest in 2018 (Weakfish Plan Review Team 2019). North Carolina dominates commercial harvest, followed by Virginia and New Jersey. Together, these states have consistently accounted for 70%-90% of the coast-wide commercial harvest since 1950 (ASMFC (Atlantic States Marine Fisheries Commission) 2016, Weakfish Plan Review Team 2015, 2016, 2017, 2018, 2019). The recreational fishery catches weakfish using live or cut bait, jigging, trolling, and chumming, and the majority of fish are caught in state waters. The recreational fishery primarily occurs in state waters between New York and North Carolina (Weakfish Plan Review Team 2019).

Sea turtle bycatch in the weakfish fishery has occurred. NMFS originally assessed the impacts of the fishery on sea turtles in an Opinion issued in 1997 (NMFS (National Marine Fisheries Service) 1997). While recent gillnet bycatch estimates for 2007-2011 (Murray 2013) and 2012-

2016 (Murray 2018) prorated the bycatch by species landed, they did not include an estimate of loggerhead bycatch estimate in the weakfish gillnet fishery. In an estimate of bycatch from 2002-2006, one loggerhead sea turtle was estimated to have been captured in the weakfish fishery based on a proration by species landed (Murray 2009b). These estimates encompassed both state and federal waters.

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. Weakfish has also been identified as the top landed species on observed trips where sturgeon were incidentally captured (NEFSC observer/sea sampling database, unpublished data). In addition, as described above, the weakfish-striped bass fishery was identified as having higher bycatch rates using data from 1989-2000 (ASSRT (Atlantic Sturgeon Status Review Team) 2007); however, there are a number of caveats associated with this data.

Whelk/conch fishery
A whelk/conch fishery occurs in several parts of the action area, including waters off Maine, Massachusetts, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia. While pot gear is the predominant gear used, whelk/conch are also harvested by hand and dredge. The fishery is limited entry in Massachusetts, New York, New Jersey and Virginia. Species targeted include waved, Stimpson, channeled, and knobbed whelk. Unlike lobster, there is no uniform, coast-wide management of the whelk fishery. Each state manages the fishery individually. Requirements often include licenses, gear marking, pot limits, and buoy line requirements.

Whelk fisheries overlap in time and space with sea turtles. Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, finfish, whelk, and crab species (GAR STDN, unpublished data). Unlike lobster pots, whelk pots in this area are not fully enclosed. This design of whelk pots has been suggested as a potential source of entrapment for loggerhead sea turtles that may be enticed to enter the trap to get the bait or whelks caught in the trap (Mansfield *et al.* 2001). Whelk fisheries in Massachusetts, New York, Delaware, Maryland, and Virginia were confirmed or probable fisheries involved in 22 sea turtle entanglements from 2009-2018. Seventeen entanglement events involved a leatherback sea turtle and five involved a loggerhead sea turtle. An additional 18 leatherbacks were entangled in either multiple gears (e.g., conch and lobster) or in gear where the fisherman held multiple permits, including conch, and the exact gear could not be identified. Green sea turtles have been documented in whelk/conch gear in previous years (GAR STDN, unpublished data). Atlantic sturgeon interactions with trap/pot gear have never been observed or documented and; therefore, this gear type is not expected to be a source of injury or mortality to these species.

Crab fisheries
Crab fisheries use a variety of gears including hand, pot/trap, trawl, and dredge. These fisheries occur in federal and state waters and target species such as blue, Jonah, rock and horseshoe crab. While the blue crab fishery occurs throughout the Mid-Atlantic south to the Gulf of Mexico, Maryland, Virginia, and North Carolina harvesters prosecute the majority of the effort. The

Chesapeake Bay Program's Blue Crab Management Strategy indicates that there are multiple commercial and recreational gear types, various season lengths and regulations in three management jurisdictions. Fishing practices and the resulting harvest vary because of the complex ways crabs migrate and disperse throughout Chesapeake Bay.

The Jonah and rock crab fisheries may be prosecuted in conjunction with the lobster fishery. In this case, lobster traps are likely to be used. Depending on state regulation, other style traps may be available for use. Jonah crabs are harvested from deeper waters than rock crabs, and presently, are more highly valued. The commercial Jonah crab fishery is centered around Massachusetts and Rhode Island, though landings occur throughout New England and Mid-Atlantic states. The majority of horseshoe crab harvest comes from the Delaware Bay region, followed by the New York, New England, and the Southeast regions. Trawls, hand harvests, and dredges make up the bulk of commercial horseshoe crab landings.

Sea turtles can become entangled in the vertical lines of pot/trap gear when they overlap with these fisheries. From 2009-2018, records (confirmed and probable) show five leatherbacks and seven loggerhead sea turtles interacted with the vertical lines of crab gear in New Jersey and Virginia (GAR STDN, unpublished data). While these are where takes have been reported, interactions could occur wherever crab gear and sea turtles overlap. Interactions are primarily associated with entanglement in vertical lines, although sea turtles can also become entangled in groundline or surface systems. In 2007, a leatherback sea turtle was entangled in the lines connecting whelk pots (GAR STDN, unpublished data). In 2012, a leatherback was entangled in the surface system of a mooring buoy (GAR STDN, unpublished data), indicating that interactions with surface systems are possible.

Horseshoe crab has also been identified as the top species landed on trips that have incidentally taken sea turtles (NEFSC observer/sea sampling database, unpublished data). These takes were documented in trawl gear. Based on a proration of landings, two loggerheads on average annually were estimated to have been taken in the horseshoe crab trawl fishery from 2009-2013 (Murray 2015).

The crab fisheries may have other detrimental impacts on sea turtles beyond entanglement in the fishing gear itself. Loggerheads are known to prey on crab species, including horseshoe and blue crabs. In a study of the diet of loggerhead sea turtles in Virginia waters from 1983 to 2002, Seney and Musick (2007) found a shift in the diet of loggerheads in the area from horseshoe and blue crabs to fish, particularly menhaden and Atlantic croaker. The authors suggested that this shift in loggerhead diet may be due to a decline in the crab species (Seney and Musick 2007). The physiological impacts of this shift are uncertain, although, Mansfield (2006) suggested it as a possible explanation for the declines in loggerhead abundance. Maier *et al*. (2005) detected Seasonal declines in loggerhead abundance coincident with seasonal declines of horseshoe and blue crabs were detected in the same area (Maier *et al.* 2005). While there is no evidence of a decline in horseshoe crab abundance in the Southeast during the period 1995-2003, declines were evident in some parts of the Mid-Atlantic (ASMFC (Atlantic States Marine Fisheries Commission) 2004, Eyler *et al.* 2007). Given the variety of loggerheads prey items (Bjorndal

1997, Burke *et al.* 1993, Dodd 1988, Morreale and Standora 1998) and the differences in regional abundance of horseshoe crabs and other prey items (ASMFC (Atlantic States Marine Fisheries Commission) 2004, Eyler *et al.* 2007), a direct correlation between loggerhead sea turtle abundance and horseshoe crab and blue crab availability cannot be made at this time. Nevertheless, the decline in loggerhead abundance in Virginia waters (Mansfield 2006) and possibly Long Island waters (Morreale and Standora 2005), coincident with noted declines in the abundance of horseshoe crab and other crab species, raised concerns that crab fisheries may be impacting the forage base for loggerheads in portions of their range.

Atlantic sturgeon are known to be caught in state water horseshoe crab fisheries using trawl gear (Stein *et al.* 2004a). With the exception of New Jersey state waters, the horseshoe crab fishery operates in all state waters that occur in the action area. Along the U.S. East Coast, hand, bottom trawl, and dredge fisheries account for the majority (86% in the 2017 fishery) of commercial horseshoe crab landings in the bait fishery. Other methods used to land horseshoe crab are gillnets, fixed nets, rakes, hoes, and tongs (ASMFC (Atlantic States Marine Fisheries Commission) 2019, Horseshoe Crab Plan Review Team 2019). For most states, the bait fishery is open year round. However, the fishery operates at different times due to movement of the horseshoe crab. New Jersey has prohibited commercial harvest of horseshoe crabs in state waters (N.J.S.A. 23:2B-20-21) since 2006 (Horseshoe Crab Plan Review Team 2019). State waters of Delaware are closed to horseshoe crab harvest and landing from January 1 through June 7 each year (7 Del Admin. C § 3200). Other states also regulate various seasonal and area closures and other state horseshoe crab fisheries are regulated with various seasonal/area closures (Horseshoe Crab Plan Review Team 2019). The majority of horseshoe crab landings from the bait fishery from 2014-2018 came from Maryland, Delaware, New York, Virginia, and Massachusetts (Horseshoe Crab Plan Review Team 2019). There is also a smaller fishery for biomedical uses.

An evaluation of bycatch of Atlantic sturgeon using the NEFSC observer/sea sampling database (1989-2000) found that the bycatch rate for horseshoe crabs was low, at 0.05% (Stein *et al.* 2004a). An Atlantic sturgeon "reward program," where commercial fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon in the Maryland waters of Chesapeake Bay (Mangold *et al.* 2007), operated from 1996 to 2012.[8] From 1996-2006, the data showed that one of 1,395 wild Atlantic sturgeon was found caught in a crab pot (Mangold *et al.* 2007).

Fish Trap, Seine, and Channel Net Fisheries

Incidental captures of sea turtles in fish traps have been reported from several states along the U.S. Atlantic coast (GAR STDN, unpublished data). From 2009 2018, records (confirmed and probable) documented 22 leatherback, two Kemp's ridley, six loggerheads, and one unknown sea turtle in pound nets/weirs from Maine through Virginia. Of the 31 interactions, seven animals were documented free swimming (GAR STDN, unpublished data). In this gear, sea turtles may become entangled in the gear or be free swimming in the pound/weir.

[8] The program was terminated in February 2012, with the listing of Atlantic sturgeon under the ESA.

The Virginia pound net fishery is contiguous to the action area at the mouth of Chesapeake Bay. Sea turtle interactions with the Virginia pound net fishery have been documented, and interactions reported to the Greater Atlantic Region Sea Turtle Disentanglement Network (GAR STDN) are included above. NMFS has taken regulatory action to address sea turtle bycatch in the Virginia pound net fishery. The most recent Opinion on this fishery anticipated the take of up to 805 (one lethal) loggerhead, 161 Kemp's ridley (one lethal), 16 green (one lethal), and 11 Atlantic sturgeon (none lethal) in the pound and heart portions of the gear. The leaders may also capture sea turtles and Atlantic sturgeon. NMFS anticipated that up to one loggerhead (lethal), one Kemp's ridley (lethal), one green (lethal), eight leatherback (four lethal), and two Atlantic sturgeon (one lethal) could occur annually (NMFS 2018c).

Long haul seines, beach seines, purse seines, and channel nets are also known to incidentally capture sea turtles in sounds and other inshore waters along the U.S. Atlantic coast, although no lethal interactions have been reported (NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center) 2001). No information on interactions between Atlantic sturgeon and fish traps, long haul seines, or channel nets is currently available; however, depending on where this gear is set and the mesh size, the potential exists for Atlantic sturgeon to be entangled or captured in net gear.

American lobster trap fishery

An American lobster trap fishery occurs in state waters of New England and the Mid-Atlantic and is managed under the Commission's Interstate Fishery Management Plan (ISFMP). Like the federal waters component of the fishery, the state waters fishery uses trap/pot gear to land lobster. Trap/pot gear is known to entangle sea turtles. Often for these entanglements, the gear cannot be documented to a specific fishery.

Leatherback, loggerhead, green, and Kemp's ridley sea turtles are known to interact with trap/pot gear. As described above, interactions are primarily associated with entanglement in vertical lines. Records of stranded or entangled sea turtles indicate that fishing gear can wrap around the neck, flipper, or body of the sea turtle and severely restrict swimming or feeding (GAR STDN, unpublished data; NMFS STSSN, unpublished data). As a result, these interactions often result in the injury or mortality to sea turtles.

As described in the Batched Fisheries Opinion (NMFS 2021b), there were 81 leatherback entanglements from 2009-2018 in state and unknown waters confirmed to the lobster fishery. Two of the cases were confirmed to recreational pot gear. All entanglements involved the vertical line of the gear. These verified/confirmed entanglements occurred in waters off Maine, Massachusetts, and Connecticut from May through October. The majority were documented in waters off Massachusetts (GAR STDN, unpublished data).

Atlantic sturgeon interactions with trap/pot gear have never been observed (NEFSC observer/sea sampling database, unpublished data) or documented; therefore, this gear type is not expected to be a source of injury or mortality to this species.

American shad fishery

An American shad fishery occurs in state waters of New England and the Mid-Atlantic and is managed under the Commission's ISFMP. Amendment 3 to the ISFMP requires states and jurisdictions to develop sustainable FMPs, which are reviewed and approved by the Commission's Technical Committee, in order to maintain recreational and commercial shad fisheries (ASMFC (Atlantic States Marine Fisheries Commission) 2010). Eight entities in the action area have developed these FMPs. The fishery occurs in rivers and coastal ocean waters. In 2005, the directed at-sea fishery was closed and subsequent landings from the ocean are only from the bycatch fishery. Given this, the fishery is not expected to interact with sea turtles.

In the past, approximately 40-500 Atlantic sturgeon were reportedly captured in the spring shad fishery in Delaware. In recent years, this fishery has turned more to striped bass. Most of the Atlantic sturgeon were captured in the Delaware Bay, with only 2% caught in the Delaware River. The fishery uses five-inch mesh gillnets that are left to soak overnight; based on the available information, there is little bycatch mortality (NMFS (National Marine Fisheries Service) 2011). Recreational hook and line shad fisheries are known to capture Atlantic sturgeon, particularly in southern Maine.

Striped Bass Fishery

Since 1981, the ASMFC has managed striped bass, from Maine to North Carolina through an ISFMP. The striped bass fishery occurs only in state waters. With the exception of a defined area around Block Island, Rhode Island for possession, federal waters have been closed to the harvest and possession of striped bass since 1990. All states are required to have recreational and commercial size limits, recreational creel limits, and commercial quotas. The commercial striped bass fishery is closed in Maine, New Hampshire, and Connecticut, but open in Massachusetts (hook and line only), Rhode Island, New Jersey (hook and line only), Delaware, Maryland, and Virginia. Recreational striped bass fishing occurs all along the U.S. East Coast.

The striped bass fishery uses gears known to interact with sea turtles, including trap, pound nets, gillnets, trawl, and hook-and-line (ASMFC 2018). When prorated by species landed, striped bass was one of the trawl and gillnet fisheries in which sea turtles were estimated (Murray 2015b; Murray 2018). Several states have reported incidental catch of Atlantic sturgeon during striped bass fishing activities (NMFS Sturgeon Workshop 2011). In southern Maine and New Hampshire, the recreational striped bass fishery is known to catch Atlantic sturgeon, although numbers are not available. There are also numerous reports of Atlantic sturgeon bycatch in recreational striped bass fishery along the south shore of Long Island, particularly around Fire Island and Far Rockaway. Unreported mortality is likely occurring.

Data from the Atlantic Coast Sturgeon Tagging Database showed that from 2000-2004, the striped bass fishery accounted for 43% of Atlantic sturgeon recaptures (ASSRT 2007). The striped bass-weakfish fishery also had one of the highest bycatch rates of 30 directed fisheries according to NMFS Observer Program data from 1989-2000 (ASSRT 2007).

State gillnet fisheries
State gillnet fisheries occur in many portions of the action area. However, limited information is available on interactions between these fisheries and protected species. Large and small mesh gillnet fisheries occur in state waters. For example, the black drum shark gillnet fisheries in Virginia state waters fisheries uses large mesh (10- to 14-inch) gillnets. Meshes smaller than 10 inches are used in the croaker and dogfish fisheries. Entanglements of sea turtles in large mesh gillnet sets targeting and/or landing black drum have been recorded (NEFSC observer/sea sampling database, unpublished data). Similarly, sea turtles are vulnerable to capture in small mesh gillnet fisheries occurring in state waters. Observer coverage in state gillnet fisheries has been limited. For example, 31 trips were observed in the Long Island Sound gillnet fishery from 2014 through 2018. There has also been limited coverage on coastal gillnet fisheries in the mid-Atlantic on vessels with federal permits and, to a lesser extent, vessels with state only permit. Through this limited coverage, interactions have been recorded with Kemp's ridley, loggerhead, green, and leatherback sea turtles in gillnets operating in state waters (NEFSC observer/sea sampling database, unpublished data). As gillnet gear is known to pose an interaction risk to listed species of sea turtles and Atlantic sturgeon, these fisheries have the potential to interact with these species when the fisheries overlap with them

High levels of sea turtle strandings in North Carolina in 1999 were determined to likely result from incidental capture in the large mesh gillnet fishery in Pamlico Sound. Since 2000, NMFS has issued five ESA section 10(a)(1)(B) incidental take permits (65 FR 65840, November 2, 2000; 66 FR 51023, October 5, 2001; 67 FR 67150, November 4, 2002; 70 FR 52984, September 6, 2005; 78 FR 57132, September 17, 2013) to the North Carolina Division of Marine Fisheries (NC DMF) authorizing the incidental take of sea turtles in certain components of the gillnet fishery. The most recent permit (78 FR 57132, September 17, 2013) authorizes the take through August 2023. Required measures under the permit include restricted soak times, restricted net lengths, attendance requirements, time-area closures, and adaptive management (78 FR 57132, September 17, 2013). NC DMF also has a permit for the incidental take of Atlantic sturgeon DPSs associated with the inshore gillnet fishery. The conservation plan requires specific monitoring for Atlantic sturgeon. If allowable thresholds are approached, NC DMF will place additional restrictions (e.g., closures, attendance requirements) on the fishery. In addition, the observer coverage will identify and adaptively respond to "hotspots" (79 FR 43716, July 28, 2014). The level of take specified in these permits is detailed in section 5.1.4.

The 2017 Benchmark Assessment (ASMFC 2017) used data from NEFOP, the North Carolina gillnet fisheries, and the South Carolina American shad gillnet fishery to assess Atlantic sturgeon bycatch. For the North Carolina gillnet fisheries predicted bycatch for 2004-2005 ranged from 1,286 Atlantic sturgeon in 2011 to 13,668 in 2008. The Atlantic sturgeon caught in this fishery were primarily juveniles. The percent observed sturgeon that died ranged from 0-20% with an overall mean of 6%. Estimates of dead discards ranged from 0-424 fish (ASMFC 2017).

In 2017, 167 Atlantic sturgeon were reported as bycatch from state water fisheries (0-3 miles offshore, including rivers and estuaries). This included 51 fish in the North Carolina gillnet fishery. Connecticut (15), Maryland (1), and Virginia (11) also reported bycatch in 2017 (ASMFC 2019).

State Trawl Fisheries

Trawl fisheries also occurs in state waters in the action area. Virginia (VA Code Ann. §28.2-315), New Hampshire (NH Rev Stat §21149), and Delaware (7 Del C §927) prohibit trawling in state waters. Other states such as Maryland prohibit its use in certain areas.

A Northern shrimp fishery has occurred in waters off Maine, New Hampshire, and Massachusetts, and is managed under the ASMFC's ISFMP. Due to recruitment failure and a collapsed stock, fishing moratoria were instituted by the ASMFC for the 2014-2018 fishing seasons. In November 2018, the ASMFC's Northern Shrimp Section extended the moratorium on commercial fishing through 2021. The majority of northern shrimp are caught with otter trawls, which must be equipped with Nordmore grates (ASMFC (Atlantic States Marine Fisheries Commission) 2011). When the fishery is open, it is a winter fishery with the season occurring anytime between December 1 and May 31 (ASMFC 2017).

Bottom otter trawls in the Northern shrimp fishery are known to interact with Atlantic sturgeon, but exact numbers are not available (NMFS (National Marine Fisheries Service) 2011). A majority (84%) of Atlantic sturgeon bycatch in otter trawls occurs at depths <20 meters, with 90% occurring at depths of <30 meters (ASMFC (Atlantic States Marine Fisheries Commission) 2007). During the NEFSC's spring and fall inshore northern shrimp trawl surveys, northern shrimp are most commonly found in tows with depths of >64 meters (ASMFC (Atlantic States Marine Fisheries Commission) 2011), which is well below the depths at which most Atlantic sturgeon bycatch occurs. Given that the Northern shrimp trawl fishery is a winter fishery, it is not expected to overlap with sea turtles in the action area.

Other trawl fisheries occur in state waters, but information is limited. In these fisheries, the gear may operate along or off the bottom. From 2009-2018, observers have documented the take of Kemp's ridley, loggerhead, green, and leatherback sea turtles in state waters (NEFSC observer/sea sampling database, unpublished data). The top landed species on trips that captured turtles included scup, summer flounder, longfin squid, horseshoe crab, and butterfish. Atlantic sturgeon have also been observed captured on state trawl fisheries from 2009-2018. Top landed species on these trips included, among others, summer flounder, little skate, scup, butterfish, longfin squid, spiny dogfish, smooth dogfish, and bluefish. Information available on interactions between ESA-listed species and these fisheries is incomplete.

State recreational fisheries

Observations of state hook and line recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles can interact with recreational fishing gear. When swimming near rod and reel fishing gear, sea turtles can be "foul-hooked" on the flipper or entangled in the fishing line. Sea turtles are also known to bite the bait and become hooked in the mouth or esophagus, or swallow the hook. Most of the reports of interactions come from fishing piers, but there are also reports of offshore captures (NMFS and USFWS 2008). A summary of known impacts of hook-and-line captures on loggerhead and Kemp's ridley sea turtles can be found in the TEWG (1998, 2000, 2009) reports.

Stranding data also provide evidence of interactions between recreational hook-and-line gear and sea turtles. While data from stranded animals contain certain biases and cannot be used to quantify the magnitude of a particular threat, it does provide some information on interactions with recreational gear. From Maine through Virginia, there were 186 cases reported from 2016-2018 in the STSSN database in which recreational fishing gear was present (NMFS STSSN, unpublished data). This included 36 loggerhead, 122 Kemp's ridley, two green, one leatherback, and 25 unknown turtles. NMFS conducts outreach on what to do if you hook or entangle a sea turtle while fishing. In addition, Virginia Aquarium's Stranding Response Program has developed a pier partner program that provides signage for the pier and training to the pier operator on what to do if a sea turtle is hooked. Since the program began in 2014, there have been 253 reports received with 172 animals admitted. In 2018, the Aquarium received a record number of hooked turtle reports. Of the 66 reported cases, they admitted 45 sea turtles for exam. Almost 87% of these were Kemp's ridleys. Sea turtle captures on recreational hook and line gear are not uncommon, but the overall level of take and post-release mortality are unknown.

Atlantic sturgeon have also been observed captured in state recreational fisheries, yet the total number of interactions that occur annually is unknown. There have been no post-release survival studies for this species. However, we anticipate that Atlantic sturgeon will likely be released alive, due to the overall hardiness of the species. NMFS also engages in educational outreach efforts on disentanglement, release, and handling and resuscitation of Atlantic sturgeon.

5.3 Other Activities

5.3.1 Maritime Industry

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with ESA-listed species. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Commercial traffic and recreational pursuits can also adversely affect ESA-listed species through propeller and boat strikes. Vessel interactions have been documented with sea turtles and Atlantic sturgeon. The extent of the problem is difficult to assess because the interactions occur at sea and are often only detected when the animal strands. It is also often not known if the animal was struck pre- or post-mortem. It is important to note that although minor vessel collisions may not kill an animal directly, they may weaken or otherwise affect an animal, which may make it more vulnerable to other threats.

5.3.2 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local, or private action, may affect ESA-listed species in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants (e.g., PCBs); storm water runoff from coastal towns, cities, and villages; runoff into rivers emptying into bays; groundwater discharges; sewage treatment plant effluents; and oil spills. Oil spills may affect ESA-listed species either directly or through the food chain.

Degraded water quality from point and non-point sources can impact protected species. Run-off can introduce pesticides, herbicides, and other contaminants into the system on which these species depend. Contaminants could degrade habitat if pollution and other factors reduce the food available to marine animals. In 2017, NMFS completed an Opinion on EPA's registration of certain pesticides (NMFS 2017). Effects ranged from killing species directly to reductions in prey, and impaired growth. Species likely to be affected include, among others, sea turtles and Atlantic sturgeon (all five DPSs). In specifying the ITS, NMFS identified surrogates for anadromous fish and sea turtles (NMFS 2017).

Oil spills, resulting from anthropogenic activities (e.g., commercial vessel traffic/shipping), directly and indirectly affect all components of the marine ecosystem. Larger oil spills may result from severe accidents, although these events would be rare. The pathological effects of oil spills on sea turtles specifically have been documented in several laboratory studies (Vargo et al. 1986). There have been a number of documented smaller oil spills in the northeastern U.S.

As many ESA-listed species ranges extend beyond that of the action area, oil spills that occur outside the action area, but within the range of the species, also have the potential to affect ESA-listed species that occur within the action area. For instance, on April 20, 2010, the Deepwater Horizon oil spill occurred off the coast of Louisiana in the Gulf of Mexico. The effects of this spill on ESA-listed species are discussed in the *Status of the Species* section.

Marine debris (e.g., discarded fishing line, boat lines, and plastics) can directly or indirectly affect listed species. Discarded line (fishing or boat) can entangle sea turtles or Atlantic sturgeon, causing injury or mortality. Sea turtles may ingest plastic and other marine debris, which they could mistake for food. For instance, jellyfish are a preferred prey for leatherbacks, and plastic bags, which may look like jellyfish to the turtles, are often found in the turtles' stomach contents (Mrosovsky *et al.* 2009, Nelms *et al.* 2015, NRC (National Research Council) 1990, Schuyler *et al.* 2014). While marine debris is known to affect these species, the effects have not been quantified and impacts at the population level are not well understood.

5.3.3 Coastal development

Beachfront development, lighting, and beach erosion control are ongoing activities along the coastlines of the U.S. and within the action area. In the southeast and Mid-Atlantic, these activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Human activities along nesting beaches at night may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Coastal development may also impact Atlantic sturgeon if it disturbs or degrades foraging habitats or otherwise affects the ability of sturgeon to use coastal habitats.

5.4 Reducing Threats to ESA-listed Sea Turtles

Numerous efforts are ongoing to reduce threats to listed sea turtles. Below, we detail efforts that are ongoing within the action area. The majority of these activities are related to regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries. These include sea turtle release gear requirements for Atlantic HMS; TED requirements for Southeast shrimp trawl fishery and the southern part of the summer flounder trawl fishery; mesh size restrictions in the North Carolina gillnet fishery and Virginia's gillnet and pound net fisheries; modified leader requirements in the Virginia Chesapeake Bay pound net fishery; area closures in the North Carolina gillnet fishery; and gear modifications in the Atlantic sea scallop dredge fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions and strandings are collected. The summaries below discuss all of these measures in more detail.

5.4.1 Education and Outreach Activities

Education and outreach activities are some of the primary tools to effectively reduce the threats to all protected species. For example, NMFS has been active in public outreach to educate fishermen about sea turtle handling and resuscitation techniques, and educate recreational fishermen and boaters on how to avoid interactions with sea turtles and Atlantic sturgeon. NMFS is engaged in a number of education and outreach activities aimed specifically at increasing mariner awareness of the threat of ship strikes to protected species. NMFS also offers educational programs to students. One such program is "SCUTES" (Student Collaborating to Undertake Tracking Efforts for Sturgeon), which offers educational programs and activities about the movements, behaviors, and threats to Atlantic sturgeon. While the effects of these efforts at reducing impacts to protected species cannot be quantified, they are anticipated to reduce impacts through education and promoting stewardship. Outreach occurs through websites, NMFS presence at industry meetings, outreach events and trade shows, publications in industry trade journals and news outlets, and dockside interactions between NOAA staff and industry. NMFS intends to continue these outreach efforts in an attempt to reduce interactions and the likelihood of injury to protected species and to potentially improve the condition of the ESA-listed species or its designated critical habitat in the action area.

5.4.2 Stranding and Salvage Programs

The Sea Turtle Stranding and Salvage Network (STSSN) does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the U.S. Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles, reducing mortality of injured or sick animals. NMFS manages the activities of the STSSN. Data collected by the STSSN are used to monitor stranding levels, to identify areas where unusual or elevated mortality is occurring, and to identify sources of mortality. The data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network, through incidental takes, or permitted in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for sea turtle species.

NMFS was designated the lead agency to coordinate the Marine Mammal Health and Stranding Response Program (MMHSRP), which was formalized by the 1992 Amendments to the MMPA. The program consists of state volunteer stranding networks, biomonitoring, Analytical Quality Assurance for marine mammal tissue samples, a Working Group on Marine Mammal Unusual Mortality Events (UME) and a National Marine Mammal Tissue Bank. Additionally, a serum bank and long-term storage of histopathology tissue are being developed. The MMHSRP's permit (permit #18786) includes the incidental take of unidentified sea turtles (10), leatherback sea turtles (two), and Atlantic sturgeon (three).

A salvage program operating under an ESA section 10(a)(a)(A) permit is in place for Atlantic sturgeon. Atlantic sturgeon carcasses can provide pertinent life history data and information on new or evolving threats to Atlantic sturgeon. Their use in scientific research studies can reduce the need to collect live Atlantic sturgeon. The NMFS Sturgeon Salvage Program is a network of individuals qualified to retrieve and/or use Atlantic and shortnose sturgeon carcasses and parts for scientific research and education. All carcasses and parts are retrieved opportunistically and participation in the network is voluntary.

5.4.3 Disentanglement Networks

In 2002, in response to the high number of leatherback sea turtles found entangled in pot gear along the U.S. Northeast Atlantic coast, NMFS Northeast Region (now GARFO) established the NMFS Greater Atlantic Region Sea Turtle Disentanglement Network (GAR STDN). The GAR STDN is a component of the larger STSSN program, and operates in all states in the region. The GAR STDN responds to entangled sea turtles, disentangling and releasing live animals, thereby reducing injury and mortality. In addition, the GAR STDN collects data on sea turtle entanglement events, providing valuable information for management purposes. NMFS GARFO oversees the GAR STDN program and manages the GAR STDN database.

Any agent/employee of NMFS, the U.S. FWS, the USCG, any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his/her official duties, is allowed to take endangered sea turtles encountered in the marine environment if such taking is necessary to: (1) aid a sick, injured, or entangled endangered sea turtle; (2) dispose of a dead endangered sea turtle; or (3) salvage a dead endangered sea turtle for scientific or educational purposes (70 FR 42508, July 25, 2005). NMFS affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

5.4.4 Regulatory Measures for Sea Turtles

Large-Mesh Gillnet Requirements in the Mid-Atlantic
Since 2002, NMFS has regulated the use of large mesh gillnets in federal waters off North Carolina and Virginia (67 FR 13098, March 21, 2002) to reduce the impact of these fisheries on ESA-listed sea turtles. These restrictions were revised in 2006 (73 FR 24776, April 26, 2006). Currently, gillnets with stretched mesh size of seven inches (17.8 centimeters) or larger are prohibited in the U.S. EEZ during the following times and in the following areas:

(1) north of the North Carolina/South Carolina border to Oregon Inlet, North Carolina at all times,
(2) north of Oregon Inlet, North Carolina to Currituck Beach Light, North Carolina from March 16 through January 14,
(3) north of Currituck Beach Light, North Carolina to Wachapreague Inlet, Virginia from April 1 through January 14, and
(4) north of Wachapreague Inlet, Virginia to Chincoteague, Virginia from April 16 through January 14.

NMFS has also issued regulations to address the interaction of sea turtles in gillnet gear fished in Pamlico Sound, North Carolina. Waters of Pamlico Sound are closed to fishing with gillnets with a stretched mesh size larger than 4 ¼ inches (10.8 centimeters) from September 1 through December 15 each year to protect sea turtles. The closed area includes all inshore waters of Pamlico Sound, and all contiguous tidal waters, south of 35° 46.3' N, north of 35° 00' N, and east of 76° 30' W (50 CFR 223.206). As described above, NMFS has also issued incidental take permits for Atlantic sturgeon and sea turtles in Pamlico Sound gillnet fisheries. The permit includes mandatory measures to reduce take, and impacts from take, in this fishery.

TED Requirements in Trawl Fisheries
Turtle Excluder Devices (TEDs) are required in the summer flounder and southeast shrimp fisheries. TEDs allow sea turtles to escape the trawl net, reducing injury and mortality resulting from capture in the net. Approved TEDs are required in the shrimp trawl fishery operating in the Atlantic and Gulf Areas (50 CFR 222.102) unless the trawler is fishing under one of the exemptions (e.g., bait shrimper, pusher-head trawl) and all requirements of the exemption are met (50 CFR 223.206). On February 21, 2003, NMFS issued a final rule to amend the TED regulations to enhance their effectiveness in the Atlantic and Gulf Areas of the southeastern U.S. by requiring an escape opening designed to exclude leatherbacks as well as large loggerhead and green sea turtles (68 FR 8456). NMFS published a final rule, effective April 1, 2021, that requires TEDs to exclude small sea turtles on skimmer trawls vessels 40 feet or greater in length (84 FR 70048, December 20, 2019).

TEDs are also required for summer flounder trawlers in the summer flounder fishery-sea turtle protection area. This area is bounded on the north by a line extending along 37°05' N (Cape Charles, Virginia) and on the south by a line extending out from the North Carolina-South Carolina border. Vessels north of Oregon Inlet, North Carolina are exempt from the TED requirement from January 15 through March 15 each year (50 CFR 223.206). The TED requirements for the summer flounder trawl fishery do not require the use of the larger escape opening.

Pound net requirements in Virginia
NMFS has issued several regulations to help protect sea turtles from entanglement in, and impingement on Virginia pound net gear (66 FR 33489, June 22 2001; 67 FR 41196; June 17, 2002; 68 FR 41942, July 16, 2003; 69 FR 24997, May 5, 2004; 71 FR 36024; June 23, 2006; 73 FR 68348, November 18, 2008; 80 FR 6925, February 9, 2015). All offshore pound leaders in Pound Net Regulated Area I (Figure 18) must meet the definition of a modified pound net leader from May 6 through July 15. The modified leader has been found to be effective in reducing sea turtle interactions as compared to the unmodified leader. Under the ESA regulations, nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II must have mesh size less than 12 inches (30.5 centimeters) stretched mesh and may not employ stringers (50 CFR 223.206) from May 6 through July 15 each year. A pound net leader is exempt from these measures only if it meets the definition of a modified pound net leader. The 2015 regulation (80 FR 6925) modified the definitions of offshore and inshore pound net leaders under the ESA. In addition, there are compliance training, monitoring and reporting requirements in this fishery (50 CFR 223.206).

Under the Bottlenose Dolphin Take Reduction Plan, fishermen with offshore pound nets must use a modified pound net leader year-round within the Bottlenose Dolphin Pound Net Regulated Area (Figure 19). Pound nets fished in offshore and inshore areas must be fished with all three continuous sections (i.e., pound, heart, and leader) in the Bottlenose Dolphin Pound Net Regulated Area or Regulated Areas I and II under the ESA sea turtle conservation requirements. An exception is that one or more sections may be missing for up to 10 days for setting, removing, and/or repairing the gear.

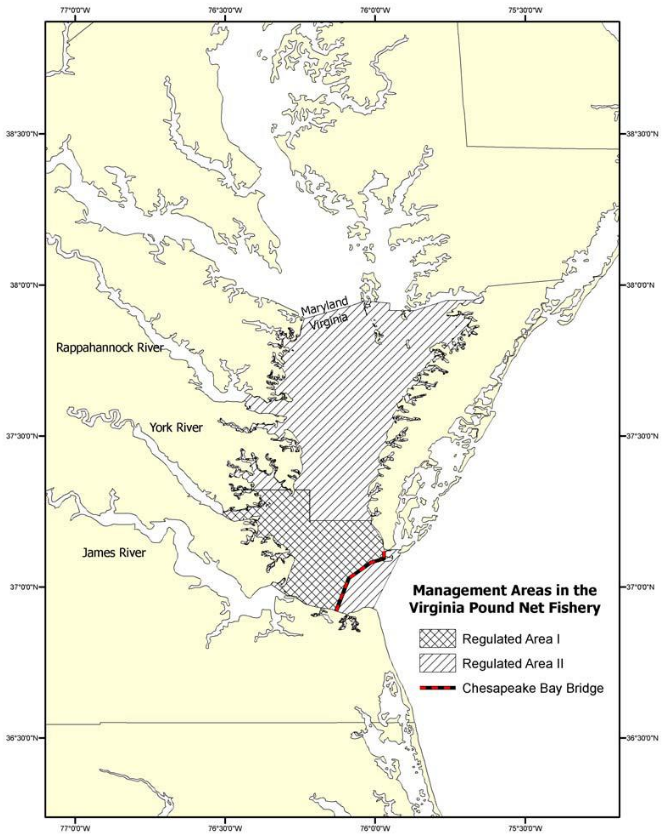

Figure 18. Virginia Pound Net Regulated Areas.

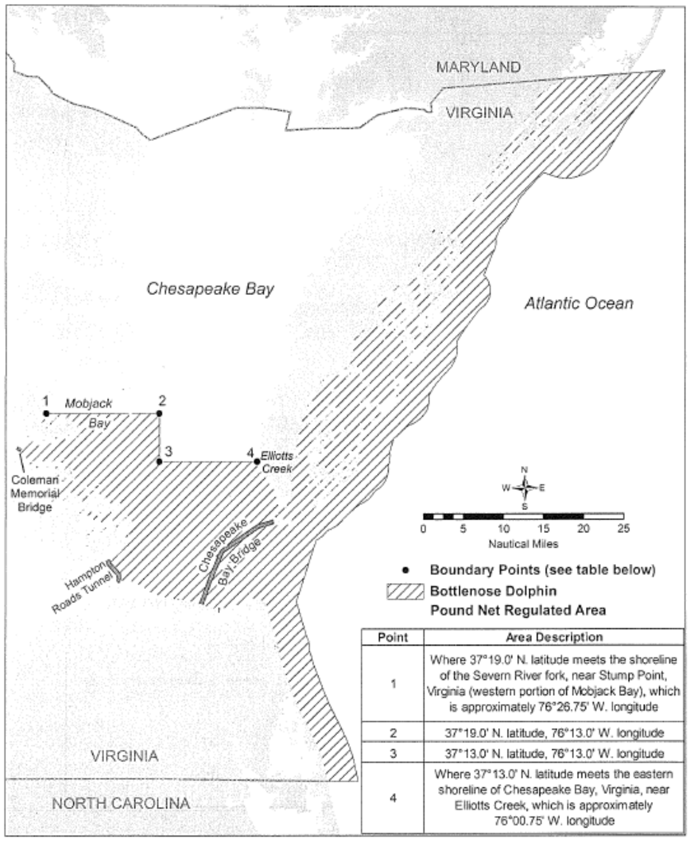

Figure 19. Bottlenose Dolphin Pound Net Regulated Areas.

Longline requirements in the HMS fishery

In 2020, NMFS SERO completed two biological opinions on the FMP for the Atlantic HMS fisheries for swordfish, tunas, and sharks (NMFS (National Marine Fisheries Service) 2020a, b). These opinions concluded that the actions are not likely to jeopardize the continued existence of any hard-shell or leatherback sea turtle. Sea turtle conservation requirements in the HMS fishery are related to the fishing gear, bait, and disentanglement gear and training (50 CFR 648.21). NMFS requires the use of specific gears and release equipment in the pelagic longline component of the HMS fishery in order to minimize lethal impacts to sea turtles. Sea turtle handling and release protocols for the HMS fishery are described in detail in NMFS SEFSC (2008). Sea turtle handling and release placards are required to be posted in the wheelhouse of certain commercial fishing vessels. NMFS has also initiated an extensive outreach and education program for commercial fishermen that engage in these fisheries in order to minimize the impacts of this fishery on sea turtles. As part of the program, NMFS has distributed sea turtle identification and resuscitation guidelines to HMS fishermen who may incidentally hook, entangle, or capture sea turtles during their fishing activities and has also conducted hands-on workshops on safe handling, release, and identification of sea turtles.

Modified Dredge Requirements in the Atlantic Sea Scallop Fishery
In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and mortality as a result of capture, NMFS required federally-permitted scallop vessels fishing with dredge gear to modify their gear by adding an arrangement of horizontal and vertical chains (hereafter referred to as a "chain mat") between the sweep and the cutting bar. This modification was required when fishing in Mid-Atlantic waters south of 41°09' N from the shoreline to the outer boundary of the U.S. EEZ during the period of May 1-November 30 each year (70 FR 30660, May 27, 2005). The requirement was subsequently modified by emergency rule on November 15, 2006 (71 FR 66466) and by final rules published on April 8, 2008 (73 FR 18984) and May 5, 2009 (74 FR 20667). In 2015, NMFS aligned the requirements with the TDD requirements as described below. Since 2006, the chain mat modifications have reduced the severity of most sea turtle interactions with scallop dredge gear (Murray 2011, 2015a, 2020a). However, these modifications are not expected to reduce the overall number of sea turtle interactions with scallop dredge gear.

Beginning May 1, 2013, all limited access scallop vessels, as well as Limited Access General Category vessels with a dredge width of 10.5 feet or greater, were required to use a TDD in the Mid-Atlantic (west of 71° W) from May 1 through October 31 each year (77 FR 20728, April 6, 2012). The purpose of the TDD requirement is to deflect sea turtles over the dredge frame and bag rather than under the cutting bar, so as to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). When combined with the effects of chain mats, which decrease captures in the dredge bag, the TDD should provide greater sea turtle benefits by reducing serious injury and mortality due to interactions with the dredge frame, compared to a standard New Bedford dredge.

In 2015, NMFS aligned the TDD and chain mat requirements (80 FR 22119, April 21, 2015). Currently, chain mats are required on any vessel with a sea scallop dredge and required to have a federal Atlantic sea scallop fishery permit, regardless of dredge size or vessel permit category, entering waters west of 71° W from May 1 through November 30. Similarly, any limited access scallop vessel and limited access general category vessel with a dredge width of 10.5 feet or greater is required to use a TDD west of 71° W from May 1 through November 30.

Handling and Resuscitation Requirements
NMFS has developed and published sea turtle handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities (66 FR 67495, December 31, 2001). Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear. NMFS has conducted outreach to fishermen participating in fisheries in the Greater Atlantic Region, providing wheelhouse cards detailing the requirements.

5.5 Reducing Threats to Atlantic Sturgeon

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing, including dam removals, moratoria on commercial and recreational fishing, and the implementation of a Sturgeon Salvage Network and educational programs for sturgeon throughout the U.S. Atlantic (e.g., SCUTES: Students Collaborating to Undertake Tracking Efforts for Sturgeon). In the near future, NMFS will be convening a recovery team, and drafting a recovery plan that will outline recovery goals, criteria, and steps necessary to recover all Atlantic sturgeon DPSs. To develop population estimates for each DPS, 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. Guidelines developed by sturgeon researchers in cooperation with NMFS staff (Moser et al., 2000; Damon-Randall et al. 2010; Kahn and Mohead 2010) provide standardized research protocols that minimize the risk to sturgeon species from capture, handling, and sampling. Efforts are also underway to better understand threats, such as poor water quality and bycatch, faced by the populations and ways to minimize these threats. 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.

5.6 Magnuson-Stevens Fishery Conservation and Management Act

In addition to the measures described in sections 5.4 and 5.5, there are numerous regulations mandated by the Magnuson-Stevens Fishery Conservation and Management Act that benefit ESA-listed species. Many fisheries are subject to different time and area closures. These area closures can be seasonal, year-round, and/or gear based. Closure areas benefit ESA-listed species due to elimination of active gear in areas where sea turtles and/or Atlantic sturgeon are present. However, if closures shift effort to areas with a comparable or higher density of sea turtles or Atlantic sturgeon, and/or the shift in effort results in increases in gear soak or tow time and/or quantity of fishing gear set/towed in the affected area, then risk of interaction could actually increase. Fishing effort reduction measures (*i.e.*, landing/possession limits or trap allocations) may also benefit ESA-listed species by limiting the amount of time that gear is present in the species environment. Additionally, gear restrictions and modifications required for fishing regulations also decrease the risk of entanglement with endangered species. National Standard 9 of the MSA specifies conservation and management measures shall, to the extent practicable, (a) minimize bycatch and (b) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. This includes bycatch of sea turtles and ESA-listed fish. For a complete listing of fishery regulations in the action area visit: https://www.fisheries.noaa.gov/content/greater-atlantic-region-regulations.

5.7 Status of the Species within the Action Area

5.7.1 Sea Turtles

The scallop fishing activities considered in this Opinion and habitat used by sea turtles overlap in the action area. Adult and/or juvenile loggerhead, leatherback, Kemp's ridley, and green sea turtles may be migrating or foraging in the areas where the scallop fishery will occur. As described in the status of the species, the occurrence of loggerhead, Kemp's ridley, green, and leatherback sea turtles along the U.S. Atlantic coast is primarily temperature dependent. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas to foraging grounds as water temperatures warm in the spring. The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Shoop and Kenney 1992; Morreale and Standora 1998, 2005; Braun-McNeill and Epperly 2004; James et al. 2005a, 2005b, 2005c; Mansfield et al. 2009; TEWG 2009, NEFSC and SEFSC 2011; Ceriani et al. 2012; Griffin et al. 2013; Winton et al. 2018).

Within the action area, sea turtles are found as far north as Georges Bank and the Gulf of Maine seasonally. They occur throughout the bays and estuaries of most Mid-Atlantic states and some Northeast ones as well (e.g., Cape Cod Bay, Massachusetts), from shallow waters along the shoreline and near river mouths to deeper waters of the Atlantic Ocean. They are present in Greater Atlantic waters from May to November each year, with the highest number of individuals present from June to October. Sea turtles arrive in waters off Virginia in late April/early May and in the Gulf of Maine in June (Braun-McNeill and Epperly 2002, Ceriani *et al.* 2012, Griffin *et al.* 2013, Morreale and Standora 2005, Palka *et al.* 2017, Winton *et al.* 2018). Leatherback sea turtles have a similar seasonal distribution but have a more extensive range compared to the hard-shelled species (Archibald and James 2016, Dodge *et al.* 2014, James *et al.* 2005a, James *et al.* 2005b, Mitchell *et al.* 2002, Shoop and Kenney 1992).

Sea turtles have been documented in the action area by fisheries observers and through aerial and vessel surveys and satellite tracking programs(Archibald and James 2016, Barco *et al.* 2018, James *et al.* 2005a, James *et al.* 2005b, James *et al.* 2005c, Kraus *et al.* 2016, NMFS 2015a, 2016, 2018a, NMFS (National Marine Fisheries Service) 2019a, Patel *et al.* 2018, Winton *et al.* 2018). The Atlantic Marine Assessment Program for Protected Species (AMAPPS) is a comprehensive program to assess abundance, distribution, and ecology of marine mammals, sea turtles, and seabirds throughout the U.S. Atlantic. From 2010-2018, aerial and shipboard surveys (approximately 191,000 kilometers of trackline) from Nova Scotia, Canada, through Florida detected more than 8,000 sea turtles including loggerhead, leatherback, Kemp's ridley, and green sea turtles (Palka *et al.* 2017). These sightings occurred throughout most of the action area (see AMAPPS sightings at http://seamap.env.duke.edu/). From 2010-2018, the NEFSC and Coonamessett Farm Foundation deployed 180 satellite tags on loggerhead sea turtles. Data from these satellite tags was used to assess the relative density of sea turtles (Palka *et al.* 2017, Winton *et al.* 2018). Researchers also continue to tag loggerhead and leatherback sea turtles though this program (NMFS 2015a, 2016, 2018a, NMFS (National Marine Fisheries Service) 2019a). Other studies have focused on exploring species distribution relative to prey and physical oceanography.

In the summer of 2010, as part of the AMAPPS project, the NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead sea turtles in the portion of the northwestern Atlantic continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada (NMFS 2011). The abundance estimates were based on data collected from an aerial line-transect sighting survey as well as satellite tagged loggerheads. The preliminary regional abundance estimate was about 588,000 individuals (approximate inter-quartile range of 382,000-817,000) based on only the positively identified loggerhead sightings, and about 801,000 individuals (approximate inter-quartile range of 521,000-1,111,000) when based on the positively identified loggerheads and a portion of the unidentified sea turtle sightings (NMFS 2011).

Barco et al. (2018) estimated loggerhead sea turtle abundance and density in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay using data from 2011-2012. As Chesapeake Bay falls outside the action area, the focus here is on the results for the ocean waters off Virginia and Maryland. During aerial surveys, loggerhead sea turtles were the most common sea turtle species detected, followed by greens and leatherbacks, with few Kemp's ridleys documented. Density varied both spatially and temporally. Loggerhead abundance and density estimates in the ocean were higher in the spring (May-June) than the summer (July-August) or fall (September-October) (Barco *et al.* 2018).

AMAPPS data, along with other sources, have been used in recent modelling studies. Winton et al. (2018) modelled the spatial distribution of satellite-tagged loggerhead sea turtles in the Northwest Atlantic. The Mid-Atlantic Bight was identified as an important summer foraging area and the results suggest that the area may support a larger proportion of the population, over 50% of the predicted relative density of loggerheads north of Cape Hatteras from June to October (NMFS (National Marine Fisheries Service) 2019a, Winton *et al.* 2018). Using satellite telemetry observations from 271 large juvenile and adult sea turtles collected from 2004 to 2016, the models predicted that overall densities were greatest in the shelf waters of the U.S. Atlantic coast from Florida to North Carolina (Figure 20, left side). Tagged loggerheads primarily occupied the continental shelf from Long Island, New York to Florida, with some moving offshore. Monthly variation in the Mid-Atlantic Bight (Figure 20, right side) indicated migration north to the foraging grounds from March to May and migration south from November to December. In late spring and summer, predicted densities were highest in the shelf waters from Maryland to New Jersey. In the cooler months, the predicted densities in the Mid-Atlantic Bight were higher offshore (Winton *et al.* 2018). South of Cape Hatteras, there was less seasonal variability and predicted densities were high in all months. Many of the individuals tagged in this area remained in the general vicinity of the tagging location. The authors did caution that the model was driven, at least in part, by the weighting scheme chosen, is reflective only of the tagged population, and has biases associated with the non-random tag deployment. Most loggerheads tagged in the Mid-Atlantic Bight were tagged in offshore shelf waters north of Chesapeake Bay in the spring. Thus, loggerheads in the nearshore areas of the Mid-Atlantic

Bight may have been under-represented while those in more northern areas may be as well given the initial tagging locations (Winton *et al.* 2018). Despite these caveats, this data is the best available scientific and commercial data on loggerhead density in the action area.

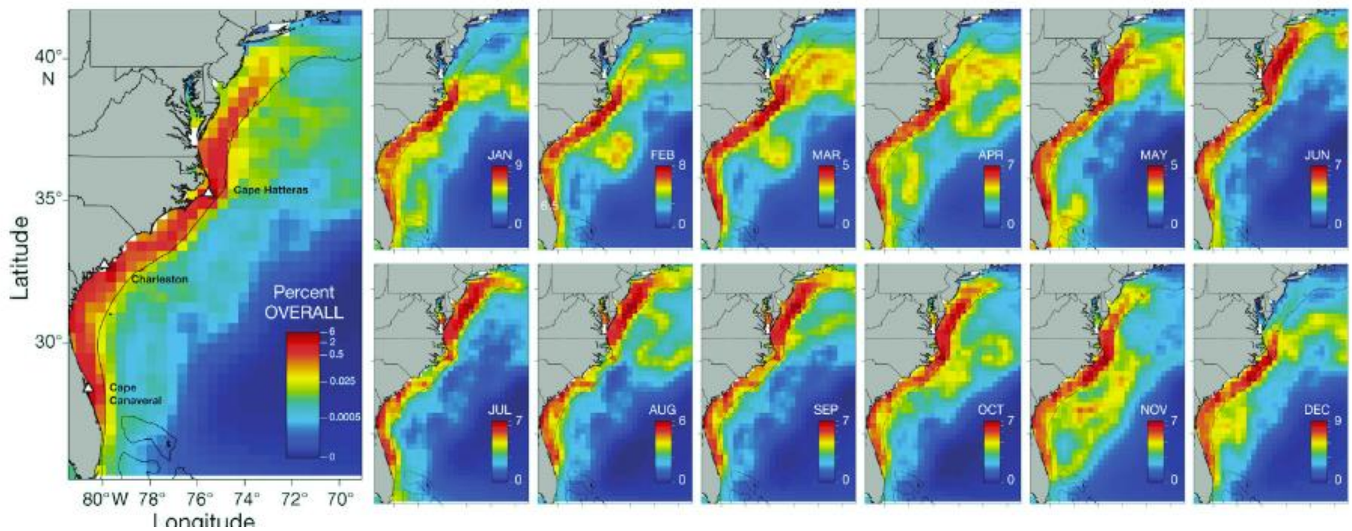

Figure 20. Overall and monthly log density of tagged loggerhead sea turtles predicted from a space-time geostatistical mixed effects model. The proportion of the predicted density in each cell is indicated by the key. Source: Winton et al. 2018.

One of the main factors influencing sea turtle presence in Mid-Atlantic waters and north is seasonal temperature patterns (Ruben and Morreale 1999). The distribution of sea turtles is limited geographically and temporally by water temperatures (Braun-McNeill *et al.* 2008, Epperly *et al.* 1995, James *et al.* 2006a, Mansfield *et al.* 2009), with warmer waters in the late spring, summer, and early fall being the most suitable. Water temperatures too low or too high may affect feeding rates and physiological functioning (Milton and Lutz 2003); metabolic rates may be suppressed when a sea turtle is exposed for a prolonged period to temperatures below 8-10°C (George 1997, Milton and Lutz 2003, Morreale *et al.* 1992). That said, loggerhead sea turtles have been found in waters as low as 7.1°-8°C (Braun-McNeill *et al.* 2008, Smolowitz *et al.* 2015, Weeks *et al.* 2010). However, in assessing critical habitat for loggerhead sea turtles, the review team considered the water-temperature habitat range for loggerheads to be above 10°C (NMFS (National Marine Fisheries Service) 2013). Sea turtles are most likely to occur in the action area when water temperatures are above this temperature, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records).

To better understand loggerhead behavior on the Mid-Atlantic foraging grounds, Patel et al. (2016) used a remotely operated vehicle (ROV) to document the feeding habitats (and prey availability), buoyancy control, and water column use of 73 loggerheads recorded from 2008-2014. When the mouth and face were in view, loggerheads spent 13% of the time feeding on non-gelatinous prey and 2% feeding on gelatinous prey. Feeding on gelatinous prey occurred near the surface to depths of 16 meters. Non-gelatinous prey were consumed on the bottom. Turtles spent approximately 7% of their time on the surface (associated with breathing), 42% in the near surface region, 44% in the water column, 0.4% near bottom, and 6% on bottom. When diving to depth, turtles displayed negative buoyancy, making staying at the bottom easier (Patel *et al.* 2016).

Patel et al. (2018) evaluated temperature-depth data from 162 satellite tags deployed on loggerhead sea turtles from 2009 to 2017 when the water column is highly stratified (June 1-October 4). Turtles arrived in the Mid-Atlantic Bight in late May as the Cold Pool formed and departed in early October when the Cold Pool started to dissipate. The Cold Pool is an oceanographic feature that forms annually in late May. During the highly stratified season, tagged turtles were documented throughout the water column from June through September. Fewer bottom dives occurred north of Hudson Canyon early (June) and late (September) in the foraging season (Patel *et al.* 2018).

Satellite tagging studies have also been used to understand leatherback sea turtle behavior and movement in the action area (Dodge *et al.* 2014, Dodge *et al.* 2015, Eckert *et al.* 2006, James *et al.* 2005a, James *et al.* 2005b, James *et al.* 2006b). These studies show that leatherback sea turtles move throughout most of the North Atlantic from the equator to high latitudes. Key foraging destinations include, among others, the eastern coast of U.S. (Eckert *et al.* 2006). Telemetry studies provide information on the use of the water column by leatherback sea turtles. Based on telemetry data for leatherbacks (n=15) off Cape Cod, Massachusetts, leatherback turtles spent over 60% of their time in the top 10 meters of the water column and over 70% in the top 15 meters (Dodge *et al.* 2014). Leatherbacks on the foraging grounds moved with slow, sinuous area-restricted search behaviors. Shorter, shallower dives were taken in productive, shallow waters with strong sea surface temperature gradients. They were highly aggregated in shelf and slope waters in the summer, early fall, and late spring. During the late fall, winter, and early spring, they were more widely dispersed in more southern waters and neritic habitats (Dodge *et al.* 2014). Leatherbacks (n=24) tagged in Canadian waters primarily used the upper 30 meters of the water column and had shallow dives (Wallace *et al.* 2015).

Dodge et al. (2018) used an autonomous underwater vehicle (AUV) to remotely monitor fine-scale movements and behaviors of nine leatherbacks off Cape Cod, Massachusetts. The "TurtleCam" collected video of tagged leatherback sea turtles and simultaneously sampled the habitat (e.g., chlorophyll, temperature, salinity). Representative data from one turtle was reported in Dodge et al. (2018). During the 5.5 hours of tracking, the turtle dove continuously from the surface to the seafloor (0-20 meters). Over a two-hour period, the turtle spent 68% of its time diving, 16% swimming just above the seafloor, 15% at the surface and 17% just below the surface. The animal frequently surfaced (>100 times in ~2 hours). The turtle used the entire water column, feeding on jellyfish from the seafloor to the surface. The turtle silhouetted prey 36% of the time, diving to near/at bottom and looking up to locate prey. The authors note that silhouetting prey may increase entanglement in fixed gear if a buoy of float is mistaken for jellyfish (Dodge *et al.* 2018).

5.7.2 Atlantic Sturgeon

The marine and estuarine range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Based on the best available scientific and commercial data, Atlantic sturgeon originating from any of five DPSs could occur in the waters of the action area (Damon-Randall *et al.* 2013, Wirgin *et al.* 2015b). Eggs, early life stages, and juveniles (as used here referring to Atlantic sturgeon offspring that have not emigrated from the natal river) are not present in the action area. Sub-adult and adult Atlantic sturgeon occur in waters off the Northeast and Mid-Atlantic year round. Atlantic sturgeon are known to use the action area for migration and foraging. Foraging behaviors typically occur in areas where suitable forage and appropriate habitat conditions are present. These areas include tidally influenced flats and mud, sand, and mixed cobble substrates (Stein *et al.* 2004b). Within the marine range of Atlantic sturgeon, several marine aggregation areas have been identified adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard. Depths in these areas are generally no greater than 25 meters (Dunton *et al.* 2010, Erickson *et al.* 2011, Laney *et al.* 2007, Stein *et al.* 2004b). Given the depth range, it is expected that these identified aggregations are primarily in state waters. The scallop fishery and Atlantic sturgeon overlap, suggesting that if suitable forage and/or habitat features are present, adults and sub-adults from any of the five listed DPSs may be foraging or undertaking migrations in the areas where scallop fishing activities will occur.

5.8 The Impact of the Environmental Baseline on ESA-Listed Species

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on the ESA-listed species considered in this consultation. Some of these stressors (e.g., vessel strike, entanglement) result in mortality or serious injury to individual animals, whereas others (e.g., a fishery that impacts prey availability) result in more indirect or non-lethal impacts. Assessing the aggregate impacts of these stressors on species is difficult, especially since many of the species in this Opinion are wide ranging and subject to stressors in locations throughout the action area and outside the action area.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on ESA-listed resources to be the status and trends of those species. As noted in the *Status of the Species*, some of the species considered in this consultation are experiencing increases in population abundance, some are declining, and for others, their status remains unknown. In considering these trends, we must also consider that some are based on a proxy for the overall population. For example, sea turtle trends are primarily based on nesting data that assesses a subset of the population. The trends must be considered in this context. Taken together, this indicates that the *Environmental Baseline* is impacting species in different ways. The species experiencing increasing population abundances are doing so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* may slow their recovery, recovery is not being prevented. For the species that may be declining in abundance, it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects[9], among others, that cause their limited population size to become a threat in and of itself. A thorough review of the status and trends of each species is discussed in the *Status of Species* section of this Opinion.

6.0 CLIMATE CHANGE

The discussion below presents background information on global climate change, as well as 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 those predicted environmental changes may affect listed species. Climate change is relevant to the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections of this Opinion. Therefore, rather than include partial discussions in several sections of this Opinion, we are synthesizing this information into one discussion. Consideration of the effects of the proposed action in light of predicted changes in environmental conditions due to anticipated climate change are included in the *Effects of the Action* below (section 7.0).

6.1 Background Information on Global Climate Change

In a special report "Global Warming of 1.5°C", the Intergovernmental Panel on Climate Change (IPCC) found that human activities are estimated to have caused approximately 1°C (likely range 0.8°C to 1.2°C) of global warming over pre-industrial levels. It is likely to reach 1.5°C between 2030 and 2050 under current conditions (high confidence) (IPCC (Intergovernmental Panel on Climate Change) 2018). Since the 1860s, the Northeast U.S. shelf sea surface temperature (SST) has exhibited an overall warming trend, with the past decade measuring well above the long term average (and the trend line). Changes in the Gulf Stream, increases in the number of warm core ring formations and anomalous onshore intrusions of warm salty water are affecting the coastal ocean dynamics with important implications for commercial fisheries and protected species. Annual surface and bottom temperatures in the Gulf of Maine and Georges Bank have trended warmer since the early 1980s. Gulf of Maine bottom temperatures were nearly 1°C warmer than average in 2019. Seasonal surface temperatures have trended warmer in spring, summer, and fall throughout New England. The 2018 summer sea surface temperatures were the highest on record in the Gulf of Maine with temperature moderating slightly in 2019. Annual surface and bottom temperatures in the Mid-Atlantic Bight have also trended warmer since the early 1980s,

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[9] Demographic stochasticity is caused by random independent events of individual mortality and reproduction, which cause random fluctuations in population growth rate. It is most strong in small populations. Inbreeding depression is the reduced biological fitness of a population from breeding of related individuals, inbreeding. Allee effects are broadly characterized as a decline in individual fitness in populations with a small size or density.

and seasonal temperatures have similarly trended warmer in spring, summer, and fall (NEFSC 2021a, 2021b).

Model projections of global mean sea level rise (relative to 1986-2005) suggest an indicative range of 0.85-2.5 feet (0.26 to 0.77 meters) by 2100 for 1.5°C of global warming which is 0.32 feet (0.1 meter) less than for global warming of 2°C (medium confidence). Sea level rise is expected to continue well beyond 2100 (high confidence) and the magnitude and rate of rise depend on future emission pathways (IPCC (Intergovernmental Panel on Climate Change) 2018). 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 also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008).

Ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average; given this, existing projections from the IPCC may be too conservative (Saba et al. 2016).

The past few 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. 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 (Intergovernmental Panel on Climate Change) 2007). There is evidence that the NADW has already freshened significantly (IPCC (Intergovernmental Panel on Climate Change) 2007). 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 entire world (Greene *et al.* 2008). Changes in salinity and temperature are also thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC (Intergovernmental Panel on Climate Change) 2007). Specifically, recent research on the North Atlantic Oscillation (NAO), which impacts climate variability throughout the Northern Hemisphere, has found potential changes in NAO characteristics under future climate change until 2100 (Hanna and Cropper 2017).

Global warming of 1.5°C is projected to shift the ranges of many marine species to higher latitudes and drive the loss of coastal resources. The risk of irreversible loss of many marine and coastal ecosystems increases with global warming, especially at 2°C or higher (high confidence) (IPCC (Intergovernmental Panel on Climate Change) 2018). 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 changes in ice cover, salinity, oxygen levels, and circulation.

Changes to the marine ecosystem due to climate change may result in changes in the distribution and abundance of the prey for protected species.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change on smaller geographic scales, such as the action area. The effects of future change will vary greatly among coastal regions for the U.S. For example, sea level rise is projected to be worse in low-lying coastal areas where land is sinking (e.g., the Gulf of Mexico) than in areas with higher, rising coastlines (e.g., Alaska) (Jay *et al.* 2018). 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. As climate warms, water temperatures in streams and rivers are likely to increase; this will likely result wide-ranging effects to aquatic ecosystems. Changes in temperature will be most evident during low flow periods when the water column in waterways are more likely to warm beyond the physiological tolerance of resident species (NAST 2000). Low flow can impede fish entry into waterways and combined with high temperatures can reduce survival and recruitment in anadromous fish (Jonsson and Jonsson 2009).

Expected consequences of climate change for river systems are wide ranging. 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 (Hulme 2005). Rivers could experience 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). Increased water volume in a warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants 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 along the U.S. Atlantic coast 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. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008). Given this, a global analysis of the potential effects of climate change on river basins indicates that large river basins impacted by dams will need a higher level of reactive or proactive management interventions in response to climate change than basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to respond and/or adapt to change. Given the above, under a continually changing environment, maintaining healthy riverine ecosystems will likely require adaptive management strategies (Hulme 2005).

Recent changes in climate conditions are well documented and are predicted to continue (USGCRP 2017; IPCC 2019), increasing the likelihood for effects to marine and anadromous protected species and their habitats. In marine systems, climate change impacts extend beyond changes in temperature and precipitation to include changes in pH, ocean currents, loss of sea ice, and sea level rise. The increased frequency and intensity of floods, droughts, summer low-flows, and stressful water temperatures already occurring in freshwater rivers and streams used by anadromous species are expected to continue or worsen in many locations. Estuaries may experience changes in habitat quality/quantity and productivity as a result of changes in freshwater flows, nutrient cycling, sediment delivery, sea level rise, and storm surge.

6.2 Species Specific Information on Climate Change Effects

6.2.1 Sea Turtles

Sea turtle species have persisted for millions of years. They are ectotherms, meaning that their body temperatures depends on ambient temperatures. Throughout this time they have experienced wide variations in global climate conditions and are thought to have previously adapted to these changes through changes in nesting phenology and behavior (Poloczanska *et al.* 2009). Given this, climate change at normal rates (thousands of years) is not thought to have historically been a problem for sea turtle species. However, at the current rate of global climate change, future effects to sea turtles are probable. Climate change has been identified as a threat to all species of sea turtles found in the action area (Conant *et al.* 2009, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013, NMFS (National Marine Fisheries Service) *et al.* 2011, Seminoff *et al.* 2015). However, trying to assess the likely effects of climate change on sea turtles is extremely difficult given the uncertainty of regional climate change projections and the scope and scale of sea turtle habitat, biology, and behavioral change. In the Northwest Atlantic, specifically, loggerhead, green, and leatherback sea turtles are predicted to be among the more resilient species to climate change, while Kemp's ridley turtles are among the least resilient (Fuentes *et al.* 2013). Leatherbacks may be more resilient to climate change in the Northwest Atlantic because of their wide geographic distribution, low nest-site fidelity, and gigantothermy (Dutton *et al.* 1999, Fuentes *et al.* 2013, Robinson *et al.* 2009). Gigantothermy refers to the leatherback's ability to use its large body size, peripheral tissues as insulation, and circulatory changes in thermoregulation (Paladino *et al.* 1990). Leatherbacks achieve and maintain substantial differentials between body and ambient temperatures through adaptations for heat production, including adjustments of the metabolic rate, and retention (Wallace and Jones 2008). However, modeling results show that global warming poses a "slight risk" to females nesting in French Guiana and Suriname relative to those in Gabon/Congo and West Papua, Indonesia (Dudley *et al.* 2016). More recently, Lettrich et al. (2020) and Lettrich et al. (in prep) have determined that in the Northwest Atlantic, the vulnerability of Kemp's ridley and leatherback sea turtles to climate change is very high, the vulnerability of green sea turtles is high, and the vulnerability of loggerhead sea turtles is moderate.

Sea turtles are most likely to be affected by climate change due to:

(1) changing air/land temperatures and rainfall at nesting beaches that could affect reproductive output including hatching success, hatchling emergence rate, and hatchling sex ratios;

(2) sea level rise, which could result in a reduction or shift in available nesting beach habitat, an increased risk of erosion and nest inundation, and reduced nest success;

(3) changes in the abundance and distribution of forage species, which could result in changes in the foraging behavior and distribution of sea turtle species as well as changes in sea turtle fitness and growth;
(4) changes in water temperature, which could possibly lead to a shift in their range, changes in phenology (timing of nesting seasons, timing of migrations) and different threat exposure; and
(5) increased frequency and severity of storm events, which could impact nests and nesting habitat, thus reducing nesting and hatching success.

Current approaches have limited power to predict the magnitude of future climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species. Over the next ten years, sea surface temperatures are expected to rise less than 1°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution and recruitment of sea turtles or their prey. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present for longer periods. A recent study by Patel et al. (2021) in which nearly 200 loggerheads were tagged and tracked in the Mid-Atlantic Bight indicated that the habitat envelope for these turtles consisted of SSTs ranging from 11.0° to 29.7°C. The core range consisted of SSTs between 15.0° and 28.0°C, with the highest probability of presence occurred in regions with SST between 17.7° and 25.3°C. Their model was then forced by a high-resolution global climate model under a doubling of atmospheric CO_2 to project loggerhead probability of presence over the next 80 years. Results suggest that loggerhead thermal habitat and seasonal duration will likely increase in northern regions of the Northwest Atlantic shelf.

As the climate continues to warm, feminization of sea turtle populations is a concern for many sea turtle species, which undergo temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and higher female-biased sex ratios (*e.g.*, (Glen and Mrosovsky 2004, Hawkes *et al.* 2009)). Increases in precipitation might cool beaches (Houghton *et al.* 2007); thereby, mitigating some impacts relative to increasing sand temperature. Though the predicted level of warming over the period of the action is small (i.e., <1°C), feminization occurs over a small temperature range (1°-4°C) (Wibbels 2003) and several populations in the action area already are female biased (Gledhill 2007, Laloë *et al.* 2016, Patino-Martinez *et al.* 2012, Witt *et al.* 2010). The existing female bias among juvenile loggerhead sea turtles is estimated at approximately three to two females per males (Witt *et al.* 2010). Feminization is a particular concern in tropical nesting areas where over 95% female biased nests are already suspected for green sea turtles, and leatherbacks are expected to cross this threshold within a decade (Laloë *et al.* 2014, Laloë *et al.* 2016, Patino-Martinez *et al.* 2012). It is possible for populations to persist, and potentially increase with increased egg production, with strong female biases (Broderick *et al.* 2000, Coyne and Landry 2007, Godfrey *et al.* 1999, Hays *et al.* 2003), but population productivity could decline if access to males becomes scarce (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population. Behavioral changes could help mitigate the impacts of climate change, including shifting of the breeding season and location to avoid warmer temperatures. For example, the start of the nesting season for loggerheads has already shifted as the climate has warmed

(Weishampel *et al.* 2004). Nesting selectivity could also help mitigate the impacts of climate on sex ratios as well (Kamel and Mrosovsky 2004).

At St. Eustatius in the Caribbean, there is an increasing female biased sex ratio of green sea turtle hatchlings (Laloë *et al.* 2016). While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause as warmer sand temperatures at nesting beaches can result in the production of more female embryos. At this time, we do not know how much of this bias is also due to hatchery practices as opposed to temperature. Global warming may exacerbate this female skew. An increase in female bias is predicted in St. Eustatius, with only 2.4% male hatchlings expected to be produced by 2030 (Laloë *et al.* 2016). The study also evaluated leatherback sea turtles on St. Eustatius. The authors found that the model results project the entire feminization of green and leatherback sea turtles due to increased air temperature within the next century (Laloë *et al.* 2016). The extent to which sea turtles may be able to cope with this change, by selecting cooler areas of the beach or shifting their nesting distribution to other beaches with smaller increases in sand temperature, is currently unknown.

Several leatherback nesting areas are already predominantly female, a trend that is expected to continue with some areas expecting at least 95% female nests by 2028 (Gledhill 2007, Laloë *et al.* 2016, Patino-Martinez *et al.* 2012). Hatchling success has declined in St. Croix (Garner *et al.* 2017), though there is some evidence that the overall trend is not climate or precipitation related (Rafferty *et al.* 2017). Excess precipitation is known to negatively impact hatchling success in wet areas, but can have a positive effect in dry climates (Santidrián-Tomillo *et al.* 2015). In Grenada, increased rainfall (another effect of climate change) was found to have a cooling influence on leatherback nests, so that more male producing temperatures (less than 29.75°C) were found within the clutches (Houghton *et al.* 2007). There is also evidence for very wet conditions inundating nests or increasing fungal and mold growth, reducing hatching success (Patino-Martinez *et al.* 2014). Very dry conditions may also affect embryonic development and decrease hatchling output. Leatherbacks have a tendency towards individual nest placement preferences, with some clutches deposited in the cooler tide zone of beaches and have relatively weak nesting site fidelity; this may mitigate the effects of long-term changes in climate on sex ratios (Fuentes *et al.* 2013, Kamel and Mrosovsky 2004).

If nesting can shift over time or space towards regions with cooler sand temperatures, these effects may be partially offset. A shift towards earlier onset of loggerhead nesting was associated with an average warming of 0.8°C in Florida (Weishampel *et al.* 2004). Early nesting could also help mitigate some effects of warming, but has also been linked to shorter nesting seasons in this population (Pike *et al.* 2006), which could have negative effects on hatchling output. Nesting beach characteristics, such as the amount of precipitation and degree of shading, can effectively cool nest temperatures (Lolavar and Wyneken 2015). However, current evidence suggests that the degree of cooling resulting from precipitation and/or shading effects is relatively small and therefore, even under these conditions, the production of predominantly female nests is still possible (Lolavar and Wyneken 2015). However, the impact of precipitation, as well as humidity and air temperature, on loggerhead nests is site specific and data suggest temperate sites may see improvements in hatchling success with predicted increases in precipitation and temperature (Montero *et al.* 2018, Montero *et al.* 2019). Conversely, tropical areas already produce 30% less output than temperate regions and reproductive output is expected to decline in these regions (Pike 2014).

Warming sea temperatures are likely to result in a shift in the seasonal distribution of sea turtles in the action area. In the northern part of the action area, sea turtles may be present earlier in the year if northward migrations from their southern overwintering grounds begin earlier in the spring. Likewise, if water temperatures are warmer in the fall, sea turtles could remain in the more northern areas later in the year. Potential effects of climate change include range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson *et al.* 2009). McMahon and Hays (2006) reported that warming caused a generally northerly migration of the 15°C SST isotherm from 1983 to 2006. In response to this, leatherbacks expanded their range in the Atlantic north by 330 kilometers (McMahon and Hays 2006). An increase in cold stunning of Kemp's ridley sea turtles in New England has also been linked to climate change and could pose an additional threat to population resilience (Griffin *et al.* 2019).

In addition, although nesting occurs in the Mid-Atlantic (i.e., North Carolina and into Virginia), recent observations have caused some speculation that the nesting range of some sea turtle species may shift northward as the climate warms and that nest crowding may increase as sea level rises and available nesting habitat shrinks (Reece *et al.* 2013). Recent instances include a Kemp's ridley nest in New York in July 2018 (96 hatchlings), a loggerhead nest in Delaware in July 2018 (48 hatchlings), and a loggerhead nest in Maryland in September 2017 (seven live hatchlings). The ability to shift nesting in time and space towards cooler areas could reduce some of the temperature-induced impacts of climate change (e.g., female biased sex ratio). Fuentes et al. (2020) modelled the geographic distribution of climatically suitable nesting habitat for sea turtles in the U.S. Atlantic under future climate scenarios, identified potential range shifts by 2050, determined sea-level rise impacts, and explored changes in exposure to coastal development as a result of range shifts. Overall, the researchers found that, with the exception of the northern nesting boundaries for loggerhead sea turtles, the nesting ranges were not predicted to change. Fuentes et al. (2020) noted that range shifts may be hindered by expanding development. They also found that loggerhead sea turtles would experience a decrease (10 percent) in suitable nesting habitat followed by declines in nesting habitat for green turtles. No significant changes was predicted in the distribution of climatically suitable nesting area for leatherbacks by 2050. Sea level rise is projected to inundate current habitats; however, new beaches will also be formed and suitable habitats could be gained, with leatherback sea turtles potentially experience the biggest gain in suitable habitat (Fuentes et al. 2020).

Despite site-specific vulnerabilities of the Northwest Atlantic Ocean loggerhead DPS, this DPS may be more resilient to changing climate than other management units (Fuentes et al. 2013). Van Houtan and Halley (2011) recently developed climate based models to investigate loggerhead nesting (considering juvenile recruitment and breeding remigration) in the Northwest Atlantic and North Pacific. These models found that climatic conditions and oceanographic influences explain loggerhead nesting variability. Specifically, climate variability alone explained an average 60 percent (range 18 percent-88 percent) of the observed nesting changes in the Northwest Atlantic and North Pacific over the past several decades. In terms of future nesting projections, modeled climate data predict a positive trend for Florida nesting (the Northwest Atlantic Ocean DPS), with increases through 2040 as a result of the Atlantic Multidecadal Oscillation (Van Houtan and Halley 2011). In a separate model, Arendt et al (2013) suggested that nesting variability represents a response to both climate variability and historical anthropogenic impacts. The nest count increases since 2008 may reflect a potential recovery response (Arendt et al. 2013).

Climate change may also increase hurricane activity, leading to an increase in debris in nearshore and offshore environments. This, in turn, could increase the occurrence of entanglements, ingestion of pollutants, or drowning. In addition, increased hurricane activity may damage nesting beaches or inundate nests with seawater. Increasing temperatures are expected to result in increased polar melting and changes in precipitation that may lead to rising sea levels (Titus and Narayanan 1995).

Hurricanes and tropical storms occur frequently in the southeastern U.S. They impact nesting beaches by increasing erosion and sand loss and depositing large amounts of debris on the beach. A lower level of leatherback nesting attempts occurred on sites more likely to be impacted by hurricanes (Dewald and Pike 2014). These storm events may ultimately affect the amount of suitable nesting beach habitat, potentially resulting in reduced productivity (TEWG (Marine Turtle Expert Working Group) 2007). These storms may also result in egg loss through nest destruction or inundation. Climate change may be increasing the intensity of hurricanes (IPCC (Intergovernmental Panel on Climate Change) 2014).

These environmental/climatic changes could result in increased erosion rates along nesting beaches, increased inundation of nesting sites, a decrease in available nesting habitat, and an increase in nest crowding (Baker *et al.* 2006, Daniels *et al.* 1993, Fish *et al.* 2005, Reece *et al.* 2013). Changes in environmental and oceanographic conditions (e.g., increases in the frequency of storms, changes in prevailing currents), as a result of climate change, could accelerate the loss of sea turtle nesting habitat, and thus, loss of eggs (Antonelis *et al.* 2006, Baker *et al.* 2006, Conant *et al.* 2009, Ehrhart *et al.* 2014).

Tidal inundation and excess precipitation can contribute to reduce hatchling output, particularly in wetter climates (Pike 2014, Pike *et al.* 2015, Santidrián-Tomillo *et al.* 2015). This is especially problematic in areas with storm events and in highly developed areas where the beach has nowhere to migrate. Females may deposit eggs seaward of erosion control structures, potentially subjecting nests to repeated tidal inundation. A recent study by the U.S. Geological Survey found that sea levels in a 620-mile “hot spot” along the East Coast are rising three to four times faster than the global average (Sallenger *et al.* 2012). In the next 100 years, the study predicted that sea levels will rise an additional 20-27 centimeters along the Atlantic coast “hot spot” (Sallenger *et al.* 2012). The disproportionate sea level rise is due to the slowing of Atlantic currents caused by fresh water from the melting of the Greenland Ice Sheet. Sharp rises in sea levels from North Carolina to Massachusetts could threaten wetland and beach habitats, and negatively affect sea turtle nesting along the North Carolina and Virginia coasts. If warming temperatures moved favorable nesting sites northward, it is possible that rises in sea level could constrain the availability of nesting sites on existing beaches (Reece *et al.* 2013). There is limited evidence of a potential northward range shift of nesting loggerheads in Florida, and it is predicted that this shift, along with sea level rise, could result in more crowded nesting beaches (Reece *et al.* 2013).

In the case of Kemp's ridleys, most of their critical nesting beaches are undeveloped and may still be available for nesting despite shifting landward. Unlike much of the Texas coast, the Padre Island National Seashore (PAIS) shoreline in Texas, where increasing numbers of Kemp's ridley are nesting, is accreting. Given the increase in nesting at the PAIS, as well as increasing and slightly cooler sand temperatures than at other primary nesting sites, PAIS could become an increasingly important source of males for a species, which already has one of the most restricted nesting ranges of all sea turtles. Nesting activity of Kemp's ridleys in Florida has also increased over the past decade, suggesting the population may have some behavioral flexibility to adapt to a changing climate (Pike 2013). Still, current models predict long-term reductions in sea turtle fertility as a result of climate change; however, these effects may not be seen for 30 to 50 years because of the longevity of sea turtles (Davenport 1997, Hawkes *et al.* 2007, Hulin and Guillon 2007).

Changes in water temperature may also alter the forage base and thus, foraging behavior of sea turtles (Conant *et al.* 2009). Likewise, if changes in water temperature affected the prey base for loggerhead, leatherback, Kemp's ridley, or green sea turtles, there may be changes in the abundance and distribution of these species in the action area. Depending on whether there was an increase or decrease in the forage base and/or a seasonal shift in water temperature, there could be an increase or decrease in the number of sea turtles in the action area. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as changes in salinity, light levels, and temperature (Duarte 2002, Saunders *et al.* 2013, Short and Neckles 1999). If seagrasses in the action area decline, it is reasonable to expect that the number of foraging hard-shelled sea turtles, namely greens, would also decline as well. Rising water temperatures, and associated changes in marine physical oceanographic systems (e.g., salinity, oxygen levels, and circulation), may also impact the distribution/abundance of leatherback prey (i.e., jellyfish) and in turn, impact the distribution and foraging behavior of leatherbacks (Attrill *et al.* 2007, Brodeur *et al.* 1999, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013, Purcell 2005, Richardson *et al.* 2009). Loggerhead sea turtles are thought to be generalists (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008), and, therefore, may be more resilient to changes in prey availability. As noted above, because we do not know the adaptive capacity of these individuals, or what level of temperature change would cause a shift in distribution, it is not possible to predict changes to the foraging behavior of sea turtles over the next ten years. If sea turtle distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact to sea turtles due to the availability of food. Similarly, if sea turtles shifted to areas where different forage was available, and sea turtles were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. However, should climatic changes cause sea turtles to shift to an area or time where insufficient forage is available, impacts to these species would be greater.

Kemp's ridley sea turtles are also the most commonly documented species during cold stun events in the Greater Atlantic Region. With prolonged exposure to low water temperatures, sea turtles become hypothermic and can experience debilitating lethargic conditions. These events occur in the fall at higher latitudes when sea turtles do not migrate south before water temperatures decline. Griffin et al. (2019) suggest that warming sea surface temperatures in the Gulf of Maine are associated with increased strandings of Kemp's ridleys in Massachusetts. The warmer temperatures may be allowing Kemp's ridley distribution to expand and may act as an ecological bridge between the Gulf Stream and nearshore waters (Griffin *et al.* 2019).

6.2.2 Atlantic Sturgeon

Hare et al. (2016) assessed the vulnerability to climate change of a number of species that occur along the U.S. Atlantic coast. The authors define vulnerability as "the extent to which abundance or productivity of a species in the region could be impacted by climate change and decadal variability." Atlantic sturgeon were given a vulnerability rank of very high (99% certainty from bootstrap analysis) and a climate exposure rank of very high. Three exposure factors contributed to this score: sea surface temperature, ocean acidification, and air temperature. The authors concluded that Atlantic sturgeon are relatively invulnerable to distribution shifts. Climate factors such as sea level rise, reduced dissolved oxygen, and increased temperatures have the potential to decrease productivity, but the magnitude and interaction of effects is difficult to assess (Hare *et al.* 2016). Increasing hypoxia, in combination with increasing temperature, affects juvenile Atlantic sturgeon metabolism and survival (Secor and Gunderson 1998). A multivariable bioenergetics and survival model predicted that within the Chesapeake Bay, a 1°C increase in Bay-wide temperature reduced suitable habitat for juvenile Atlantic sturgeon by 65% (Niklitschek and Secor 2005). These studies highlight the importance of the availability of water with suitable temperature, salinity and dissolved oxygen; climate conditions that reduce the amount of available habitat with these conditions would reduce the productivity of Atlantic sturgeon.

Changes in water availability may also affect the productivity of populations of Atlantic sturgeon. In rivers with dams or other barriers that limit access to upstream freshwater reaches, spawning and rearing habitat may be restricted by increased saltwater intrusion; however, no estimates of the impacts of such change are currently available.

7.0 EFFECTS OF THE ACTION

In this *Effects of the Action* section, we present the results of our assessment of the probable effects of the federal action that is the subject of this consultation on threatened and endangered species and designated critical habitat. Effects of the action are defined as all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action, and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.17).

The analysis in this section forms the foundation for our jeopardy analysis in section 9.0. The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the action. Data are limited, so we are often forced to make assumptions to overcome the limits in our knowledge. Sometimes, the best available information may include a range of values for a particular aspect under consideration or different analytical approaches may be applied to the same data set. When appropriate in those cases, the uncertainty is resolved in favor of the species (House of Representatives Conference Report No. 697, pg. 1442, 96th Congress, Second Session, 12 (1979)). We generally select the value that would lead to conclusions of higher, rather than lower, risk to endangered or threatened species. This approach provides the "benefit of the doubt" to threatened and endangered species.

In this section of the Opinion, we assess the direct and indirect effects of the proposed action on ESA-listed sea turtles and the five DPSs of Atlantic sturgeon. The purpose of the assessment is to determine if it is reasonable to conclude that the fishery is likely to have direct or indirect effects on those species that appreciably reduce their likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution.

As described in section 4.0, we have determined that ESA-listed NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles, as well as the GOM, NYB, CB, Carolina, and SA DPSs of Atlantic sturgeon may be adversely affected by the authorization of the scallop fishery as a result of interactions with gear and vessels used in the fishery. Our assessment of the effects of ESA-listed species interactions with scallop gear and fishing vessels is provided below in order for us to make a determination in section 9.0 as to whether the proposed action is likely to jeopardize the continued existence of these species.

7.1 Approach to the Assessment

We begin our analysis of the effects of the action by first reviewing what activities (e.g., gear types and techniques, vessel transits) associated with the proposed action are likely to adversely affect sea turtles and Atlantic sturgeon in the action area (i.e., the proposed action stressors). We next review the range of responses to an individual's exposure to that stressor and the factors affecting the likelihood, frequency, and severity of exposure. Afterwards, our focus shifts to evaluating and quantifying exposure. We estimate the number of individuals of each species likely to be exposed and the likely fate of those animals.

The *Integration and Synthesis* section of this Opinion follows the *Effects of the Action* section and integrates information we presented in the *Status of the Species* and *Environmental Baseline* with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species. Because we previously concluded that the proposed action is not likely to adversely affect several listed species and areas designated as critical habitat for listed species (section 4.1), these listed species and critical habitat are not considered in the analyses that follow.

To identify, describe, and assess the effects to listed species considered in this Opinion, we reviewed information on: (1) bycatch of loggerhead, leatherback, Kemp's ridley, and green sea turtles and Atlantic sturgeon in the scallop fishery from the NEFSC observer/sea sampling database and the published literature (Murray 2011, 2015a, 2015b, 2020a, 2020b; Warden 2011), (2) life history of sea turtles and Atlantic sturgeon, and (3) effects of bottom trawl and vessel interactions on sea turtles and Atlantic sturgeon in similar fisheries in the U.S. Atlantic. These sources of information include status reviews, stock assessments, biological reports, recovery plans, and numerous other references from the published literature as cited in this Opinion.

Potential Stressors

We consider all stressors from the proposed action that may adversely affect endangered or threatened species, their ecological interactions, or critical habitat designated for the listed species. At any point in time, a single fishing vessel may be the source of one or more of these potential stressors, and listed individuals may be exposed to one or more of these stressors.

Potential stressors from the proposed action include interactions with fishing gear and vessel strikes. Effects caused by the authorization of the scallop fishery on threatened and endangered species stem primarily from interactions with the fishing gear that results in the strike, capture, injury, or death of an individual, listed species. Our analysis, therefore, assesses adverse effects from physical contact with fishing gear. We also assume the potential effects of each gear type are proportional to the number of interactions between the gear and each species. Two basic types of fishing gear are used in the scallop fishery: dredges and bottom trawls. Another potential effect of the proposed action on listed species is via vessel interactions, which may result in the injury and/or death of an individual. Additional consequences caused by or resulting from the proposed action may include habitat degradation or a reduction of prey/foraging base (discussed below sections in 7.2.3 and 7.3.3).

7.2 Effects to Sea Turtles

7.2.1 Effects from Gear Interactions

Certain fishing gears may directly affect sea turtles. Of the gears used by the scallop fishery, sea turtles are known to interact with scallop dredge and bottom otter trawl gear.

7.2.1.1 Factors Affecting Sea Turtle Interactions with Scallop Fishing Gear

The primary factors affecting sea turtle interactions with the scallop fishery are: (1) overlap in time and space, (2) method of fishing, (3) the behavior of sea turtles in the presence of gear, and (4) oceanographic features. As described in the *Status of the Species* section, the occurrence of NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles in

Northwest Atlantic waters is primarily temperature dependent. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas as water temperatures warm in the spring (Braun-McNeill and Epperly 2002, Braun-McNeill *et al.* 2008, James *et al.* 2005a, James *et al.* 2005b, James *et al.* 2005c, Keinath *et al.* 1987, Morreale and Standora 1998, Morreale and Standora 2005, Musick and Limpus 1997, Shoop and Kenney 1992). Recreational anglers have reported sightings of sea turtles in inshore waters (bays, inlets, rivers, or sounds) as far north as New York as early as March-April, but in relatively low numbers (Braun-McNeill and Epperly 2002). The trend is reversed in the fall as water temperatures cool. Near Cape Hatteras during late fall and early winter, the narrowness of the continental shelf and influence of the Gulf Stream helps to concentrate sea turtles, making them more susceptible to fishery interactions (Epperly *et al.* 1995). Greater numbers of loggerheads, Kemp's ridleys, and greens are found in inshore, nearshore, and offshore waters of the southern Mid-Atlantic (Virginia and North Carolina) from May-November (Mansfield *et al.* 2009) and in inshore, nearshore, and offshore waters of the northern Mid-Atlantic (New York and New Jersey) from June-October (Braun-McNeill and Epperly 2002, Keinath and Musick 1993, Morreale and Standora 1994). Hard-shelled sea turtles are more commonly found in waters south of Cape Cod and Georges Bank, but may also occur in waters farther north (Morreale and Standora 1994). Leatherback sea turtles have a similar seasonal distribution, but have a more extensive range into the Gulf of Maine compared to the hard-shelled sea turtle species (James *et al.* 2005a, James *et al.* 2005b, Mitchell *et al.* 2002, Shoop and Kenney 1992).

Extensive survey effort of the continental shelf from Cape Hatteras to Nova Scotia, Canada in the 1980s revealed that loggerheads were observed at the surface from the beach to bottom depths up to 4,481 meters (CETAP 1982). However, they were generally found in waters where bottom depths ranged from 22-49 (median 36.6) meters deep (Shoop and Kenney 1992). Leatherbacks were sighted at the surface in waters with bottom depths ranging from 1-4,151 meters deep (Shoop and Kenney 1992). However, 84.4% of leatherback sightings occurred in waters where the bottom depth was less than 180 meters, whereas 84.5% of loggerhead sightings occurred in waters where the bottom depth was less than 80 meters (Shoop and Kenney 1992). Neither species was commonly found in waters over Georges Bank, regardless of season (Shoop and Kenney 1992). The CeTAP study did not include Kemp's ridley and green sea turtle sightings, given the difficulty of sighting and identifying these sea turtle species (CETAP 1982).

In the summer of 2010, as part of the AMAPPS project, the NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead sea turtles in the portion of the northwestern Atlantic continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada (NMFS 2011). The abundance estimates were based on data collected from an aerial line-transect sighting survey as well as satellite tagged loggerheads. The preliminary regional abundance estimate was about 588,000 individuals (approximate inter-quartile range of 382,000-817,000) based on only the positively identified loggerhead sightings, and about 801,000 individuals (approximate inter-quartile range of 521,000-1,111,000) when based on the positively identified loggerheads and a portion of the unidentified sea turtle sightings (NMFS 2011).

More recently as part of another AMAPPS survey, the NEFSC and SEFSC conducted two shipboard and two aerial line transect surveys covering U.S. Atlantic waters from Florida to Maine, from the coastline to the U.S. EEZ and slightly beyond from June 27 to September 28, 2016 (NMFS 2016). The aerial abundance surveys targeted sea turtles in Atlantic continental shelf waters from the shore to about the 328-foot (100 meter) or 656-foot (200 meter) depth contour, depending on the location. The shipboard abundance surveys targeted sea turtles in waters at the shelf break, starting from the offshore edge of the plane's survey area to waters farther offshore to the U.S. EEZ and slightly beyond. The surveys completed about 18,338 nautical miles (33,963 kilometers) of track lines: 5,796 nautical miles (10,735 kilometers) from ships and 12,542 nautical miles (23,228 kilometers) from planes. The most frequently detected sea turtles were loggerheads, with about 1,000 individuals that ranged from 26°-41° N, mostly in waters on the continental shelf. Studies conducted in 2016 also investigated methods to estimate spatial and temporal distributions of tagged loggerhead sea turtle densities (NMFS 2016).

Researchers also conducted aerial surveys in coastal ocean waters of Maryland and Virginia from spring through fall in 2011 and 2012 (Barco *et al.* 2018). Ocean abundance estimates of loggerheads were highest in the spring months of May-June and lower in the fall months of September-October. Ocean abundance estimates for loggerheads during the summer months of July-August were in between the spring and fall ranges, while no surveys were flown in the winter months from November-March (Barco *et al.* 2018).

Sea turtle interactions with dredge and bottom trawl gear used in the scallop fishery can involve collisions with gear, glancing blows off of the gear, or captures of the entire animal within the gear itself. In the case of captures, drowning may occur due to forced submergence. Studies have also shown that capture in fishing gear followed by rapid decompression may result in gas bubble formation in the blood stream (embolism) and tissues. This can lead to organ injury, impairment, and mortality in some animals (Crespo-Picazo *et al.* 2020, Fahlman *et al.* 2017, García-Párraga *et al.* 2014, Parga *et al.* 2020). Gas embolism has been documented in green, loggerhead, and leatherback sea turtles (Crespo-Picazo *et al.* 2020, García-Párraga *et al.* 2014, Parga *et al.* 2020) and in turtles caught in trawl gear (Fahlman *et al.* 2017). The likelihood of fatal decompression increases with increasing depth fished (Fahlman *et al.* 2017). Size of the gear (e.g., mesh/twine size), the duration of tows, and the effectiveness of gear modifications (e.g., chain mats and TDDs on dredges) will influence the likelihood of injury and mortality to sea turtles that are incidentally caught (Epperly *et al.* 2002, Epperly and Teas 2002, Murray 2008, 2009a, 2018, 2020, Stacy *et al.* 2015, Warden 2011a, b).

Although NMFS observers have observed some portion of scallop dredge trips taken in every month in recent years (not counting 2020 and early 2021 due to restrictions from COVID-19), sea turtle interactions with scallop dredge gear have primarily been observed in the months of June through October (with the exception of two December interactions recorded in 2011 and 2015; Murray 2015a, 2020a). This is consistent with the time of year when sea turtles are present in the action area. In terms of depth and distribution, observed sea turtle interactions in the scallop dredge fishery have primarily occurred in continental shelf waters between 40-60 meters deep off the coast from New Jersey to Virginia (Murray 2011, 2015a, 2020a).

In regards to captures in scallop dredge gear, Haas *et al*. (2008) described a number of locations where sea turtle captures in scallop dredge gear were recorded by fishery observers prior to the requirement of chain mats including: in the dredge (generic), in the bag, on top of the catch, in the sweep or chains, in the frame, atop of the dredge, and other. Out of 74 sea turtle captures recorded from 1996-2005, the most frequent occurred in the dredge (n=27), in the dredge bag (n=11), or on top of the catch (n=7). Only a few sea turtles were reported in the sweep (n=2), in the dredge frame (n=4), or atop of the dredge (n=1). About 75% of the sea turtles were brought aboard the fishing vessel. Of the sea turtles not brought aboard, some were recorded as being bumped by the gear, being in the dredge but swimming out, swimming from the gear while it was being rinsed, being washed off the bail, being atop of the dredge, falling from the sweep area, or falling "from" or "out of" the dredge (Haas *et al*. 2008). Based on this information, predicting where on the dredge the majority of sea turtle interactions will occur has been and will continue to be difficult, especially given recent gear modifications such as chain mats and TDDs that are designed to keep sea turtles from being captured in the gear. However, sea turtles may continue to be captured in dredge gear if the gear is not designed properly, if it malfunctions, or if the sea turtle is small enough such that the gear modifications are not successful in excluding or deflecting the turtle from the dredge.

NMFS has considered other factors that might affect the likelihood that sea turtles will collide with, be struck by, or become captured in fishing gear. These other factors include the behavior of sea turtles around fishing gear, as well as the effect of certain oceanographic features. Video footage recorded by NMFS SEFSC's Pascagoula Laboratory showed that loggerhead sea turtles will keep swimming in front of an advancing shrimp trawl, rather than deviating to the side, until the turtles become fatigued and are caught by the trawl or the trawl is hauled up (NMFS 2002). At a workshop on mitigating interactions in trawl fisheries, it was noted that sometimes sea turtles remained on the bottom with bottom disturbance from trawl gear, while others shot to the top (DeAlteris 2010). There was also additional discussion about whether sea turtle behavior in front of approaching trawl gear might be indicative of how long it had been since the turtle had last surfaced for air (DeAlteris 2010). The information on behavior in front of and around trawl gear is inconclusive (DeAlteris 2010).

Benthic immature and adult loggerhead and Kemp's ridley sea turtles feed on benthic organisms such as crabs, whelks, and other invertebrates including bivalves (Burke *et al.* 1994, Burke *et al.* 1993, Dodd 1988, Keinath *et al.* 1987, Lutcavage and Musick 1985, Morreale and Standora 2005, Seney and Musick 2005, Seney and Musick 2007). Green sea turtles also feed on the ocean bottom. Therefore, if loggerhead, Kemp's ridley, and green sea turtles are foraging on the bottom or swimming through the water column in areas where the fisheries operate, they would be at risk.

Observations of sea turtle interactions in bottom trawls indicate that fisheries using this gear type are capable of incidentally capturing sea turtles and that some of these interactions are lethal. Sea turtles have been observed to dive to the bottom and hunker down when alarmed by loud noise or gear (Memorandum to the File, L. Lankshear, December 4, 2007; DeAlteris 2010), which could place them in the path of bottom gear such as a trawl. However, others may instead continue to swim in front of an advancing trawl or swim above it.

Research conducted on the use of the water column by sea turtles provides additional information on the co-occurrence of sea turtles and fisheries. Starting in 2007, Coonamessett Farm began a series of research projects to assess and implement the use of an ROV to observe sea turtle behavior in the water column and on the sea floor in the Mid-Atlantic. The ROV studies focused on Atlantic sea scallop fishing grounds with water depths of 131-262 feet (40-80 meters) during the months of June (2008, 2009), July (2009), August, (2008) and September (2007, 2009) (Smolowitz and Weeks 2010, Weeks *et al.* 2010). During these studies, over 50 sea turtles were tracked by ROV for periods ranging from two minutes to over eight hours (Smolowitz and Weeks 2010, Weeks *et al.* 2010). In addition to footage collected from the ROV, visual observations and recordings from the masthead were obtained. A range of loggerhead behaviors were observed, including feeding, diving, swimming, surface, and social behaviors. Loggerheads were observed feeding on jellyfish within the top 33 feet (10 meters) of the surface and on crabs and scallops on the ocean bottom (Smolowitz and Weeks 2010, Weeks *et al.* 2010). A number of sea turtles were recorded on the ocean bottom at depths of 161-230 feet (49-70 meters), and water temperatures of 7.5°-11.5°C (Smolowitz and Weeks 2010, Weeks *et al.* 2010). Bottom times in excess of 30 minutes were recorded (Weeks *et al.* 2010).

Tagging studies have shown that leatherback sea turtles, which occur seasonally in western North Atlantic continental shelf waters where the scallop fishery operates, stay within the water column rather than near the bottom (James *et al.* 2005a). Given the largely pelagic life history of leatherbacks (Rebel 1974; CeTAP 1982; NMFS and USFWS 1992), and the dive-depth information on leatherback use of western North Atlantic continental shelf waters (James *et al.* 2005a, 2005b; Dodge et al. 2014, 2018; Wallace *et al.* 2015), they are likely to spend more time in the water column than on the bottom. Given that leatherbacks forage primarily within the water column rather than on the bottom, interactions between leatherbacks and scallop gear are expected to occur when the gear is traveling through the water column versus on the bottom.

The effect of certain oceanographic features may affect the likelihood of an interaction with sea turtles. A review of the data associated with 11 sea turtles captured by the scallop dredge fishery in 2001 concluded that the captured sea turtles appeared to have been near the shelf/slope front (D. Mountain, pers. comm.). Intensity of biological activity in the Northwest Atlantic has been associated with oceanographic fronts, including nutrient fluxes and biological productivity. Particular oceanographic features and processes that influence biological activity include vertical mixing by tides; seasonal heating and cooling that leads to winter convection and vertical stratification in summer; pressure gradients from density contrasts set up by deep water inflows and lower salinity waters; and influxes of the cold, fresher waters associated with Scotian Shelf Water (Townsend *et al.* 2006). There may be an increased risk of interactions between sea turtles and fishing gear in areas where these oceanographic features occur simply because there are possibly more sea turtles and more fishing gear present, which increases the potential for interactions. However, at present we are unable to determine if any of these oceanographic features affect the likelihood of interactions between sea turtles and the scallop fishery. As discussed later on in this section, variables such as latitude, bottom depth, and sea surface temperature have been correlated with sea turtle interaction rates with dredge and bottom trawl gear in the Mid-Atlantic (Murray 2020a, 2020b).

Given the seasonal distribution of sea turtles and the times and areas when the scallop fishery operates, all four species of sea turtles are likely to overlap with the operation of the fishery primarily from May through November in both Mid-Atlantic and Georges Bank waters. Loggerhead interactions are possible year-round in the southern portion of the Mid-Atlantic (Murray and Orphanides 2013), and with warming SSTs being observed in the Northeast U.S. in recent years, the other three sea turtle species could be as well. Based on the best, currently available information, sea turtle interactions with scallop gear are likely at times when and in areas where their distribution overlaps with the fishery.

7.2.1.2 Existing Information on Sea Turtle Interactions with Scallop Fishing Gear

The discussion of sea turtle interactions that follows will focus on scallop dredge and bottom trawl gear. Sea turtles incidentally captured in commercial fishing gear must be reported to NMFS on VTRs that are required for all federal fisheries except the American lobster and Jonah crab fisheries. At present, we acknowledge that compliance with the requirement for federally-permitted fishermen to report sea turtle interactions on their VTRs is low (as evidenced by the lack of vessel reported interactions overall, even for trips in which observers have been onboard and reported the interactions through the NEFOP, IFS, or ASM Programs). Without reliable VTR reporting of sea turtle interactions, we are using information collected through the NEFOP, IFS, and ASM Programs, which are managed through the NEFSC Fisheries Monitoring and Research Division (FMRD). These programs collect, process, and manage data and biological samples obtained by trained observers during commercial fishing trips throughout the New England and the Mid-Atlantic regions.

Additional training of observers since 2001 has greatly increased the number of sea turtles that are identified to species by observers. However, unknowns are occasionally reported because the observer does not always have sufficient time or an optimal perspective to identify the sea turtle to species (*e.g.*, when a sea turtle drops or swims out of the gear before the dredge or trawl can be fully brought on deck). Unidentified sea turtles documented in NEFSC observer reports and sea turtle bycatch analyses are assumed to be either loggerheads, Kemp's ridleys, or greens as these species are often identified by observers as "unidentified hard shelled" turtles, whereas leatherbacks are more distinctive and can in most cases be accurately identified by an observer.

The compensation rates for fishing year 2020 supported observer coverage levels of approximately 18% for open areas and 24% for each of the access areas. These coverage rates are higher than what are needed to cover Standardized Bycatch Reporting Methodology (SBRM) requirements and other scallop fishery needs in both open areas and all access areas. The fishing year 2020 observer coverage rates for the LA fleet are 5% for open areas and the Mid-Atlantic Access Area (MAAA); and 10% for the Closed Area I (CAIAA), Closed Area II (CAIIAA), Nantucket Lightship-North (NLAA-N), and Nantucket Lightship-South (NLAA-S) Access

Areas. Additionally, the LAGC IFQ coverage rates are 3.5% for the MAAA and 5% for open areas, CAIAA, CAIIAA, NLAA-N, and NLAA-S (https://www.fisheries.noaa.gov/new-england-mid-atlantic/commercial-fishing/atlantic-sea-scallop-fishery-fishing-year-2020-observer).

Past observed interactions of sea turtles in dredge and trawl gear were reviewed in the 2012 Opinion for the scallop fishery. Updated information is provided herein. The majority of interactions between sea turtles and fisheries off the U.S. Atlantic coast have occurred south of the New England region; this is likely because the distribution of sea turtles correlates with warmer water temperatures, resulting in greater densities of sea turtles south of Cape Cod. Given the current levels of observer coverage and VTR reporting, the number of observed and reported sea turtle interactions in scallop fishing gear are likely a fraction of the total amount occurring. However, there are multi-year, model-based bycatch estimates available for loggerhead sea turtles in the scallop dredge fishery and for all four species of sea turtles in bottom trawl fisheries, which provide an estimate of the total number of encounters based on an extrapolation of observed interactions (Murray 2020a, 2020b; Linden 2020).

Scallop Dredge Gear

Sea turtle interactions in scallop dredge gear have been documented by NMFS trained observers as far back as 1996 (NEFSC FMRD database). The majority of sea turtles observed captured in the scallop dredge fishery are loggerheads. Sea turtle interactions with the scallop dredge fishery as reported by observers can include sea turtles that are observed to be captured in the gear (either in the dredge bag or on parts of the dredge frame such as the sweep or chains), those lying on top of the gear without being physically caught on the gear, and those observed to swim into the gear or that are bumped by the gear when they are at the water surface (Haas *et al*. 2008; Murray 2011, 2015a, 2020a). We will begin by describing the first two multi-year estimates of sea turtle bycatch in the scallop dredge fishery for 2001-2014 (Murray 2011, 2015a) and then discuss the most recent analysis from last year for 2015-2019 (Murray 2020a).

Of the 53 sea turtles identified to species during “on-watch” scallop dredge gear tows from 2001-2014, 52 were loggerheads and one was a Kemp’s ridley (Murray 2011, 2015a). “On watch” indicates that the observers are systematically collecting data on the haul characteristics, the catch, and details of any protected species interactions (Murray 2020a). One of the sea turtles captured was severely decomposed and wrapped in gillnet gear, so was excluded from the analysis because it is unlikely the mortality occurred during the scallop dredge haul. Sixteen sea turtles were not identified to species. “Off-watch” observed sea turtles from 2001-2014 included nine loggerheads, one Kemp’s ridley, and five unidentified sea turtles (Murray 2011, 2015a). Observers may collect data opportunistically when they are “off-watch,” but these data are not used in the calculation of interaction rates because it is not known what fraction of off-watch interactions are reported (Murray 2020a). During 2001-2008, 88% (n=49) of observed loggerheads interacting with dredge gear during on and off-watch hauls were alive (with or without injuries), and 12% (n=7) were dead. One Kemp’s ridley was alive and the other was dead. All of the unidentified species were alive. Seventy-eight percent (n=18) of the benthic immature loggerheads were alive, and 100% of the adults were alive (Murray 2011). During

2009-2014, all of the observed sea turtles interacting with dredge gear that were included in the analysis (n=4) were alive (Murray 2015a). During this period, all observed loggerhead interactions occurred on dredges equipped with chain mats and none were observed on dredges using TDDs (Murray 2015a).

For 2001-2008, the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic scallop dredge fishery prior to the implementation of chain mats (1 January 2001 through 25 September 2006) was estimated to be 288 turtles (95% CI: 209-363), 218 of which were confirmed loggerheads (95% CI: 149-282). After the implementation of chain mats (26 September 2006 through 2008), the average annual number of observable interactions was estimated to be 20 turtles (95% CI: 3–42), 19 of which were confirmed loggerheads (95% CI: 2-41). If the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled species after chain mats were implemented would have been 125 turtles per year (95% CI: 88–163), 95 of which would have been confirmed loggerheads (95% CI: 63-130) (Murray 2011). For 2009-2014, the average annual observable sea turtle interactions in the Mid-Atlantic scallop dredge fishery plus unobserved, quantifiable interactions was 22 loggerheads per year (95% CI: 4-67), 9-19 of which were lethal (Murray 2015a).

From 2015-2019, the most recent five-year period that has been statistically analyzed for sea turtle interactions with scallop dredges, a total of six sea turtle captures in dredge gear (four loggerheads and two Kemp's ridleys) were reported by NMFS trained observers that were "on-watch" (Murray 2020a; Figure 21). Three additional loggerheads and an unidentified sea turtle were observed but removed from the analysis because these interactions could either not be attributed to the dredge fishing event or the interaction occurred while the observer was "off-watch" (Murray 2020a).

Murray (2020a) estimated that the scallop dredge fishery in the Mid-Atlantic interacted with an average of 155 loggerhead sea turtles per year, with a 95% CI of 99-219, from 2015-2019. The 95% CI encompasses the average annual amount of loggerhead interactions with scallop dredge gear that are "reasonably certain" to have occurred. Although Georges Bank is included in the study area for the Murray (2020b) trawl bycatch analysis, there is no estimate of loggerhead sea turtle bycatch in scallop dredge gear on Georges Bank or in the Gulf of Maine due to a lack of observed bycatch events. With so few records outside the Mid-Atlantic, too little information was available to support a robust model-based analysis for the entire action area. We expect interactions outside the Mid-Atlantic to be rare since the distribution of loggerheads in the Northwest Atlantic is temperature-dependent and more common in waters south of Cape Cod (Shoop and Kenney 1992; Morreale and Standora 1998; Mitchell *et al*. 2003). In the event that future interactions between loggerheads and scallop dredge gear occur outside of the Mid-Atlantic (i.e., on Georges Bank or in the Gulf of Maine), we assume they will be infrequent enough that they are accounted for within the 95% CI of the Murray (2020a) bycatch estimate.

The most recent NMFS observer record of a sea turtle interaction with scallop dredge gear was of a loggerhead in July 2019, which was a live turtle caught inside the dredge bag in which the chain mats equipped to the dredge were broken/damaged and the frame was not a TDD (Murray 2020a). There were no recorded sea turtle captures in scallop dredge gear in 2020 or thus far in 2021 (NEFSC FMRD database).

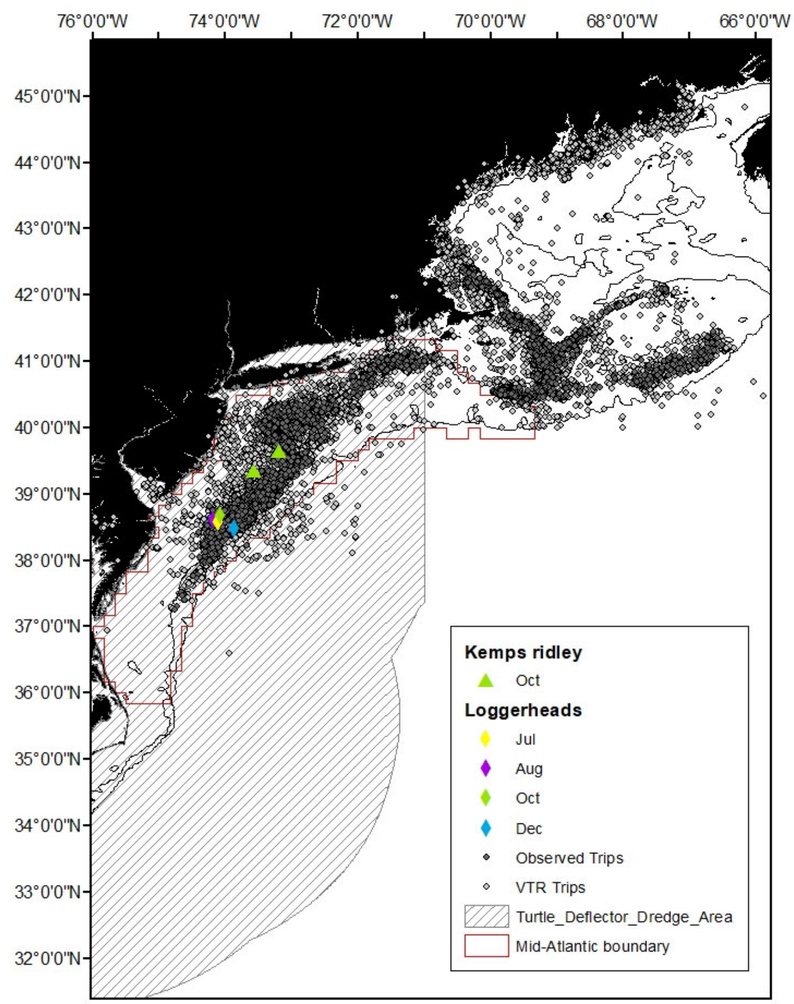

Figure 21. Distribution of observed and VTR trips as well as sea turtle interactions with scallop dredge gear during on-watch hauls from 2015-2019. Taken from Murray (2020a).

There are currently no model-based bycatch estimates for Kemp’s ridley, leatherback, and green sea turtles interactions in scallop dredge gear. As described in more detail in section 7.2.1.3 below, to estimate bycatch for those species, we analyze all available fisheries observer data.

Bottom Trawl Gear

Sea turtle interactions in scallop bottom trawl gear have been documented by NMFS-trained observers as far back as 2004. Similar to scallop dredge gear, the majority of sea turtles observed captured in the scallop bottom trawl fishery are loggerheads. We will begin by describing the first three multi-year estimates of sea turtle bycatch in the U.S. Atlantic bottom trawl fisheries for 1996-2013 (Murray 2008, 2015b; Warden 2011) and then discuss the most recent analysis from last year for 2014-2018 (Murray 2020b).

For bottom trawl gear, observer and commercial data were stratified by Ecological Production Unit (EPU), latitude zone, season, and depth, based on factors associated with loggerhead bycatch rates in previous bycatch analyses (i.e., latitude, SST, depth) (Murray 2011, 2015a, 2015b; Warden 2011). Within the Mid-Atlantic EPU, latitude zones included: Northern (>=39°N to the Mid-Atlantic boundary with the Georges Bank EPU); Middle (>37°N and <39°N) and Southern (<=37°N). Season was used as a proxy for SST. Summer was defined as July-October and winter as November-June. Depth groups were defined as shallow (<=50 meters) or deep (>50 meters). Within the Georges Bank EPU, rates were also stratified by season and depth groups. While few to no interactions occurred in the Georges Bank EPU, it was stratified as a separate region for a number of reasons. These include: (1) the EPUs are characterized by distinct patterns in oceanographic properties, fish distributions, and primary production (Ecosystem Assessment Program 2012); (2) previous analyses of turtle interactions delineated the "Mid-Atlantic" with the same boundaries, facilitating comparisons across time series; and (3) observer coverage is allocated separately across fleets operating in the Mid-Atlantic versus Northeast regions, of which Georges Bank is a part.

Previous NEFSC bycatch reports for bottom trawls apportioned estimated bycatch to individual fisheries to help aid fishery management evaluations. Trips in a certain time and area using trawls were estimated to have a certain bycatch rate of loggerhead sea turtles. Estimated bycatch on each trip was apportioned to multiple fisheries proportional to the catch composition of that trip by weight (Murray 2013, 2015, Warden 2011a, b). This method was meant to reflect the variety of managed fisheries operating in the action area that interact with sea turtles. As we have now batched all federal trawl fisheries under GARFO jurisdiction into one Opinion (NMFS 2021b), minus the scallop trawl fishery, we only need to partition out bycatch for the scallop fishery, which is a small percentage of the total trawl take estimate. The process for partitioning out scallop trawl bycatch for sea turtles is explained in Linden (2020).

The estimates of sea turtle bycatch in bottom trawl gear published in Murray (2020b), and then apportioned for the scallop trawl fishery specifically by Linden (2020), represent the best available information for and analysis of sea turtle bycatch in Mid-Atlantic and Georges Bank trawl fisheries. For the first time, such estimates for trawl gear were calculated for all four species of sea turtles, not just loggerheads.

Murray (2020b) analyzed fisheries observer data and VTR data from fishermen to estimate the number of sea turtle interactions in bottom trawl gear in U.S. Mid-Atlantic and Georges Bank waters that occurred between 2014 and 2018. These reports on interactions represent the most accurate predictor of annual sea turtle interactions in U.S. bottom trawl fisheries south of the Gulf of Maine to Cape Hatteras, North Carolina.

There were a sufficient number of recorded sea turtle interactions in bottom trawl gear to support trawl bycatch estimates for all four sea turtle species in both the Mid-Atlantic and on Georges Bank during the most recent time period assessed (2014-2018) (Murray 2020b, Linden 2020). Loggerhead sea turtles represent the majority of sea turtles species observed incidentally captured in bottom trawl gear in the action area, including bottom trawls for scallops and bottom trawls for all other fish species. From 2014-2018 (the most recent five-year period that has been statistically analyzed for trawls), NEFOP observers documented 50 loggerhead sea turtle interactions in U.S. Atlantic bottom trawl gear[10], 48 of which occurred in the Mid-Atlantic[11]. The ASM Program documented no sea turtles over this period. Observers also recorded five Kemp's ridleys, three leatherbacks, and two green sea turtles in bottom trawl gear from 2014-2018 in the Mid-Atlantic and on Georges Bank (Figure 22). The majority (83%) of the observed interactions occurred between July and October. Interaction rates were stratified by region, latitude zone, season, and depth. Within each stratum, observed interaction rates were multiplied by total days fished from VTR trips to calculate the estimated number of sea turtle interactions.

The highest loggerhead interaction rate (0.43 turtles/day fished) was in waters south of 37ºN (approximately Virginia Beach, Virginia) during November to June in waters greater than 164 feet (50 meters) deep (Murray 2020b). This is in the southernmost portion of the Greater Atlantic Region where both sea turtles and effort in the scallop fishery occur year round due to more moderate temperatures. The greatest number of estimated sea turtle interactions occurred in the Mid-Atlantic region north of 39ºN (approximately Cape May, New Jersey) during July to October in waters less than 164 feet (50 meters) deep, due to a greater amount of commercial trawling effort in this stratum compared to those farther south. Within each stratum, interaction rates for non-loggerhead species were lower than rates for loggerheads (Murray 2020b).

From 2014-2018, 571 loggerheads (CV=0.29, 95% CI=318-997) were estimated to have interacted with bottom trawl gear in the U.S. Mid-Atlantic while 12 loggerheads (CV=0.70, 95% CI=0-31) were estimated to have interacted with bottom trawls on Georges Bank (Murray 2020b). Subsequently, Linden (2020) partitioned out the estimated loggerhead takes that were estimated to have occurred in trawls catching scallops. That estimate was 6.60 loggerheads over the five-year period with a 95% CI of 1.34-12.83 for the Mid-Atlantic and Georges Bank combined.

[10] Takes in the southern Mid-Atlantic shrimp twin trawl fishery were not included in the bycatch analysis or this Opinion because takes in this fishery are estimated by the NMFS Southeast Region and Northeast observers no longer observe this fishery. Additionally, authorization of the Mid-Atlantic shrimp twin trawl fishery is not part of the proposed action under consideration in this consultation.

[11] One of these included a sea turtle that could not be identified to species, but for this analysis it was presumed to be a loggerhead based on characteristics described by observers. The observer noted it was "dark brown, tannish with 5 vertebral scutes and an estimated length of [36 inches] 91 centimeters".

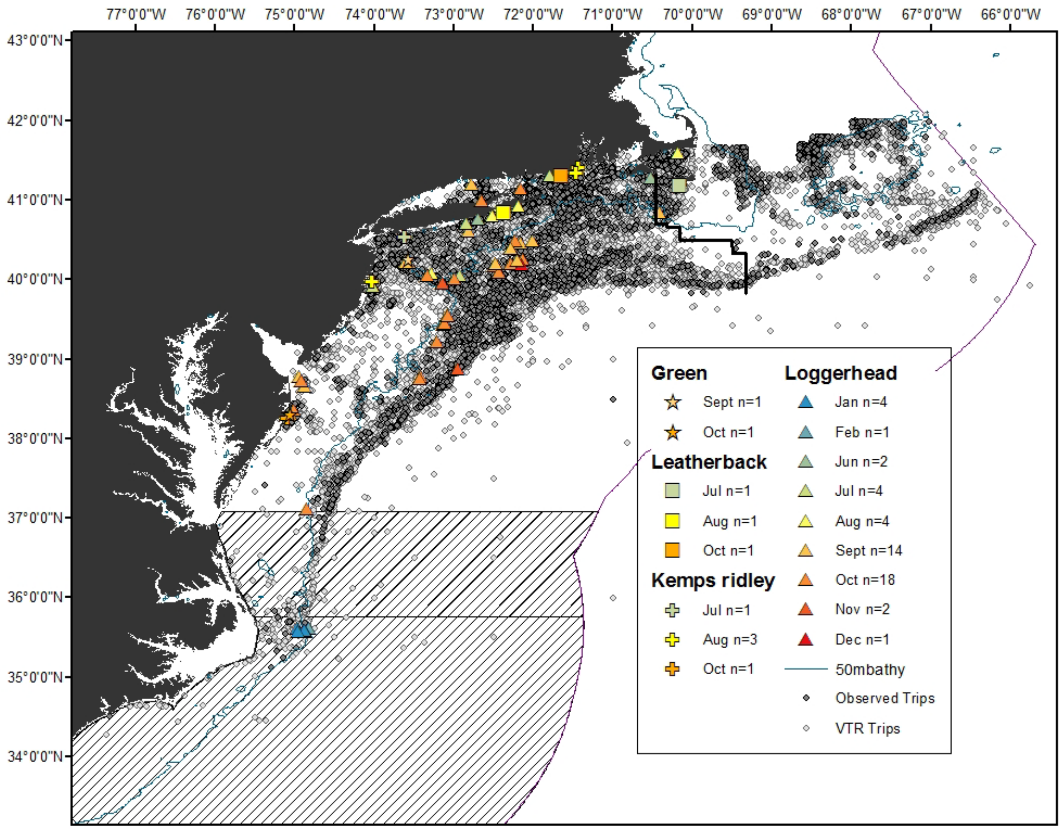

Figure 22. Distribution of observed and VTR trips as well as sea turtle interactions with bottom trawl gear during on-watch hauls from 2014-2018. Taken from Murray (2020b).

From 2014-2018, a total of 46 Kemp's ridley (CV=0.45, 95% CI=10-88) and 16 green (CV=0.73, 95% CI=0-44) sea turtles were estimated to have interacted with bottom trawl gear in the Mid-Atlantic, of which 23 and 8 resulted in mortality, respectively. There were no observed interactions between bottom trawl gear and Kemp's ridley sea turtles on Georges Bank. During this period, 20 (CV=0.72, 95% CI = 0-50) and 6 (CV=1.0, 95% CI=0-20) leatherback interactions were estimated to have occurred in the Mid-Atlantic and on Georges Bank, respectively, which resulted in 13 total mortalities. There were 0 Kemp's ridley, green, and leatherback sea turtles estimated to have been excluded by TEDs (i.e., unobservable but quantifiable interactions) (Murray 2020b).

Documented sea turtle interactions with trawl gear after the period analyzed in Murray (2020b) are presented for additional reference; however, they are not yet included in any model-based estimates of sea turtle bycatch in the U.S. Mid-Atlantic or Georges Bank (Table 19). As shown below, there was one loggerhead interaction in bottom trawl gear for scallops documented in the 2019-2020 time period, which occurred in 2019.

Table 19. Documented bycatch of sea turtles in trawl gear recorded by the NEFOP and ASM Program in 2019 and 2020 (i.e., since the most recent bycatch estimate (Murray 2020b), along with the most landed commercial species (by hail weight) per trip. Source: NEFSC FMRD database.

	Horseshoe crab	Scup	Sea scallop	Squid, Atlantic longfin	Summer flounder
Loggerhead sea turtle	1	1	1	2	2
Unidentified sea turtle				1	

7.2.1.3 Estimating Interactions with and Mortality of Sea Turtles

Scallop dredge fishery

As described above, due to several factors, the total number of sea turtle interactions in the scallop dredge fishery cannot be directly observed and instead must be estimated. Loggerhead interactions have been estimated in the dredge fishery across three sequential, multi-year periods over the past 20 years: 2001-2008 (Murray 2011), 2009-2014 (Murray (2015a), and 2015-2019 (Murray 2020a). The estimates of loggerhead sea turtle interactions with scallop dredge gear as presented in Murray (2020a) provide the most recent and best available information for determining the anticipated number of loggerhead sea turtle interactions in the dredge fishery. The methods in Murray (2020a) allow us to account for and estimate not only observable interactions, but also unobservable yet quantifiable (*i.e.*, inferred) interactions such as a sea turtle interacting with a chain mat or TDD below the water surface and not entering the dredge bag or ending up on deck (Warden and Murray 2011).

As described in Murray (2020a), the scallop dredge fishery in the Mid-Atlantic was estimated to interact with an average of 155 loggerhead sea turtles per year, with a 95% CI of 99-219, from 2015-2019. For the purposes of this Opinion, we are using the upper end of the 95% CI (219 interactions per year) to estimate future take given it is the most conservative estimate of the anticipated amount of loggerhead sea turtle interactions in the dredge component of the fishery, and is the highest amount that would be "reasonably certain" to occur. Of the estimated 219 interactions per year, 30 were characterized as observable and the other 189 were characterized as "inferred." Although we expect interactions outside the Mid-Atlantic to be rare since the distribution of loggerheads in U.S. waters is more common in waters south of Cape Cod, we expect any infrequent interactions that occur outside of the Mid-Atlantic to be accounted for within the estimate (which is the upper end of the 95% CI rather than the mean). Overall, we expect up to 1,095 loggerhead sea turtles (219 per year over five years) will interact with scallop dredge gear over a five-year period. This represents the total number of interactions we are expecting in the dredge component of the scallop fishery and not just the number observed.

Kemp's ridleys are the second most common sea turtle species known to interact with scallop dredge gear, albeit at much lower levels than loggerheads based upon past fisheries observer data and their comparatively lower level of abundance in the action area. Using the "on watch" observer data presented in Murray (2011), only 2% (1 out of 48) of sea turtle interactions in the dredge fishery from 2001-2008 for which the species was able to be confirmed were Kemp's ridleys. There was also one "off watch" observation of a Kemp' ridley in scallop dredge gear on Georges Bank in August 2005. No Kemp's ridleys were observed captured in dredge gear from 2009-2014. However, two live Kemp's ridleys were documented as captured in dredge gear from 2015-2019. Although the sample size of interactions over this most recent five-year period was small, based on these documented interactions and our knowledge that the distribution of this species overlaps with the distribution of the scallop fishery, it is likely that Kemp's ridleys will interact with and be captured in dredge gear used by the scallop fishery in the future.

Although Kemp's ridley captures in dredge gear are only documented occasionally, the observed level of interactions is likely an underestimate of the actual level of interactions occurring since chain mats and TDDs are designed to prevent most observable dredge captures. It is also possible that some of the unidentified hard-shelled sea turtles captured in the dredge fishery over the years could have been Kemp's ridleys. Based upon the two recorded captures of Kemp's ridleys in scallop dredge gear during the 2015-2019 period (both in modified gear equipped with a chain mat and TDD), confirmed captures in bottom trawl gear deployed in similar areas, the knowledge that they occupy similar ocean habitats and have similar diets as loggerheads, and additional information that juveniles are beginning to occur in the action area in greater numbers due to warming ocean temperatures (see Griffin et al. 2019 and recent cold stunning events along Cape Cod, Massachusetts), we have determined that dredge gear used in the scallop fishery will capture up to one Kemp's ridley sea turtle annually or five over a five-year period.

Applying the ratio of estimated observable to "inferred" loggerhead interactions in the dredge fishery from 2015-2019 as described in Murray (2020a), which equates to 4.6 "inferred" interactions for every one observable one (180/39), we anticipate up to 23 additional Kemp's ridley interactions (4.6 x 5 = 23) in scallop dredge gear over a five-year period, bringing the anticipated total take to 28 interactions (five observed and 23 inferred) over five years. This represents the total number of Kemp's ridley sea turtle interactions we expect to occur, including observed captures and inferred collisions with or deflections over/around the gear that are not observable beneath the ocean surface. By doing this ratio calculation, we are assuming that interaction rates in scallop dredge gear are similar for both loggerheads and Kemp's ridleys. This approach is reasonable because of the similarities in ecology amongst the two sea turtle species in terms of diet, foraging behavior, and distribution within the action area, as described in sections 4.2.1 and 7.2.1.1. We acknowledge that it is possible that the smaller size of Kemp's ridleys makes them more likely to be captured and observed in dredge gear than loggerheads, since smaller individuals have been known to fit through or be caught in the openings of the chain mats and dredge frame, however there is no information to suggest that there would be anything more than minor differences in capture rates as a result of this.

There is very limited information on the number of green sea turtles that interact with scallop dredge gear. Between 2001 and 2019 (the years included in the last three multi-year sea turtle bycatch estimates for scallop dredge gear), there were no confirmed green sea turtle interactions with or captures in scallop dredge gear (Murray 2011, 2015a, 2020a). However, an observer documented one green sea turtle interaction with scallop dredge gear in 1997; a non-lethal capture off New Jersey (71 FR 50361, August 25, 2006). Although confirmed reports of green sea turtles interacting with scallop dredge gear in recent years is lacking, based on the one documented capture in the past, confirmed captures in bottom trawl gear deployed in similar areas, and that the distribution of this species overlaps with the operation of the scallop fishery, it is likely that green sea turtles will interact with or be captured in dredge gear used in the fishery.

Although green sea turtle interactions with dredge gear have not been documented for many years, the observed level of interactions may be an underestimate of the actual level of interactions occurring in the fishery since chain mats and TDDs are designed to prevent most observable dredge captures. It is also possible that some of the unidentified hard-shelled sea turtles captured in the dredge fishery over the years could have been greens. Based upon the single past record of a green sea turtle capture in dredge gear (when chain mats and TDDs were not required and interactions were more easily observable), the knowledge that they often do not occupy the same ecological niche nor have similar diets as loggerheads and Kemp’s ridleys, and are more tropical in distribution, we have determined that scallop dredge gear will interact with up to one green sea turtle every five years. This represents the total number of green sea turtle interactions we expect to occur and not just the number observed captured in the gear. Unlike for Kemp’s ridleys, we are not applying the ratio of estimated observable to “inferred” interactions for loggerheads here as documented green sea turtle interactions with dredge gear (as well as in bottom trawl and gillnet gear in the action area) have been much less common over the past several decades (NEFSC FMRD database) and because of the more stark differences between green and loggerhead sea turtles in terms of habitat use and foraging ecology.

There have been no confirmed interactions with or captures of leatherback sea turtles in scallop dredge gear recorded by the NEFOP. Tagging studies have shown that leatherbacks, which forage seasonally in western North Atlantic continental shelf waters where the scallop dredge fishery operates, stay within the water column rather than near the bottom (James *et al*. 2005a, 2005b; Dodge et al. 2014, 2018; Wallace et al. 2015). Given the largely pelagic life history of leatherback sea turtles (Rebel 1974; CeTAP 1982; NMFS and USFWS 1992), and the dive-depth information on their use of western North Atlantic continental shelf waters (James *et al*. 2005a, 2005b), it is unlikely that a leatherback would occur on the ocean bottom in the action area. Therefore, leatherback sea turtles are extremely unlikely to be struck by or captured in scallop dredge gear when the gear is being towed along the bottom.

Based on past observations of loggerhead sea turtles captured in scallop dredge gear, we expect some sea turtle interactions with scallop dredge gear to occur within the water column (NMFS

2008, 2012). Given the large size of the dredge frame and the presence of leatherback sea turtles in areas where the scallop dredge fishery occurs, we anticipate that leatherback sea turtles may interact with scallop dredge gear when it is being raised or dropped in the water column. Based on the lack of observed captures in the period prior to chain mats and TDDs (and in months and areas where they are not currently required), interactions between leatherback sea turtles and scallop dredge gear are likely rare. However, given that chain mats and TDDs are designed to prevent most observable dredge captures, it is likely that some interactions with leatherback sea turtles have occurred but were not observed. Therefore, similar to green sea turtles, we have determined that dredge gear used in the scallop fishery will interact with up to one leatherback sea turtle every five years. This represents the total number of leatherback interactions we expect to occur and not just the number observed captured in the gear. Unlike for Kemp's ridleys, we are not applying the ratio of estimated observable to "inferred" interactions for loggerheads here as documented leatherback sea turtle interactions with dredge gear (as well as in bottom trawl and gillnet gear in the action area) have been much less common over the past several decades (NEFSC FMRD database) and because of the more stark differences between leatherback and loggerhead sea turtles in terms of habitat use and foraging ecology.

Scallop trawl fishery

The trawl bycatch estimate in Murray (2020b) estimated interaction rates for each sea turtle species with stratified ratio estimators, where rates were stratified by Ecological Production Unit (e.g., Georges Bank and Mid-Atlantic), latitude zone, season, and depth. Trawl bycatch of sea turtles for both the Mid-Atlantic and Georges Bank was estimated for all bottom trawl gear operating in each strata. Unlike previous analyses of sea turtle bycatch in trawl gear, the estimates were not subsequently apportioned based on the catch composition on each trip. This report on interactions represent the most accurate predictor of annual sea turtle interactions in U.S. bottom trawl south of the Gulf of Maine to Cape Hatteras.

The total estimated bycatch of loggerhead sea turtles in U.S. Atlantic bottom otter trawl gear over the five-year period from 2014-2018 was 571 (95% CI:318-997) in the Mid-Atlantic and 12 (95% CI: 0-31) on Georges Bank (Murray 2020b). Subsequently, Linden (2020) partitioned out the estimated loggerhead takes that were estimated to have occurred in trawls catching scallops. That estimate was 6.60 loggerheads over the five-year period with a 95% CI of 1.34-12.83 for the Mid-Atlantic and Georges Bank combined. These estimates of loggerhead sea turtle bycatch in bottom otter trawl gear provide the best available information for determining the anticipated number of loggerhead sea turtle interactions in that component of the fishery over a five-year period. For the purposes of this Opinion, we consider the upper end of the 95% CI, 13 loggerheads over a five-year period (12.83 rounded up), to be the best available information on the anticipated number of loggerhead sea turtle interactions in the trawl component of the fishery. This represents the total number of loggerhead interactions we are expecting over a five-year period in the trawl component of the fishery and not just the number observed.

The total estimated bycatch of leatherback sea turtles in U.S. Atlantic bottom otter trawl gear over the five-year period from 2014-2018 was 20 (95% CI: 0-50) in the Mid-Atlantic and six

(95% CI: 0-20) on Georges Bank (Murray 2020b). Subsequently, Linden (2020) partitioned out the estimated leatherback takes that were estimated to have occurred in trawls catching scallops. That estimate was 0.18 leatherbacks over the five-year period with a 95% CI of 0.00-0.43 for the Mid-Atlantic and Georges Bank combined. These estimates of leatherback sea turtle bycatch in bottom otter trawl gear provide the best available information for determining the anticipated number of leatherback sea turtle interactions in that component of the fishery over a five-year period. For the purposes of this Opinion, we consider the upper end of the 95% CI, <u>one leatherback over a five-year period</u> (0.43 rounded up), to be the best available information on the anticipated number of leatherback sea turtle interactions in the trawl component of the fishery. This represents the total number of leatherback interactions we are expecting over a five-year period in the trawl component of the fishery and not just the number observed.

The total estimated bycatch of Kemp's ridley sea turtles in U.S. Atlantic bottom otter trawl gear over the five-year period from 2014-2018 was 46 (95% CI: 10-88) in the Mid-Atlantic. There was no estimate for Kemp's ridley bycatch over the five-year period on Georges Bank due to a lack of observed records (Murray 2020b). Subsequently, Linden (2020) partitioned out the estimated Kemp's ridley takes that were estimated to have occurred in trawls catching scallops. That estimate was 0.89 Kemp's ridleys over the five-year period with a 95% CI of 0.41-1.51 for the Mid-Atlantic and Georges Bank combined. These estimates of Kemp's ridley sea turtle bycatch in bottom otter trawl gear provide the best available information for determining the anticipated number of Kemp's ridley sea turtle interactions in that component of the fishery over a five-year period. For the purposes of this Opinion, we consider the upper end of the 95% CI, <u>two Kemp's ridleys over a five-year period</u> (1.51 rounded up), to be the best available information on the anticipated number of Kemp's ridley sea turtle interactions in the trawl component of the fishery. This represents the total number of Kemp's ridley interactions we are expecting over a five-year period in the trawl component of the fishery and not just the number observed.

The total estimated bycatch of green sea turtles in U.S. Atlantic bottom otter trawl gear over the five-year period from 2014-2018 was 16 (95% CI: 0-44) in the Mid-Atlantic. There was no estimate for green sea turtle bycatch over the five-year period on Georges Bank due to a lack of observed records (Murray 2020b). Subsequently, Linden (2020) partitioned out the green sea turtle takes that were estimated to have occurred in trawls catching scallops. That estimate was 0.26 green sea turtles over the five-year period with a 95% CI of 0.00-0.76 for the Mid-Atlantic and Georges Bank combined. These estimates of green sea turtle bycatch in bottom otter trawl gear provide the best available information for determining the anticipated number of green sea turtle interactions in that component of the fishery over a five-year period. For the purposes of this Opinion, we consider the upper end of the 95% CI, <u>one green sea turtle over a five-year period</u> (0.76 rounded up), to be the best available information on the anticipated number of green sea turtle interactions in the trawl component of the fishery. This represents the total number of green sea turtle interactions we are expecting over a five-year period in the trawl component of the fishery and not just the number observed.

Summary

Over a five-year period, we anticipate that the scallop dredge fishery will interact with up to 1,095 loggerhead (annual average of 219), 28 Kemp's ridley, one leatherback, and one green sea turtles. Additionally, over a five-year period we anticipate that the scallop trawl fishery will interact with an estimated 13 loggerheads, one leatherback, two Kemp's ridleys, and one green sea turtle. The anticipated interactions of leatherback, Kemp's ridley, and green sea turtles in dredge gear are not as statistically rigorous as the five-year estimate for loggerheads and are instead based on either observed interactions, inferred interaction rates, or other distributional and behavioral information. These quantitative (all four species in trawl gear; loggerheads in dredge gear) and qualitative (Kemp's ridleys, leatherbacks, and greens in dredge gear) estimates of sea turtle interactions encompass those that are expected to occur throughout the action area, from the Mid-Atlantic through Georges Bank and the Gulf of Maine. However, based on records of dredge and bottom trawl interactions over the past 30+ years, the vast majority are expected to occur in the Mid-Atlantic (Murray 2004a, 2004b, 2005, 2007, 2011, 2015a, 2015b, 2020a, 2020b; Warden 2011; Linden 2020).

Age classes of sea turtles anticipated to interact with the scallop fishery

Loggerhead sea turtles. The 2008 recovery plan identifies five life stages for loggerhead sea turtles: (1) hatchling: 4 centimeters CCL, 1-5 days; (2) post-hatchling: 4-6 centimeters CCL, <6 months; (3) oceanic juvenile: 8.5-64 centimeters CCL, 7-11.5 years; (4) neritic juvenile: 46-87 centimeters CCL, 13-20 years; and (5) adult male/female: >83 centimeters CCL and >87 centimeters CCL (respectively), >25 years for females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). From 2009-2018, observed loggerheads captured in bottom trawl gear ranged from 49-119 centimeters CCL (n=126 turtles) (Murray 2015b, 2020b). These sizes include both juveniles (sexually immature) and adults.

Haas *et al*. (2008) and Murray (2011, 2015a, 2020a) all present data on loggerhead sea turtles interacting with scallop fishing gear that we can use to determine estimated sizes of future interactions. While sizes of observed interactions are often recorded, measurements may not be collected when an animal was not brought on board for sampling (e.g., fell out of dredge or net), when an observer was off-watch, or when the interaction was observed by an at-sea monitor, who is not required to collect biological information from observed bycatch. The mean CCL of sea turtles incidentally captured in the scallop dredge fishery from 1996-2005 (which included 34 loggerheads, one Kemp's ridley, and one unidentified sea turtle, and excluded moderately and heavily decomposed sea turtles) was 78.1 centimeters (95% CI: 72.9-83.4 centimeters) (Haas *et al*. 2008). Observed loggerheads incidentally captured in the scallop dredge fishery from 2001-2008 ranged from 62 to 107 centimeters CCL (Murray 2011). From 2009-2019, observed loggerheads captured in scallop dredge gear ranged from 61.5-139.5 centimeters CCL (n=8 turtles) (Murray 2015a, 2020a). These ranges correspond to the juvenile and adult life stages.

Estimates of adult equivalents are also informative in assessing impacts to populations. Adult equivalence considers a sea turtle's reproductive value, defined as the contribution of an individual in an age class to current and future reproduction. It translates the loss of individual sea turtles into the number of adults expected based on the likelihood the individual will survive to adulthood and reproduce. Compared to individual losses, monitoring adult-equivalent losses from fisheries interactions can be a more informative metric to assess population-level impacts (Haas 2010).

The most recent estimates of bycatch in dredge (Murray 2020a) and bottom trawl (Murray 2020b) gear include adult equivalents for loggerheads. Estimated annual interactions for dredge gear from 2015-2019 were equivalent to 31 adults, with 11 resulting in mortality (Murray 2020a). From 2014-2018, the total number of loggerhead sea turtle interactions across Georges Bank and the Mid-Atlantic in all bottom trawl gear, excluding the southern Mid-Atlantic shrimp twin trawl fishery, was equivalent to 182 adults and 87 adult mortalities (Murray 2020b).

Leatherback sea turtles. The TEWG specifies that sub-adults range from 100-145 centimeters and adults are >145 centimeters CCL (TEWG (Marine Turtle Expert Working Group) 2007). Stranding, sighting, and tracking records suggest that both adult and immature leatherback sea turtles occur within the action area where the scallop fishery operates (James *et al.* 2005a, James *et al.* 2005c, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992, NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center) 2001). Although there have been no documented leatherbacks captured in scallop dredge gear since NEFOP reporting began, there were two leatherbacks captured in U.S. Atlantic trawl gear from 2014-2018 that were 142.0 and 223.0 cm CCL, respectively (Murray 2020b). In addition, we know from STDN records that immature and sexually mature leatherback sea turtles have been captured in trap/pot gear in the action area. From 2009-2018, leatherbacks entangled in trap/pot gear ranged from 102.8-175 centimeters CCL (GAR STDN, unpublished data). Therefore, either immature or sexually mature leatherback sea turtles could interact with scallop dredge or trawl gear since both age classes occur in areas where the scallop fishery operates.

Kemp's ridley sea turtles. The post-hatchling stage for Kemp's ridley sea turtles was defined by the TEWG as 5-20 centimeters standard carapace length (SCL), while turtles 20-60 centimeters SCL were considered to be benthic immature (TEWG (Marine Turtle Expert Working Group) 2000). Converting SCL to CCL (Teas 1993), post-hatchling Kemp's ridley sea turtles range from 5.3-21.2 centimeters and benthic immature turtles range from 21.2-63.5 centimeters CCL. Length at sexual maturity was more recently reported to vary considerably, ranging from 47.0 to 61.0 centimeters CCL (Bjorndal *et al.* 2014). Benthic immature turtles are those animals that have recruited to coastal benthic habitat. Mid-Atlantic and coastal New England waters are known to be developmental foraging habitat for immature Kemp's ridley sea turtles, while adults have been documented from waters and nesting beaches along the South Atlantic coast of the U.S. and in the Gulf of Mexico (Morreale and Standora 2005, Musick and Limpus 1997, TEWG (Marine Turtle Expert Working Group) 2000). Kemp's ridley turtles captured in scallop dredge gear from 2015-2019 ranged from 29.0 to 33.0 centimeters CCL (n=2 turtles), sizes considered to be juveniles (Bjorndal *et al.* 2014, TEWG (Marine Turtle Expert Working Group) 2000) (Murray 2020a). Size classes of Kemp's ridleys observed captured in Mid-Atlantic and Georges Bank trawl gear from 2014-2018 ranged from 22.7-29.7 centimeters CCL (n=3 turtles), also in the size range of juvenile turtles (Murray 2020b). Given the life history of the species and the above bycatch records in recent years, we expect that only juvenile Kemp's ridley sea turtles are likely to interact with gear used in the scallop fishery.

Green sea turtles. Hirth (1997) defined a juvenile green sea turtle as a post-hatchling up to 40 centimeters SCL. A sub-adult was defined as green sea turtles from 41 centimeters through the onset of sexual maturity, and sexual maturity was defined as green sea turtles greater than 70-100 centimeters SCL (Hirth 1997). As they are for Kemp's ridleys, Mid-Atlantic waters are recognized as developmental habitat for juvenile green sea turtles after they enter the benthic environment (Morreale and Standora 2005, Musick and Limpus 1997). The one green sea turtle captured in the scallop dredge fishery in 1997 had an estimated length of 70 centimeters (Haas *et al*. 2008). Two green sea turtles were captured in Mid-Atlantic and Georges Bank trawl gear from 2014-2018 and measured 25.6 and 31.0 centimeters CCL, respectively, which are within the juvenile size range (Murray 2020b). However, nesting individuals are known to occur and feed in the Mid-Atlantic on occasion. A green sea turtle nest was documented in Delaware in 2011 and nests have also been recorded previously in North Carolina and Virginia ((Hawkes *et al.* 2005) https://dwr.virginia.gov/blog/sea-turtles-in-virginia/; https://www.delawareonline.com/story/news/2018/10/26/rare-delaware-sea-turtle-nest-could-sign-climate-changed/1759869002/). Thus, we expect that both juvenile and adult green sea turtles are likely to interact with gear used in the scallop fishery.

Estimated mortality of sea turtles captured in scallop fishing gear

Sea turtle interactions with scallop dredge and trawl gear likely result in a higher level of sea turtle mortality than is evident based on the number of sea turtles returned to the water alive (due to post-interaction mortalities). Injuries suffered by sea turtles interacting with scallop fishing gear fall into two main categories: (1) submergence injuries characterized by an absence or obvious reduction in breathing and consciousness with no other apparent injury, and (2) contact injuries resulting from collisions with the gear or entanglement of flippers and/or other body parts in the gear. Contact injuries can be characterized by scrapes to soft tissue, cracks to the carapace and/or plastron, missing or damaged scutes, and/or bleeding from one or more orifice. The following information is provided as an assessment of the extent of these types of injuries likely to occur to sea turtles affected by the authorization of the scallop fishery. It should be noted that the severity of physical injuries to sea turtles as a result of scallop dredge interactions will be less if the turtle is interacting with a TDD or dredge equipped with chain mats as compared to a standard dredge.

Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage *et al*. 1997). Studies examining the relationship between tow duration and sea turtle mortality in the shrimp trawl fishery show that mortality was strongly dependent on trawling duration (Epperly *et al.* 2002, Henwood and Stuntz 1987, NRC (National Research Council) 1990, Sasso and Epperly 2006). The results of these studies were comparable. In general, tows of short duration have little effect on the likelihood of mortality for sea turtles caught in the trawl gear. Intermediate tow durations result in a rapid escalation to mortality, and eventually reach a plateau of high mortality, but will not equal 100% as a turtle caught within the last hour of a long tow will likely survive (Epperly *et al.* 2002, Henwood and Stuntz 1987, NRC (National Research Council) 1990, Sasso and Epperly 2006). The stress of being captured in a trawl is greater in cold water than in warm water (Epperly *et al.* 2002, Sasso and Epperly 2006). Epperly et al. (2002) gave the example that a 40 minute tow in the summer time was predicted to have a 3% mortality rate whereas a 40 minute tow in the winter time was predicted to have a 5% mortality rate. To achieve a negligible mortality rate (defined by NRC as <1%), tow duration for both seasons would have to be less than 10 minutes (Epperly *et al.* 2002, Sasso and Epperly 2006). However, in both seasons, a rapid escalation in the mortality rate did not occur until after 50 minutes (Sasso and Epperly 2006) as had been found by Henwood and Stuntz (1987). Although the data used in the reanalysis were specific to bottom otter trawl gear in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries, the authors considered the findings to be applicable to the impacts of forced submergence in general (Sasso and Epperly 2006).

Metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. Most voluntary dives appear to be aerobic, showing little if any increases in blood lactate and only minor changes in acid-base status. The story is quite different, however, in forcibly submerged sea turtles, where oxygen stores are rapidly consumed, anaerobic glycolysis is activated, and acid-base balance is disturbed, sometimes to lethal levels (Lutcavage and Lutz 1997). Forced submergence of Kemp's ridley sea turtles in shrimp trawls resulted in an acid-base imbalance after just a few minutes (times that were within the normal dive times for the species) (Stabenau *et al.* 1991). Conversely, recovery times for acid-base levels to return to normal may be prolonged. Henwood and Stuntz (1987) found that it took as long as 20 hours for the acid-base levels of loggerhead sea turtles to return to normal after capture in shrimp trawls for less than 30 minutes. This effect is expected to be worse for sea turtles that are recaptured before metabolic levels have returned to normal.

Tows by scallop dredge vessels are usually around an hour or less, while tows by bottom otter trawl vessels are usually around one to two hours in duration. However, Murray (2008) found that tow times of bottom otter trawl gear that resulted in sea turtle bycatch ranged from 0.5 to over 5 hours. Shortened tow durations in the dredge fishery, which have been used to limit yellowtail flounder bycatch (NEFMC 2011b), should help to reduce the risk of death from forced submergence for sea turtles caught in dredges (primarily those without chain mats), but they do not eliminate the risk. For the trawl fishery, assuming that the mortality rate for sea turtles from forced submergence in scallop trawl gear is comparable to that measured for the shrimp fishery by Epperly *et al*. (2002) and Sasso and Epperly (2006), sea turtles may die as a result of capture and forced submergence in trawl gear used in the scallop fishery, especially if they are caught at the beginning of long tows.

Prior to 2013, the best available information on sea turtle mortality was the number of dead sea turtles documented by the NEFOP and ASM programs and/or reported in the NEFSC bycatch estimates (Murray 2008, 2009b, Warden 2011a, b). Based on the descriptions provided by fisheries observers, it seemed probable that some injured sea turtles observed captured in commercial fishing gear and that were returned to the water alive would have subsequently died as a result of those injuries.

In November 2009, NMFS GARFO and the NEFSC hosted a workshop to discuss sea turtle injuries in regional fishing gear and associated post-interaction mortality. The purpose was to expand guidance originally developed for the scallop dredge fishery to attempt to encompass other Greater Atlantic Region gear types (e.g., gillnet, trawl) and a wide range of sea turtle injuries, and to use a consistent approach for assessing post-interaction mortality. The workshop convened various experts in sea turtle veterinary medicine, health assessment, anatomy, and/or rehabilitation. The information gathered by individual participants at this workshop was then used by NMFS to develop technical guidelines for assessing sea turtle injuries in Northeast fishing gear (Upite 2011). In 2015, to promote national consistency when assessing post-interaction mortality in trawl, net, dredge, and pot/trap gear, NMFS convened an expert working group of veterinarians, sea turtle biologists, observer program experts, and resources managers to inform the development of national criteria (Stacy *et al.* 2015). Subsequent to the workshop, NMFS developed national guidance on assessing post-interaction mortality (NMFS 2017b). Each year, NMFS reviews records of incidental capture in trawl, gillnet, dredge, pot/trap, vertical fishing line, fish trap, and aquaculture gear to determine the mortality in these gear types (Upite *et al.* 2019). Based upon the best available scientific and commercial data, we have determined that these guidelines are reasonable measures of what to expect for sea turtles captured by fishing gear and associated post-interaction mortality.

Workgroup members annually review each observer record and first determine if the injury was a result of the fishery interaction (haul/set/tow), using the guidance and expert opinion. If related to the fishery in question, then the members use the national criteria to place the turtle into one of the three categories with the identified post-interaction mortality rates, or provide justification for a 100% mortality determination. After the determinations are finalized, the records are separated by gear type. The mortality rates by gear type are calculated based upon the percent probability of mortality and numbers of turtles in each category (Upite *et al.* 2019). The associated mortality rates (10% or 20% [depending on the depth of the fishing activity], 50%, 80%) for the three categories factor in any potential variations in species differences. As the criteria apply to all sea turtle species and life phases (NMFS 2017b), all species are combined in the mortality rate estimates for each gear type (Upite, 2019 #3097}. Therefore, the resulting mortality percentages apply to all sea turtle species.

Mortality percentages are calculated over a rolling five-year period. The mortality percentages for the four most recent five-year periods, which overlap with the bycatch estimates, are presented in Table 20 (Upite et al. 2019; Memoranda from Carrie Upite, Sea Turtle Recovery Coordinator, to Jennifer Anderson, ARA for Protected Resources; February 26, 2020, and April 26, 2021). These post-interaction mortality rates for trawls are consistent with those calculated over the past several five-year periods dating back to 2006-2010, although the rates for dredges are substantially lower over the past three five-year periods (range: 35%-40%) than they were for years prior (range: 67%-100%), most of which were prior to the TDD requirements. A major factor there is the sample size of dredge interactions – it is so low (five in the last time period) that one or two cases can drastically change the percentages.

Table 20. Rolling 5-year estimated mortality rates by gear type.

	Dredge	Trawl
2012-2016	40%	47%
2013-2017	40%	48%
2014-2018	38%	46%
2015-2019	35%	43%

<u>Post-interaction mortality calculation - dredge gear</u>

Contact injuries involving damage to the carapace and/or plastron of sea turtles have occasionally been observed in the scallop dredge fishery, most often in the case of dredges not equipped with chain mats from the time period prior to the chain mat requirements. However, fishery observers often cannot assess whether dredge-related injuries occurred on the bottom, in the water column, or on the deck of the vessel; they can only determine whether injuries occurred before or after the turtle was brought aboard the vessel (Haas *et al*. 2008). As stated in section 7.2.1 above, no underwater interactions of living sea turtles with scallop dredge gear have been observed or photographed; although studies by Milliken *et al*. (2007) and Smolowitz *et al*. (2010) used video monitoring of sea turtle carcasses to assess the effects of a TDD on sea turtles. Given the current knowledge of sea turtle life history, the condition of sea turtles captured in or upon dredge gear as described by observers (Haas *et al*. 2008; Murray 2011, 2015a, 2020a), and an understanding of the gear and how it is fished, there are several ways that a sea turtle might suffer injuries during interactions with dredge gear. Scallop dredge gear is heavy and fishes with part of the gear in contact with the bottom. If loggerhead, Kemp's ridley, and green sea turtles are foraging in areas where scallop dredging occurs, they will likely be spending some of their time on or near the bottom where they would be at risk of being struck or captured by scallop dredge gear.

Given that the cutting bar of a standard dredge rides only a few inches off the seabed (Smolowitz 1998), and the gear weighs approximately 4,500 pounds (Memorandum to the File, E. Keane, March 2008), it is reasonable to conclude that a sea turtle struck by a dredge on or very near the bottom would suffer cracks to the shell (carapace and/or plastron) as a result of being struck by the dredge and passing under the gear that is forward of the dredge bag opening before passing into the dredge bag. If a sea turtle enters the dredge bag, it may be injured by large rocks that are also caught in the dredge bag. It is reasonable to conclude that sea turtles caught in scallop dredge gear may also be injured during one or more steps that are necessary to empty the dredge bag. Under typical fishing activities, the dredge is hauled to the surface at the end of each tow alongside the vessel, lifted above the deck of the vessel and emptied by turning the bag over. After the bag is dumped, the dredge frame is often dropped on top of the catch. Contact between the dredge bag and the side of the vessel as the bag is hauled out of the water, as well as the dumping of the catch and the sudden lowering of the gear onto the deck are times when sea turtles captured in or upon the gear could reasonably be injured as a result of hitting against the side of the vessel, falling onto the deck, or being hit by the dredge contents and/or the dredge itself. Again, it is expected that most of these injuries, with a few exceptions, will occur due to interactions with non-TDD, non-chain mat equipped dredges.

Some observers have reported sea turtles that are found within the dredge bag upon hauling of the gear that have no apparent injuries. Given the weight of the dredge frame, the presence of the cutting bar forward of the dredge opening, and the typical shallow height of the cutting bar above the seabed while the dredge is fished, it seems improbable that a sea turtle on or very near the bottom in the path of the dredge could be passed over by the dredge frame and cutting bar, swept into the dredge bag, tumbled around or hit by debris inside the dredge bag as the gear is towed on the bottom, and not suffer any apparent injury. However, during haulback of the dredge, it is possible that a sea turtle in the water column could pass into the dredge bag with little or no contact with the cutting bar and the dredge frame in front of the opening to the dredge bag. Thus, the sea turtle would have no observable severe injuries (*i.e.*, cracks to the carapace and/or plastron) upon hauling of the dredge. For these reasons, we assert that some sea turtles may interact with or be captured in non-chain mat equipped dredge gear when the dredge is in the water column. In regards to leatherback sea turtles, all dredge interactions are expected to occur in the water column and are expected to be non-lethal for those equipped with chain mats.

As described in section 3.0, NMFS requires scallop dredge gear to be equipped with chain mats when fished in Mid-Atlantic waters west of 71°W longitude during the period of May 1 through November 30 each year. NMFS also requires all limited access and certain LAGC scallop vessels to utilize a TDD in Mid-Atlantic waters west of 71°W longitude from May through November. The effects of the proposed action (the authorization of the scallop fishery) include the effects of the fishery using both chain mats and TDDs. Since sea turtles, no matter how initially captured, can suffer injuries following capture in or upon the dredge (*e.g.*, from being tumbled around or hit by debris in the dredge while the gear is fishing on the bottom, from the dredge hitting into the side of the vessel during haulback, or from falling and crushing injuries suffered during emptying of the dredge bag on deck), keeping sea turtles from going underneath the dredge and keeping them out of the dredge bag are expected to reduce the severity of some interactions that occur.

Installing a chain mat over the opening of the dredge bag and using a TDD will not increase or decrease the number of sea turtles that will come into contact with dredge gear used in the fishery. The chain mat simply prevents a sea turtle encountering the gear from entering the dredge bag where it would be at further risk of injury, while a TDD is designed to deflect sea turtles over the dredge rather than underneath it. In 2008, the TDD was evaluated in Cape Cod Bay, Massachusetts. Seven frozen sea turtle carcasses were placed in the path of the modified dredge, interactions were videoed, and five recovered carcasses were evaluated for injuries. The only observed damage to the carcasses were superficial scratches and chips, and in the nine video recorded interactions, all carcasses hit the dredge at some point and passed over the dredge frame (Smolowitz *et al*. 2010). In a TDD, the placement of the cutting bar forward of the dredge frame allows a sea turtle to be directed up and over dredge. In a standard dredge, the cutting bar is behind and under the depressor plate, preventing a sea turtle from rising above the dredge. Sea turtles are also not expected to suffer injuries as a result of swimming into or being hit by the chain mat, only, during a water column interaction. During haulback, a dredge travels through the water column at speeds of one to four miles per hour. Sea turtles that are struck by the chain mat portion of the dredge during haulback are not expected to sustain serious injury leading to death, given the slow speed of the vessel during haulback (NMFS 2008a) and given that contact is made in the water column (a fluid environment) rather than against the bottom. Although many sea turtles caught in or retained upon scallop dredge gear have had some type of obvious injury when first observed, regulations require that fishermen return all sea turtles (regardless of the level of injury) to the water as soon as possible unless they require care or resuscitation.

All five of the observed scallop dredge interactions from 2014-2018 involved loggerheads (3) or Kemp's ridleys (2). For observed sea turtle interactions in dredges, the sample size is too small to develop valid mortality rates for each species. Thus, the decision was made to combine all species in order to develop one mortality rate by gear type. Further, the associated mortality rates (20%, 50%, 80%) for the three categories factor in any potential variations in species differences. The Technical Guidelines and resulting mortality percentages apply to all sea turtle species. After the review of observer records from 2015-2019, the Northeast Sea Turtle Injury Workgroup calculated a resulting observable mortality rate for scallop dredge gear of 35% (six records reviewed; Memorandum from Carrie Upite, Sea Turtle Recovery Coordinator, to Jennifer Anderson, ARA for Protected Resources; April 26, 2021). However, given the small sample size of observer records for scallop dredge gear over that time period, the workgroup advised that those results should be interpreted with caution.

The estimated mortality rate of 35% in scallop dredge gear for 2015-2019 is substantially lower than the rate estimated for standard dredges in the 2012 Opinion (80%), but is higher than the rate estimated for chain mat and TDD modified dredges (28%) which is based on experimental trials described in Smolowitz et al. (2010). The new rate calculated by the Workgroup uses more comprehensive and updated injury guidelines and considers a more recent time series of take information than the 80% rate for standard dredges and 64% rate for chain mat equipped dredges (Smolowitz et al. 2010), which may better reflect the current fishery where gear modifications are being used throughout much of it, even in areas and times outside the chain mat and TDD requirements (NMFS unpublished data). The mortality rate of 35% for scallop dredge gear represents recent information, post-chain mats and TDDs, and although it may not the most comprehensive across a large number of years, it equates to the post-interaction rate for all interactions estimated in Murray (2020a). In Murray (2020a), different mortality rates were applied to the total estimated observable and inferred interactions. A 66% mortality rate was applied to estimated observable interactions, per evaluations by the Northeast Sea Turtle Injury Workgroup for data from 2006-2019 (Upite *et al.* 2018) (39 x 0.66 = 25.74, rounded up to 26). While the workgroup calculates mortality rates by rolling five-year periods, Murray (2020a) combined the scallop dredge data from the various five-year periods to produce a longer time series with a larger sample size and estimated mortality rate for 2006-2019. A 28% mortality rate was then applied to inferred interactions, based on the experimental TDD trials described in Smolowitz *et al.* (2010) (180 x 0.28 = 50.4, rounded up to 51). Thus, for the next five year period, we are using the post-interaction mortality calculations in Murray (2020a), which equate to an estimated 77 lethal interactions per year (26+51 = 77, or 385 of the 1,095 loggerheads over five years) based upon the upper ends of the 95% CIs for observable and inferred interactions. And when pooled together, the total mortality rate for all dredge interactions in fact equals the 35% rate in dredge gear that was calculated by the Workgroup for 2015-2019.

Applying a mortality rate of 66% to all observable interactions (within the chain mat and TDD regulated area as well as those anticipated to occur outside the Mid-Atlantic) and 28% to all inferred interactions is appropriate and should be considered the best available information to apply to the anticipated interactions. Observable interactions remain low in the scallop dredge fishery because chain mats and TDDs reduce the likelihood that turtles are captured and brought onboard. While subsurface interactions are estimated to still be occurring, the impact to sea turtles is reduced because the mortality rate of modified dredges (28%) is estimated to be lower than the observable mortality rate (66%). Per Murray (2020a), the average annual mortality of loggerheads from 2015 to 2019 was 53, but would have been approximately double that (107) without dredge modifications.

As the observable mortality rates for dredge gear can also be applied to the other three sea turtle species, it is anticipated that the one leatherback and one green sea turtle interaction with scallop dredge gear anticipated every five years may result in mortality (1 x 66% = 0.66, which is rounded up to one). For Kemp's ridleys, we anticipate that four of the five observed captures may result in mortality (5 x 66% = 3.3, which is rounded up to four), while seven of the 23 inferred interactions every five years will be lethal (23 x 28% = 6.4, rounded up to seven).

<u>Post-interaction mortality calculation - trawl gear</u>

The 2009 and 2015 workshops and resulting Technical Guidelines apply to other Greater Atlantic Region fishing gears besides scallop dredge gear. The same approach outlined above for scallop dredge gear was taken to review and determine the post-interaction mortality rate for trawl gear. After the review of observer records from 2014-2018, the Northeast Sea Turtle Injury Workgroup calculated an estimated mortality rate of 46% for trawl gear (71 records reviewed; Memorandum from Carrie Upite to Jennifer Anderson, February 26, 2020). Although there is a more recent five-year period of mortality rates for trawl gear (2015-2019), we have chosen to use the rate from the 2014-2018 period as it aligns with the five-year period of the latest bottom trawl bycatch estimate from Murray (2020b) and is a more conservative percentage than the 43% mortality from the 2015-2019 data. Thus, of the 13 loggerhead interactions expected to occur in the scallop trawl fishery every five years, six of those are expected to result in mortality (13 x 0.46 = 5.98, which is rounded up to six). As the estimated mortality rate for trawls also applies to the other three sea turtle species, it is anticipated that the one leatherback, one of the two Kemp's ridleys, and the one green sea turtle interaction with scallop trawl gear every five years may result in mortality.

7.2.2 Effects from Vessel Strikes

Vessels participating in the scallop fishery pose a potential threat to sea turtles when transiting to and from fishing areas and when moving during fishing activity (Memorandum from Jennifer Anderson, ARA for Protected Resources to The File, December 23, 2020). The degree of threat varies by vessel type (planing vs. displacement hull), vessel speed (Hazel *et al.* 2007, Work *et al.* 2010), sea turtle distribution and density in relation to vessel traffic (co-occurrence), sea turtle behavior, and environmental conditions (e.g., sea state, visibility). When sustaining injuries from vessels, sea turtles may be struck by the hull or by some portion of the steering or propulsion system. In fact, the most commonly recognized injuries are from propellers (Foley *et al.* 2019). Records from the STSSN show that both juvenile and adult sea turtles are subject to vessel strikes (NMFS STSSN database, unpublished data). All four sea turtle species can occur at or near the surface in open-ocean and coastal areas, whether resting, feeding, or periodically surfacing to breathe. Therefore, loggerhead, leatherback, Kemp's ridley, and green sea turtles may all be struck by vessels operating in the scallop fishery, with any strike resulting in possible injury or mortality to the animal.

The proportion of vessel-struck sea turtles that survive is unknown. In some cases, it is not possible to determine whether documented injuries on stranded animals resulted in death or were post-mortem injuries. However, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles. Based on data from off the coast of Florida, there is good evidence that when vessel strike injuries are observed as the principle finding for a stranded sea turtle, the injuries were both ante-mortem and the cause of death (Foley *et al.* 2019). Foley et al. (2019) found that the cause of death was vessel strike or probable vessel strike in approximately 93% of stranded sea turtles with vessel strike injuries. Sea turtles found alive with concussive or propeller injuries are frequently brought to rehabilitation facilities; some are later released and others are deemed unfit to return to the wild and remain in captivity. Sea turtles in the wild have been documented with healed injuries so at least some sea turtles survive without human intervention.

To analyze the effects of scallop vessels operating in the action area on sea turtles, we evaluated the best available scientific and commercial data on vessel traffic and sea turtle strandings. Here, we summarize the analysis we conducted (see Memorandum from Jennifer Anderson, ARA for Protected Resources to The File, December 23, 2020 for the detailed analysis). Vessel types that occur in the action area include fishing, recreational, and commercial (e.g., cargo, military, passenger, tankers, tug-tow) vessels. However, data is limited on the use of the area by commercial vessels other than fishing vessels and, therefore, this information was not used in the analysis. Recreational boating surveys are available for 2012 and 2013 (Monmouth University 2016, Starbuck and Lipsky 2012). These and VTR data are the best available data on vessel use of the area. Based on the data provided in the recreational surveys (Monmouth University 2016, Starbuck and Lipsky 2012), we estimate that 13,082,108 recreational trips were taken from Maine to Virginia during May through October in each year from 2012 to 2013. To better understand the overall vessel traffic in the GAR in 2012 and 2013, VTR data for commercial fishing trips (for the scallop fishery in the Opinion and fisheries outside it) were also queried over this time frame. This resulted in an average of 240,365 trips reported on VTRs from May through October in 2012 and 2013. Combining these estimates, a minimum of 13,322,473 trips were taken each year from 2012 to 2013. This provides us with an estimated minimum number of trips taken from May through October in these years. While sea turtles are generally present in the action area from May through November, data on vessel trips in November was, with the exception of VTR data, not available.

Taking into consideration the information above, data provided by recreational boating surveys in 2012 and 2013, as well as VTR data, provide the best available scientific and commercial data to estimate the rate of sea turtles struck annually by vessels operating from Maine to Virginia. Therefore, we used STSSN stranding data from 2012 and 2013 to estimate the number of sea turtles struck from Maine through Virginia. There were 173 stranded sea turtles from May through October with propeller marks or evidence of watercraft injury during this period.[12] This includes animals that are alive and dead. For dead turtles, injuries can occur ante- or post-mortem. Foley et al. (2019) found that in 93% of stranded turtles with evidence of vessel strike, the injury occurred ante-mortem and was the cause of death. Using this, we presume that 7% of the animals that stranded dead may have received the injuries post-mortem; therefore, the number of that stranded dead was adjusted down. This resulted in 162 strandings due to vessel strikes in 2012 and 2013. Not all sea turtles that are injured or die at sea will strand; studies estimate that up to 7-27% of at-sea mortalities will strand (Epperly *et al.* 1996, Murphy and Hopkins-Murphy 1989). To account for vessel-struck animals that do not strand, we corrected the observed number with the detection value of 17% (the mid-point between the estimates provided in Murphy (1989) and Epperly (1996)). This results in an estimate of 476 sea turtles stranding due to vessel strikes from Maine through Virginia from May through November each year (2012 and 2013).[13]

Using the minimum number of trips taken by recreational and commercial fishing vessels in 2012 and 2013 (i.e., 13,322,473 trips) and the estimated number of sea turtles stranding due to vessel strikes (i.e., 476 sea turtles), we estimate that one turtle is struck every 27,988 trips (=13,322,473/476). Applying this rate to the trips taken by vessels in the scallop fishery, we estimated the number of sea turtles struck by vessels operating in the scallop fishery. Based on VTR data from 2015-2020, vessels participating in the scallop dredge fishery took, on average annually, 7,035 trips. For the purpose of this Opinion, we assume all the trips were in federal waters. While the rate calculated here (i.e., one sea turtle per 27,988 trips) is based on vessel data from May through October, we are applying the interaction rate to fishing trip data from May through November to assess interactions during the time sea turtles are present in the action area. This is appropriate given that we do not have information to suggest that the rates would be different in November, the data being used is intended to give a gross estimate of interactions, and the data from May through October represents the best available data since November data

[12] Of the 173 stranded sea turtles with propeller marks, 22 were leatherbacks, 3 were green, 23 were Kemp's ridley, 124 loggerhead, and one was an unknown turtle species.

[13] The estimated number of turtles struck each year in 2012 and 2013 applies to all vessels (i.e., fishing, recreational, cargo, ferries, etc.) operating in the area.

are not available. Applying the rate above, we estimate that 0.25 (=7,035/27,988) sea turtles of any species would be struck annually (or 1.25 every five years) by vessels operating in the scallop fishery in the action area. Given that a partial sea turtle cannot be taken, we estimate that up to two interactions (lethal or non-lethal) may occur every five years due to the authorization of the scallop fishery (Table 22). These vessel strikes could involve any of the four sea turtle species.

7.2.3 Effects to Prey and Habitat

Prey

Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish are removed from the marine environment as fisheries bycatch in the scallop fishery. None of these are typical prey species of leatherback sea turtles or of neritic juvenile or adult green sea turtles (the age classes anticipated to occur in continental shelf waters where the scallop fishery operates) (Bjorndal 1985, 1997, Mortimer 1982, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992, Rebel 1974). Therefore, the scallop fishery will not affect the availability of prey for leatherback and green sea turtles in the action area.

Neritic juveniles and adults of both loggerhead and Kemp's ridley sea turtles are known to feed on species that are caught as bycatch in numerous fisheries (Burke *et al.* 1994, Burke *et al.* 1993, Dodd 1988, Keinath *et al.* 1987, Lutcavage and Musick 1985, Morreale and Standora 2005, Seney and Musick 2005). In a study of the diet of loggerhead sea turtles in Virginia waters from 1983-2002, Seney and Musick (2007) found a shift in the diet of loggerheads in the area from horseshoe and blue crabs to fish, particularly menhaden and Atlantic croaker. The authors suggested that a decline in the crab species have resulted in the shift and loggerheads are likely foraging on fish captured in fishing nets or on discarded fishery bycatch (Seney and Musick 2007). The physiological impacts of this shift are uncertain; although, it was suggested as a possible explanation for the declines in loggerhead abundance noted by Mansfield (2006). Preliminary data from stranded loggerheads in Virginia from 2008-2012 suggests a return to a more traditional diet, with large whelks, decapod crustaceans, and horseshoe crabs constituting approximately 80% of the prey items. While differences in sea turtle size and geographic distribution compared to the earlier studies appear to be a factor, the authors suggest that reductions in blue and horseshoe crab harvest limits since the early 2000s may have increased the availability of these prey species to loggerhead sea turtles (Barco *et al.* 2015). A preliminary analysis of the gastrointestinal contents of stranded Kemp's ridley sea turtles from 2010-2013 showed their diet was similar to the 1983-2002 diet. However, insects were recorded for the first time and horseshoe crabs and mud snails were consumed more frequently compared to the earlier years. Fish, first recorded in the Kemp's ridley diet in 2000, remained an important component (Barco *et al.* 2015, Seney *et al.* 2015). In addition, while fisheries that target or incidentally catch crab species may be impacting loggerheads and Kemp's ridleys by reducing available prey, the crabs caught as bycatch are expected to be returned to the water alive, dead or injured to the extent that the organisms will shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerheads, which are known to eat a variety of live prey as well as scavenge dead organisms. Finally, some loggerheads have been observed to forage on scallops during ROV studies. The scallop fishery would reduce the availability of that type of prey; however, scallops are not the primary prey item for loggerheads, as they are opportunistic foragers across their range. As a result, the effects of the scallop fishery on the availability of prey for loggerhead and Kemp's ridley sea turtles is likely so small it cannot be meaningfully measured, detected or evaluated, and is therefore, insignificant.

Habitat

An assessment of fishing gear impacts found that mud, sand, and cobble features are more susceptible to bottom trawl gear, while granule-pebble and scattered boulder features are less susceptible. Geological structures generally recovered more quickly from trawling on mud and sand substrates than on cobble and boulder substrates; while biological structures recovered at similar rates across substrates. Susceptibility was defined as the percentage of habitat features encountered by the gear during a hypothetical single pass event that had their functional value reduced, and recovery was defined as the time required for the functional value to be restored (see Appendix D in (NEFMC 2016, 2020)). Most scallop fishing activities in the action area occur on sand and gravel bottoms, as large rocks, boulders, and outcroppings have the potential to snag and/or damage dredge and bottom trawl gear, not to mention the scallops or fish captured in the dredge bag or codend of the gear.

The foraging distribution of loggerhead, Kemp's ridley, and green sea turtles in Mid-Atlantic and New England waters is relatively expansive (from nearshore bays and sounds to deeper, offshore waters) and does not typically occur in only one type of bottom habitat or in one specific part of the action area (Conant et al. 2009; NMFS et al. 2011; Griffin et al. 2013; Seminoff et al. 2015). Due to the variety in the diets and foraging behaviors of these three hard-shelled species (most are omnivorous and are capable of feeding both on the bottom and at the surface), dredging or bottom trawling in access or open areas with a known abundance of scallops should not significantly impact or remove foraging habitat for these species that could not be found in a suite of areas nearby and throughout the action area. Although scallop beds may serve as foraging habitat for loggerhead and Kemp's ridleys, neither species forages solely on or relies on scallops for the majority of their prey. In regards to their preferred prey, many crab and mollusk species have been documented as highly abundant in disturbed benthic areas (Collie et al. 1997). Leatherback sea turtles have a broader distribution in U.S. Atlantic waters than the hard-shelled sea turtles, and since they are pelagic feeders, would be much less impacted by alterations to benthic habitat from dredging or bottom trawling. For these reasons, and the lack of any evidence that fishing practices affect habitats in degrees that harm or harass sea turtles (see section 4.1 for our analysis of effects to loggerhead sea turtle critical habitat), we find that while fishing efforts by the scallop fishery may potentially alter benthic habitats, these alterations will be too small to be meaningfully measured or detected and will, therefore, have an insignificant effect on sea turtles.

7.3 Effects to Atlantic Sturgeon

7.3.1 Effects from Gear Interactions

Certain fishing gears may directly affect Atlantic sturgeon. Of the gears used by the scallop fishery, Atlantic sturgeon are known to interact with bottom otter trawls and dredge gear.

7.3.1.1 Factors Affecting Atlantic Sturgeon Interactions with Scallop Fishing Gear

Diets of sub-adult and adult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (ASSRT (Atlantic Sturgeon Status Review Team) 2007, Bigelow and Schroeder 1953, Collins *et al.* 2008, Guilbard *et al.* 2007, Haley 1998, Hatin *et al.* 2002, Johnson *et al.* 1997, Novak *et al.* 2017, Savoy 2007). Because of their size, body design, and the benthic nature of their invertebrate prey, it is likely that feeding sub-adult and adult Atlantic sturgeon could swim into or be captured by scallop dredge or trawl gear operating in the action area.

While migrating, Atlantic sturgeon may be present throughout the water column and could interact with trawl gear while it is moving through the water column. Atlantic sturgeon interactions with dredge and bottom trawl gear are likely at times and in areas where their distribution overlaps with the fishery.

Oceanic habitat use of sub-adult Atlantic sturgeon was examined by Dunton et al. (2010) by identifying their spatial distribution using five fishery-independent surveys. They found areas near the mouths of large bays (Chesapeake and Delaware) and estuaries (Hudson and Kennebec rivers) had higher concentrations of individuals during the spring and fall (Dunton *et al.* 2010). Similarly, Breece et al. (2018) found Atlantic sturgeon occur at higher concentrations at the Delaware mouth from late spring through fall. This work also suggested that shallower waters, warmer bottom temperatures, and areas to the eastern portion of Delaware Bay were predictive of residency, while movement was predicted by increased depth, cooler bottom temperatures, and areas toward the western part of the Bay (Breece *et al.* 2018). In a study, matching fisheries independent biotelemetry observations of Atlantic sturgeon with daily satellite observations found that depth, day-of-year, sea surface temperature, and light absorption by seawater were the most important predictors of Atlantic sturgeon occurrence(Breece *et al.* 2017). A recent analysis suggests that Atlantic sturgeon may select for co-varying environmental properties (i.e., ocean color and seas surface temperature) than geographical location (Breece *et al.* 2016). Atlantic sturgeon may experience higher levels of harm from bycatch during seasonal aggregations (Dunton *et al.* 2015) or migration (Breece *et al.* 2017).

Factors currently thought to affect Atlantic sturgeon interactions with fishing gear and mortality due to fishing gear include: (1) gear type; (2) location and depth of gear, (3) water temperature, (4) gear characteristics (e.g., mesh size), (5) soak/tow duration, and (6) geographic formations and environmental factors that influence placement of fishing gear and sturgeon movements. Atlantic sturgeon bycatch in federal fisheries has been documented in all four seasons with higher numbers of interactions in November and December in addition to April and May (Miller and Shepard 2011). Mortality is also correlated to higher water temperatures and areas of concentrated occurrence such as overwintering areas (ASMFC (Atlantic States Marine Fisheries Commission) 2007). For otter trawl fisheries, Atlantic sturgeon bycatch incidence is highest in shallower depths in June (ASMFC (Atlantic States Marine Fisheries Commission) 2007).

Recently, a number of designated wind energy areas off the U.S. Atlantic coast have been surveyed for Atlantic sturgeon occurrence and their findings generally support the above information on sturgeon movements and seasonality. In the New York Wind Energy area, a recent study showed that acoustic detections of Atlantic sturgeon were highly seasonal and peaked from November through January. Conversely, fish were relatively uncommon or entirely absent during the summer months (July-September) (Ingram *et al.* 2019). In the Delaware Wind Energy Area, Atlantic sturgeon were detected during all months of the year; however, their occurrence was lowest in August, and highest in November and December (Haulsee *et al.* 2020). In the Maryland Wind Energy Area, Atlantic sturgeon incidence was highest in the spring and fall and tended to be biased toward shallow regions and warmer waters (Rothermel *et al.* 2020).

7.3.1.2 Existing Information on Atlantic Sturgeon Interactions with Scallop Fishing Gear

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 waters less than 50 meters deep. Some information suggests that captures in trawl gear are most likely to occur in waters with depths less than 30 meters (ASMFC TC 2007). For otter trawl fisheries, the highest incidence of Atlantic sturgeon bycatch have been associated with depths less than 98 feet (30 meters) (ASMFC (Atlantic States Marine Fisheries Commission) 2007). More recently, over all gears and observer programs that have encountered Atlantic sturgeon, the distribution of haul depths on observed hauls that caught Atlantic sturgeon was significantly different from those that did not encounter Atlantic surgeon (KS test: $D = 0.60$, $p < 0.001$) with Atlantic sturgeon encountered primarily at depths less than 66 feet (20 meters) (ASMFC (Atlantic States Marine Fisheries Commission) 2017). Atlantic sturgeon captures in both state and federal waters are reported by observers and have been included in the NEFSC observer/sea sampling database since 1989, even though they were not listed under the ESA until 2012.

We have reviewed the available observer data and there has been only one NEFOP documented capture of an Atlantic sturgeon in scallop dredge gear—a live capture and release in September 2012 in NMFS statistical area 612 off the coast of New York and New Jersey (NEFSC FMRD database).

No Atlantic sturgeon have been reported as caught in trawl gear where the haul target or trip target is scallop. However, Atlantic sturgeon are known to have been captured in other trawl fisheries operating in the action area (Stein et al. 2004a; ASMFC TC 2007; Miller and Shepherd 2011; ASMFC 2017; NEFSC FMRD database). Although they are not yet included in any model-based estimates of Atlantic sturgeon bycatch, documented Atlantic sturgeon interactions with bottom trawl gear from 2016-2019 are included below for additional reference (Table 21).

The number of observed takes is affected by the level and spatial extent of observer coverage. A review of observer coverage by SBRM year and SBRM fleet indicates that there was variation between the fleets. When averaging the coverage achieved across the gear type (excluding fleets with pilot coverage), observed sea days averaged between 10.2% and 13.2% for trawl fleets for SBRM 2017 (July 2015 through June 2016) through SBRM 2020 (July 2018 through June 2019). Observed trips for these fleets averaged between 8.8% and 12.4% for the trawl fleets during this period (Hogan *et al.* 2019, Wigley *et al.* 2021). The observed numbers are generally in line with the documented bycatch levels from the previous five-year period of 2011-2015 for which bycatch estimates for trawl gear have been calculated.

Table 21: Documented bycatch of Atlantic sturgeon in bottom otter trawl (fish) recorded during the NEFOP and ASM programs from 2016 through 2019.

Year	Documented # of bycatch in bottom otter trawl gear
2016	70
2017	82
2018	188
2019	58

7.3.1.3 Estimating Interactions with and Mortality of Atlantic Sturgeon

As noted above, we have reviewed incidental bycatch data of Atlantic sturgeon recorded by the NEFOP and there has only been one observed capture in scallop dredge gear, a live capture and release in September 2012 in NMFS statistical area 612 off the coast of New York and New Jersey. Stein et al. (2004a), ASMFC TC (2007), and ASMFC (2017) do not include scallop dredges in their analyses of gears fished in the Northeast that are likely to result in the capture of Atlantic sturgeon. However, as there has been one reported interaction between scallop dredge gear and Atlantic sturgeon, the potential for Atlantic sturgeon bycatch in scallop dredge gear exists, although we expect the incidence rate to be very low. Given this information, we anticipate that no more than one Atlantic sturgeon will be captured in dredge gear fishing for scallops each year (and no more than five over a five-year period). The small sample size of observations does not allow us to make a precise determination on the anticipated levels of mortality from these captures, although we assume some could potentially result in mortality.

The capture of Atlantic sturgeon in bottom otter trawls used in commercial fisheries of New England and the Mid-Atlantic is well documented (Stein et al. 2004a; ASMFC TC 2007; Miller and Shepherd 2011; ASMFC 2017). But, as noted above, we have reviewed the NEFOP data and there are no observed captures of Atlantic sturgeon in otter trawls where the trip target or haul target was recorded as scallops. In the Atlantic sturgeon bycatch report prepared by Miller and Shepherd (2011), Table 10 of the report gives FMP weights (as a percentage of total landings) for total estimated captures (derived from the model-based estimator) of Atlantic sturgeon in otter trawl gear. For scallops, a weight of 0.013 is given based on 2006-2010 observer data. This equates to a total of about 20 estimated captures per year in the trawl fishery for scallops. However, based on the report's indication that "partitioning of discard encounters to FMPs is not a particularly informative exercise because of the high likelihood of inappropriately assigning associations/responsibilities" (Miller and Shepherd 2011), we have determined that reliance on this weight to estimate future interactions associated with the Scallop FMP is not advisable. Oftentimes scallops are landed as bycatch in other trawl fisheries that are known to incidentally capture Atlantic sturgeon (*e.g.*, summer flounder/scup/black sea bass, multispecies, skate, monkfish), and it is likely because of this that the weight for scallops is as high as it is.

Bottom trawl gear used in the scallop fishery is consistent with bottom trawl gear used in other fisheries known to capture Atlantic sturgeon. Therefore, we assume that Atlantic sturgeon captures in trawl gear used by the scallop fishery are possible. Given this information, we anticipate that no more than one Atlantic sturgeon will be captured in bottom otter trawl gear fishing for scallops each year (and no more than five over a five-year period).

The mortality rate for Atlantic sturgeon in commercial bottom otter trawls is estimated at approximately 5%, while the mortality rate for dredges is not currently known (Miller and Shepherd 2011). Based on the trawl mortality rate and the fact that the one observed dredge capture was of a live, released fish, we anticipate one Atlantic sturgeon mortality for every 20 Atlantic sturgeon captured. Given that we anticipate no more than one capture per year in both gear types, we anticipate one Atlantic sturgeon mortality every 20 years. We expect that the interactions with scallop gear could be with Atlantic sturgeon from any of the five listed DPSs, but are likely to occur in this proportion: NYB 71.4%; CB 10.7%; GOM 8.7%; SA 5.6%; Carolina 2.6%; and non-listed Canada (1.0%) (Kazyak *et al.* 2020). As the anticipated take levels for Atlantic sturgeon in the scallop fishery are extremely low, for the purposes of this Opinion we expect that any interaction can be from any of the five listed DPSs.

7.3.2 Effects from Vessel Strikes

Based on the best available information, we have concluded that vessel strikes are a significant threat to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). Given that Atlantic sturgeon sub-adults and adults from all DPSs use ocean waters from Labrador, Canada, to Cape Canaveral, Florida, 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.

The exact number of Atlantic sturgeon killed due to vessel strikes is unknown. The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but 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.). While we have some information on the number of mortalities in the Delaware and James Rivers that are thought to be due to vessel strikes (Balazik *et al.* 2012c, Brown and Murphy 2010), 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) a lack of information on the percent of incidences that the observed mortalities represent. While vessel strikes are acknowledged as a threat in several rivers as noted in the *Status of the Species* and *Environmental Baseline* sections above, we do not have information that suggests that Atlantic sturgeon are struck by vessels in the open marine environment of the action area where the vessels participating in the scallop fishery are operating. The risk of strike is expected to be considerably less in the Atlantic Ocean than in rivers. This is because of: (1) the greater water depths in ocean areas, which increases the space between bottom oriented sturgeon and vessel propellers and hulls, (2) a lack of obstructions or constrictions that would otherwise restrict the movement of sturgeon, and (3) the more dispersed nature of vessel traffic and more dispersed distribution of individual sturgeon which reduces the potential for co-occurrence of individual sturgeon with individual vessels. Given the greater depths in the vast majority of the action area (with the exception of nearshore areas where vessels will dock) and that sturgeon most often occur at or near the bottom while in the action area, the potential for co-occurrence of a vessel and a sturgeon in the water column is extremely low even if a sturgeon and vessel co-occurred generally. All of these factors are expected to decrease the likelihood of an encounter between an individual sturgeon and a vessel and also increase the likelihood that a sturgeon would be able to avoid any vessel. Based on these factors and the lack of any information to suggest that Atlantic sturgeon are struck and killed by vessels in the marine environment, vessel strikes in the action area are extremely unlikely to occur during vessel transits or fishing operations and, therefore, the effects are discountable.

7.3.3 Effects to Prey and Habitat

Prey

Diets of adult and migrant sub-adult 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).

The effects of scallop dredges and bottom trawls on benthic community structure have been the subject of a number of studies. In general, the severity of the impacts to bottom communities is a function of three variables: (1) energy of the environment, (2) type of gear used, and (3) intensity of fishing. High-energy and frequently disturbed environments are inhabited by organisms that are adapted to this stress and/or are short-lived and are unlikely to be severely affected, while stable environments with long-lived species are more likely to experience long-term and significant changes to the benthic community (Stevenson 2004, Mirarchi and CR Environmental 2005, Johnson 2002). The intensity of dredging and trawling also affects benthic communities, and significant loss of large sessile epifauna from hard substrates has been demonstrated (Stevenson 2004, Mirarchi and CR Environmental 2005). Several studies have found that dredging and trawling on mud bottoms decreases the species richness, diversity, abundance, and biomass (Johnson 2002, Stevenson 2004). However, a Massachusetts Bay trawling study found no difference between the species composition in trawled and control lanes, but found that faunal density was slightly higher in the trawled lanes (Mirarchi and CR Environmental 2005). While there may be some changes to the benthic communities on which Atlantic sturgeon feed as a result of dredging and bottom trawling, there is no evidence that these scallop fishing activities have a negative impact on availability of Atlantic sturgeon prey. Currently, there is no indication that Atlantic sturgeon are food-limited or that commercial fisheries might negatively impact their food availability, given the diversity of their diets. Given this information, it is extremely unlikely the scallop fishery will have an effect on Atlantic sturgeon prey and, therefore, effects are discountable.

Habitat
Atlantic sturgeon use the action area as a migratory route and for overwintering and likely foraging. Within the marine range of Atlantic sturgeon, several marine aggregation areas (see papers listed below for definitions of aggregation areas) have been identified adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard. Depths in these areas are generally no greater than 82 feet (25 meters) (Dunton et al. 2010, Erickson et al. 2011, Laney et al. 2007, Stein et al. 2004b). Additional studies are still needed to understand why aggregations are found at these particular sites. The sites likely serve different purposes; there is some indication that they may serve as thermal refuges, wintering sites, or marine foraging areas (Dunton et al. 2010, Erickson et al. 2011, Stein et al. 2004b). The following known marine aggregation sites are generally inshore of federal waters where the fisheries operate:

- Waters off North Carolina, including Virginia/North Carolina border (Laney et al. 2007);
- Waters off the Chesapeake and Delaware Bays (Dunton et al. 2010, Erickson et al. 2011, Oliver et al. 2013, Stein et al. 2004b))
- New York Bight (e.g., waters off Sandy Hook, New Jersey, and Rockaway Peninsula, New York) (Dunton et al. 2015, Erickson et al. 2011, O'Leary et al. 2014, Stein et al. 2004b))
- Massachusetts Bay (Stein et al. 2004b)
- Long Island Sound (Bain et al. 2000, Savoy and Pacileo 2003, Waldman et al. 2013));
- Connecticut River Estuary (Waldman et al. 2013);
- Kennebec River Estuary (Wippelhauser 2012, Wippelhauser and Squiers 2015).
- Mouth of the Saco River (Novak et al. 2017)

While there may be some overlap in aggregations and fishing effort, we have no information that indicates negative effects on Atlantic sturgeon prey items, although foraging, overwintering, and migrations may be temporarily disturbed by the use of bottom fishing gear. However, any disturbance will not rise to the level of harm or harassment as there is plenty of room in the open ocean environment for Atlantic sturgeon to move around obstacles with little expenditure of energy. Given this information, any habitat alterations will be too small to be meaningfully measured or detected and will, therefore, have insignificant effects on Atlantic sturgeon.

7.4 Summary of anticipated interactions of ESA-listed species in the scallop fishery

The primary gear types used in the scallop fishery are dredges and bottom trawls. The greatest amount of effort and landings for scallops are accounted for by dredge vessels, which may interact with sea turtles and Atlantic sturgeon. Trawl vessels may also interact with sea turtles and Atlantic sturgeon, but at lower numbers based upon the observer data and bycatch estimates and the fact that there is much less trawl effort in the fishery at present. Based on the analyses above in this Opinion, including analysis of observer data and comparison to similar fisheries, the scallop fishery primarily affects sea turtles in the Mid-Atlantic and Georges Bank from May through November, with the majority of interactions occurring between June and October (Haas *et al*. 2008; Murray 2011, 2015a, 2015b, 2020a, 2020b; Warden 2011). Sea turtle interactions in the Gulf of Maine and outside the above months are rare, as the Gulf of Maine represents the northern extreme of sea turtle distribution in the Northwest Atlantic and sea turtles are seasonal residents of the action area. Individuals from all five Atlantic sturgeon DPSs can occur throughout the action area and be caught by scallop dredge and bottom trawl gear at any time.

Based on the best available information, we anticipate up to 1,095 loggerhead interactions in scallop dredge gear every five years as a result of the authorization of the scallop dredge fishery. Up to 385 of those interactions are expected to result in mortalities every five years. These are estimates of total observed plus inferred (unobserved but quantifiable) interactions in the scallop dredge fishery. The authorization of the scallop fishery is also expected to result in up to one leatherback, 28 Kemp’s ridley, and one green sea turtle interactions in dredge gear every five years. The one leatherback, one green, and 11 out of the 28 Kemp’s ridley sea turtle interactions with scallop dredge gear every five years may be lethal, although as indicated above, gear modifications including chain mats and TDDs are expected to minimize the number of lethal interactions for all sea turtles that interact with scallop dredge gear.

Scallop trawl gear is expected to result in the estimated capture of up to 13 loggerhead sea turtles every five years, of which up to six are expected to be lethal. Scallop trawl gear is also expected to result in the capture of one leatherback (potentially lethal), two Kemp’s ridleys (up to one lethal), and one green sea turtle (potentially lethal) every five years. Loggerhead, leatherback, and green sea turtles interacting with scallop dredge and trawl gear are expected to include both juvenile and adult sea turtles, while Kemp’s ridley sea turtles interacting with scallop fishing gear are expected to include only benthic immature individuals.

We also anticipate that up to two sea turtles (any combination of the four species) may be struck and killed every five years by vessels operating in the scallop fishery in the action area.

Table 22. Anticipated sea turtle interactions (mortalities) with scallop dredge and trawl gear and vessels operating in the scallop fishery over a five-year period.

Species	Dredge Interactions (Mortality)	Trawl Interactions (Mortality)	Vessel Interactions (Mortality)
Loggerhead	1,095 (385)	13 (6)	2 (2) any combination of species
Leatherback	1 (1)	1 (1)	
Kemp's ridley	28 (11)	2 (1)	
Green	1 (1)	1 (1)	

Finally, the authorization of the scallop fishery is expected to result in the capture of five Atlantic sturgeon every five years (an average of one Atlantic sturgeon annually), which may occur in either dredge or trawl gear and come from any of the five DPSs that are assessed above. Given an estimated mortality rate of 5% in commercially fished bottom trawl gear and a capture rate of one Atlantic sturgeon per year in either dredge or trawl gear, we anticipate one Atlantic sturgeon mortality in the scallop fishery every 20 years.

8.0 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR §402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

This section attempts to identify the likely future changes and their impact on ESA-listed species and their critical habitats in the action area. This section is not meant to be a comprehensive socio-economic evaluation, but a brief outlook on future changes in the environment. Projections are based upon recognized organizations producing best available information and reasonable rough-trend estimates of change stemming from these data. However, all changes are based upon projections that are subject to error and alteration by complex economic and social interactions.

During this consultation, we searched for information on future state, tribal, local, or private (non-federal) actions reasonably certain to occur in the action area that would have an effect on species considered in this Opinion. We did not find any information about non-federal actions other than what has already been described in the *Environmental Baseline*. The primary non-federal activities that will continue to occur in the action area are recreational fisheries, fisheries authorized by states, use of the action area by private vessels, discharge of wastewater and associated pollutants, and coastal development authorized by state and local governments. We do not have any information to indicate that effects of these activities over the life of the proposed action will have different effects than those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change.

We did not find any information about non-federal actions other than what has already been described in the *Environmental Baseline* (section 5), most of which we expect will continue in the future. An increase in these activities could similarly increase their effect on ESA-listed species and for some, an increase in the future is considered reasonably certain to occur. Given current trends in global population growth, threats associated with climate change, pollution, fisheries bycatch, aquaculture, vessel strikes and approaches, and underwater noise are likely to continue to increase in the future, although any increase in effect may be somewhat countered by an increase in conservation and management activities. For the remaining activities and associated threats identified in the *Environmental Baseline* and *Climate Change* sections, and other unforeseen threats, the magnitude of increase and the significance of any anticipated effects remain unknown. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on ESA-listed species populations. Thus, this consultation assumes effects in the future would be similar to those in the past and, therefore, are reflected in the anticipated trends described in the *Status of the Species* (section 4), *Environmental Baseline* (section 5), and *Climate Change* (section 6) sections.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

The *Status of Species*, *Environmental Baseline*, *Climate Change*, and *Cumulative Effects* sections of this Opinion discuss the natural and human-related factors that caused Northwest Atlantic DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles and the five DPSs of Atlantic sturgeon to become endangered or threatened and may continue to place those species at risk of extinction. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). The present section of this Opinion applies that definition by examining the effects of the proposed action in the context of information presented in the *Status of the Species* (see section 4), *Environmental Baseline* (see section 5), *Climate Change* (see section 6) and *Cumulative Effects* (see section 8) sections to determine: (a) if the effects of the proposed action would be expected to reduce the reproduction, numbers, or distribution of the previously listed sea turtles and fish, and (b) if any reduction in the reproduction, numbers, or distribution of these species causes an appreciable reduction in the species' likelihood of surviving and recovering in the wild.

In the 1998 NMFS/U.S. Fish and Wildlife Consultation Handbook, "survival" is defined as:

> For determination of jeopardy/adverse modification: the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said another way, survival is the condition in which a species continues to exist into the future while

> retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.

"Recovery" is defined as "[i]mprovement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act."

The analytical process we undertake to make jeopardy determinations is described in regulation as:

> Add[ing] the effects of the action and cumulative effects to the environmental baseline and in light of the status of the species and critical habitat, formulate the Service's opinion as to whether the action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. (50 CFR 402.14(g))

Our task then, when making a jeopardy determination, is to consider the biological significance of proposed action's effects on ESA-listed species and to assess whether the proposed action appreciably reduces the survival or recovery of a listed species.

We evaluate this in the context of the recovery plans for each species. Recovery plans include criteria, which, when met, would result in downlisting (changing the listing from endangered to threatened) or in a determination that the species be removed from the List of Endangered and Threatened Wildlife. Recovery criteria can be viewed as targets, or values, by which progress toward achievement of recovery objectives can be measured. Recovery criteria may include such things as population numbers and sizes, management or elimination of threats by specific mechanisms, and specific habitat conditions. In newer recovery plans, recovery criteria are often framed in terms of population parameters (Demographic Recovery Criteria) and the five listing factors (Listing Factor Recovery Criteria). For some species, the plans have not been recently updated and do not include specific Demographic and Listing Factor Recovery Criteria. Regardless of whether these are included, we evaluate each species in the context of the criteria and objectives in its recovery plan.

This Opinion has identified in the *Effects of the Proposed Action* (section 7) that the proposed action may adversely affect Northwest Atlantic DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles; and the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon because of interaction with gear used in the fisheries and, for sea turtles, strikes from vessels used in the fisheries. No other effects to ESA-listed sea turtles and Atlantic sturgeon are expected as a result of this activity. Nor do we expect adverse effects to any designated critical habitat. The discussion below provides NMFS' determinations of whether there is a reasonable expectation loggerhead, leatherback, Kemp's ridley, and green sea turtles and Atlantic sturgeon will experience reductions in reproduction, numbers, or distribution in response to these effects, and whether any reductions in the reproduction, numbers, or distribution of these species can be expected to appreciably reduce the species' likelihood of surviving and recovering in the wild.

9.1 Integration and Synthesis of Effects on Sea Turtles and Atlantic Sturgeon

This Opinion has identified in Section 7 (*Effects of the Action*) that the proposed action, the authorization of the scallop fishery under the Scallop FMP, may adversely affect NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles as a result of interactions with dredge and trawl gear as well as vessels used in the fishery. No other direct or indirect effects to ESA-listed sea turtles are expected as a result of this activity. This Opinion has also identified that the proposed action may adversely affect five Atlantic sturgeon DPSs as a result of capture in dredge or trawl gear used in the fishery. No other direct or indirect effects to ESA-listed Atlantic sturgeon are expected as a result of this activity. The following discussions in Sections 9.1.1 through 9.1.5 below provide our determinations of whether there is a reasonable expectation that NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles as well as any of the five Atlantic sturgeon DPSs will experience reductions in reproduction, numbers, or distribution in response to these effects, and whether any reductions in the reproduction, numbers, or distribution of these species can be expected to appreciably reduce the species' likelihood of surviving and recovering in the wild.

9.1.1 Loggerhead sea turtle – NWA DPS

The NWA DPS of loggerhead sea turtles is listed as threatened under the ESA. Based on nesting data and population abundance and trends at the time, NMFS and USFWS determined in 2011 that the NWA DPS should be listed as threatened and not endangered based on (1) the large size of the nesting population, (2) the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and (4) substantial conservation efforts are underway to address threats (76 FR 58868, September 22, 2011).

It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, vessel interactions, hopper dredging, and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, others remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

As previously stated, there are five subpopulations of loggerhead sea turtles within the NWA DPS (recognized as recovery units in the 2008 recovery plan for the species). These subpopulations show limited evidence of interbreeding. Recent assessments have evaluated the nesting trends for each recovery unit. It should be noted, and it is explained further below, that nesting trends are based on nest counts or nesting females. They do not include non-nesting adult females, adult males, or juvenile males or females in the population.

Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Information on nest counts is presented in the *Status of the Species*. Trends by recovery unit were variable. For the Northern Recovery Unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). More recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% (Bolten *et al.* 2019).

Nest counts at index beaches in the Peninsular Florida Recovery Unit showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington *et al.* 2009). From 2009 through 2013, a 2% decrease for the Peninsular Florida Recovery Unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests (Bolten *et al.* 2019). It is important to recognize that an increase in the number of nests has been observed from 2007 to 2018 (Bolten *et al.* 2019). Using short-term trends in nesting abundance can be misleading, and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten *et al.* 2019).

The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas Recovery Unit and there are gaps in the data prohibiting a robust analysis (Bolten *et al.* 2019, Ceriani *et al.* 2019, Ceriani and Meylan 2017).

Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult given changes to survey coverage. From 1995 to 2005, the recovery unit exhibited a significant declining trend (Conant *et al.* 2009, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. More recently, nest numbers have increased (Bolten *et al.* 2019). A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten *et al.* 2019).

The majority of nesting in the Greater Caribbean Recovery Unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita *et al.* 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart *et al.* 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013.

Estimates of the total loggerhead population for the NWA DPS spanning all age classes and sexes of turtles are not currently available. However, there is some information available for portions of the population. From 2004-2008, the adult female population of loggerheads in the Northwest Atlantic ranged from 20,000 to 40,000 or more individuals (median 30,050), with a large range of uncertainty in total population size (NMFS SEFSC (National Marine Fisheries Service Southeast Fisheries Science Center) 2009). The estimate of Northwest Atlantic adult loggerhead females was considered conservative for several reasons. The number of nests used for the Northwest Atlantic was based primarily on U.S. nesting beaches. Thus, the results are a slight underestimate of total nests because of the inability to collect complete nest counts for many non-U.S. nesting beaches within the DPS, such as those in Mexico and the Caribbean. In estimating the population size for adult nesting female loggerhead sea turtles, the report simplified the number of assumptions and reduced uncertainty by using the minimum total annual nest count (i.e., 48,252 nests) over the five years. This was a particularly conservative assumption considering how the number of nests and nesting females can vary widely from year to year (e.g., the 2008 nest count was 69,668 nests, which would have increased the adult female estimate proportionately to between 30,000 and 60,000). In addition, minimal assumptions were made about the distribution of remigration intervals and nests per female parameters, which are fairly robust and well known. A loggerhead population estimate using data from 2001-2010 estimated the loggerhead adult female population in the Northwest Atlantic at 38,334 individuals (SD =2,287) (Richards *et al.* 2011).

The AMAPPS surveys and sea turtle telemetry studies conducted along the U.S. Atlantic coast in the summer of 2010 provided a preliminary regional abundance estimate of about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS 2011). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified sea turtle sightings (NMFS 2011). Although there is much uncertainty in these population estimates, they provide some context for evaluating the size of the likely population of loggerheads in the Atlantic. These two publications (NMFS 2011, Richards *et al.* 2011) represent the most recent and best available population estimates for the NWA DPS of loggerhead sea turtles.

Although limited information is available on the genetic makeup of loggerheads in an area as extensive as the action area, it is likely that loggerheads interacting with the scallop fishery originate from several, if not all of the recovery units. Sea turtles from each of the five Northwest Atlantic nesting stocks have been documented in the action area. A genetic study on immature loggerheads captured in the Pamlico-Albemarle Estuarine Complex in North Carolina between 1995-1997 indicated that 80% of the juveniles and sub-adults utilizing this foraging habitat originated from the south Florida nesting stock, 12% from the northern nesting stock, 6%

from the Yucatán nesting stock, and 2% from other rookeries (including the Florida Panhandle, Dry Tortugas, Brazil, Greece, and Turkey nesting stocks) (Bass *et al.* 2004). Similarly, genetic analysis of samples collected from loggerheads from Massachusetts to Florida found that all five western Atlantic loggerhead stocks were represented (Bowen *et al.* 2004). However, earlier studies indicated that only a few nesting stocks were represented along the U.S. Atlantic coast. Mixed stock analysis of a foraging aggregation of immature loggerhead sea turtles captured in coastal waters off Florida, found three stocks: south Florida (69% of the loggerheads sampled) respectively), northern (10%, respectively), and Mexico (20%) (Witzell *et al.* 2002). Similarly, analysis of stranded turtles from Virginia to Florida indicated that the turtles originated from three nesting areas: south Florida (59%), northern (25%), and Mexico (20%) (Rankin-Baransky *et al.* 2001).

More recently, Haas *et al.* (2008) used two approaches in identifying the contribution of each stock in the U.S. Atlantic sea scallop fishery bycatch: an equal contribution from each stock or a weighted contribution by rookery sizes. When weighted by population size, 89% of the loggerheads captured in the U.S. Atlantic scallop fishery from 1996-2005 originated from the south Florida nesting stock, 4% were from the Mexican stock, 3% were from the northern (northeast Florida to North Carolina) stock, 1% were from the northwest Florida stock, and 0% were from the Dry Tortugas stock. The remaining 3% of loggerheads sampled were attributed to nesting stocks in Greece (Haas *et al.* 2008). Haas et al. (2008) noted that these results should be interpreted with caution given the small sample size and resulting difficulties in precisely assigning rookery contributions to a particular mixed population. A re-analysis of loggerhead genetics data by the Atlantic Loggerhead TEWG has found that it is unlikely that U.S. fishing fleets are interacting with the Mediterranean DPS (LaCasella *et al.* 2013). Given that updated, more refined analyses are ongoing and the occurrence of Mediterranean DPS juveniles in U.S. Atlantic waters is rare and uncertain, if occurring at all, it is unlikely that individuals from the Mediterranean DPS would be present in the action area (Memorandum from Patricia A. Kurkul, Regional Administrator, to the Record, November 29, 2011). As a result, those records are excluded from our analysis and are reapportioned to the five Northwest Atlantic stocks, which are expected to contribute to individuals in the action area. Note that when equal contributions of each stock were considered, Haas *et al.* (2008) found that the results varied from the weighted contributions but the south Florida nesting stock still contributed the majority of scallop fishery bycatch (63%).

These loggerhead nesting stocks in Haas et al. (2008) do not share the exact delineations of the five recovery units identified in the 2008 recovery plan. However, the Peninsular Florida Recovery Unit (PFRU) encompasses the south Florida stock, the Northern Recovery Unit (NRU) is roughly equivalent to the northern nesting stock, the northwest Florida stock is included in the Northern Gulf of Mexico Recovery Unit (NGMRU), the Mexico stock is included in the Greater Caribbean Recovery Unit (GCRU), and the Dry Tortugas Recovery Unit (DTRU) encompasses the Dry Tortugas stock. The available genetic analyses indicate the majority of bycatch in U.S. Northeast and Mid-Atlantic waters comes from the PFRU with smaller contributions from the other recovery units in the NWA DPS. However, the exact percentages of fisheries bycatch from specific nesting beaches and recovery units are not available at this time and may be variable from year to year. As a result, we are relying on the genetic analysis weighted by population size presented in Haas et al. (2008), which is the most recent and one of the most comprehensive (in terms of the area from which samples were acquired) of the loggerhead genetics studies. The best available information indicates that the proportion of the interactions from each recovery unit is consistent with the relative sizes of the recovery units.

Based on information from Murray (2020a, 2020b) and Linden (2020), we anticipate up to 1,095 loggerhead sea turtles from the NWA DPS will interact with dredge gear and up to 13 will interact with bottom trawl gear utilized in the scallop fishery every five years. Of the anticipated interactions, 385 in dredge gear and six in trawl gear every five years are expected to lead to mortality. Up to an additional two mortalities every five years may occur due to vessel strikes with scallop vessels. For the purposes of evaluating effects to the NWA loggerhead DPS, we are considering that each of the two vessel strike mortalities will be loggerhead sea turtles. Therefore, up to 393 of the of the 1,110 NWA DPS loggerheads that interact with gear or vessels in the scallop fishery every five years are expected to die or sustain serious injuries leading to death or failure to reproduce. This will result in the loss of 79 NWA DPS loggerhead sea turtles, on average, each year. Although Murray (2020a) and Murray (2020b) provide estimates of adult equivalent mortalities for scallop dredge and all bottom trawl gear in the U.S. Atlantic, we are unable to determine the exact number of adult equivalents that are likely removed by the scallop fishery and vessels since there is no specific adult equivalent estimate for vessel interactions or the scallop bottom trawl fishery independent of other bottom trawl fisheries.

The vast majority of the 79 loggerhead mortalities anticipated on average annually due to the scallop fishery (or 393 mortalities over five years) are likely to originate from the PFRU, with the remainder originating from the NRU, GCRU, NGMRU, and DTRU. Using the mean percent contributions in Haas *et al.* (2008) and then reapportioning the extra 3% of loggerheads that had been attributed to nesting stocks in Greece, we expect that 72 of the loggerheads killed on average annually will be from the PFRU, two will be from the NRU, three will be from the GCRU, one will be from the NGMRU, and one will be from the DTRU. The best available information indicates that the proportion of the interactions from each recovery unit are consistent with the relative sizes of the recovery units, and we conclude, based on the available evidence, that none of the recovery units will be disproportionately impacted by interactions in the scallop fishery. Thus, genetic heterogeneity should be maintained in the species even in the face of this level of mortality as a result of the proposed action.

The lethal removal of up to 393 loggerhead sea turtles from the NWA DPS every five years (or on average 79 annually) will reduce the number of loggerhead sea turtles compared to the number that would have been present in the absence of the proposed action (assuming all other variables remained the same). These lethal interactions would also result in a future reduction in reproduction due to lost reproductive potential, as some of these individuals would be females who would have reproduced in the future, thus eliminating each female individual's contribution to future generations. For example, an adult female loggerhead sea turtle in the NWA DPS can lay three or four clutches of eggs every two to four years, with 100 to 126 eggs per clutch (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service)

2008). The annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. A reduction in the distribution of loggerhead sea turtles is not expected from lethal interactions attributed to the proposed action. Because all the potential interactions are expected to occur at random throughout the extensive Mid-Atlantic and Georges Bank portions of the action area and loggerheads generally have large ranges in which they disperse, the distribution of loggerhead sea turtles in the action area is expected to be unaffected.

Whether the reductions in NWA DPS loggerhead numbers and reproduction attributed to the proposed action would appreciably reduce the likelihood of survival for loggerheads depends on what effect these reductions in numbers and reproduction have on overall population sizes and trends. That is, whether the estimated reductions, when viewed within the context of the *Status of the Species*, *Environmental Baseline*, *Climate Change*, and *Cumulative Effects* are to such an extent that adverse effects on population dynamics are appreciable. Loggerhead sea turtles are a slow growing, late-maturing species. Because of their longevity, loggerheads require high survival rates throughout their life to maintain a population (Conant *et al.* 2009). In other words, late-maturing species are less tolerant of high rates of anthropogenic mortality. Conant *et al.* (2009) concluded that loggerhead natural growth rates are low, natural survival needs to be high, and even low (1-10%) to moderate (10-20%) mortality can drive the population into decline. Because recruitment to the adult population is slow, population modeling studies suggest even small increased mortality rates in adults and sub-adults could substantially impact population numbers and viability (Chaloupka and Musick 1997, Crouse *et al.* 1987, Crowder *et al.* 1994, Heppell *et al.* 2005).

Actions have been taken to reduce anthropogenic impacts to loggerhead sea turtles from various sources, particularly since the early 1990s. These include lighting ordinances, predation control, and nest relocations to help increase hatchling survival, as well as measures to reduce the mortality of juveniles and adults in various fisheries and other marine activities. Conant et al. (2009) concluded that the results of their models (i.e., predicted continued declines) are largely driven by mortality of juvenile and adult loggerheads from fishery bycatch that occurs throughout the Northwest Atlantic. While significant progress has been made to reduce bycatch in some fisheries in certain parts of the loggerhead's range, and the results of new nesting trend analyses may indicate the positive effects of those efforts, notable fisheries bycatch persists. The question we are left with for this analysis is whether the effects of the proposed action appreciably reduce survival and recovery, given the current status of the species and predicted population trajectories, as well as the many natural and human-caused impacts on sea turtles. We may not see the long-term effects of the Deepwater Horizon oil release event and climate change on the population status and trends of loggerheads for several years to come.

As described in the *Status of the Species*, we consider that the Deepwater Horizon oil release had an adverse impact on loggerhead sea turtles, and resulted in mortalities, along with unknown lingering impacts outside the action area resulting from nest relocations, non-lethal exposure, and foraging resource impacts. However, there is no information to indicate that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected interactions from the scallop fishery would result in a detectable change in the population status of the NWA DPS of loggerhead sea turtles. This is especially true given the size of the population and that, unlike Kemp's ridleys, the NWA DPS of loggerheads is proportionally much less dependent on Gulf of Mexico.

It is possible that the Deepwater Horizon oil release reduced the survival rate of all age classes to varying degrees, and may continue to do so for some undetermined time. However, there is no information at this time that it has, or should be expected to have, substantially altered the long-term survival rates in a manner that would significantly change the population dynamics compared to the conservative estimates used in this Opinion. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action would reduce the likelihood of survival of the species.

We have determined that the effects on loggerhead sea turtles associated with the proposed action are not reasonably expected to cause an appreciable reduction in the likelihood of survival of the NWA DPS of loggerheads, even in light of the impacts of the Deepwater Horizon oil release, other ongoing fisheries and Federal actions, and climate change. Over the next five to ten years of the proposed action, we expect the NWA DPS of adult females to remain large (tens or hundreds of thousands of individuals) and to retain the potential for recovery, as explained below. While the effects of the proposed action will most directly affect the overall size of the population, the annual anticipated lethal take represents a small fraction, approximately 0.21% (79/38,344) of the overall adult female population estimated by Richards et al. (2011) and a very small fraction (approximately 0.02%) of the lower inter-quartile estimate of 382,000 loggerheads within the Northwest Atlantic continental shelf from the 2010 AMAPPS surveys. The lethal take estimate includes potential mortalities of both juveniles and adults, while the Richards et al. (2011) population estimate is only for adult females and the NMFS (2011) population estimate from AMAPPS is only for loggerheads in continental shelf waters, so both percentages are conservative estimates of removals. Overall, abundance estimates accounting for only a subset of the entire loggerhead sea turtle population in the NWA DPS indicate that the population is large (i.e., several hundred thousands of individuals) and we expect that the population will remain large for several decades to come. The action is also not expected to reduce the genetic heterogeneity, broad demographic representation, or successful reproduction of the population, nor affect loggerheads' ability to meet their life cycle requirements, including reproduction, sustenance, and shelter.

In the recovery plan for loggerheads, the nesting beach Demographic Recovery Criteria are specific to recovery units. This criteria for nests and nesting females were based on a time frame of one generation for U.S. loggerheads, defined in the recovery plan as 50 years. To be considered for delisting, each recovery unit will have recovered to a viable level and will have increased for at least one generation. The rate of increase used for each recovery unit was dependent upon the level of vulnerability of the recovery unit. The minimum statistical level of detection (based on annual variability in nest counts over a generation time of 50 years) of 1% per year was used for the PFRU, the least vulnerable recovery unit. A higher rate of increase of 3% per year was used for the NGMRU and DTRU, the most vulnerable recovery units. A rate of increase of 2% per year was used for the NRU, a moderately vulnerable recovery unit (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008).

A fundamental problem with restricting population analyses to nesting beach surveys is that they may not reflect changes in the non-nesting population. This is because of the long time to maturity and the relatively small proportion of females that are reproducing on a nesting beach. A decrease in oceanic juvenile or neritic juvenile survival rates may be masked by the natural variability in nesting female numbers and the slow response of adult abundance to changes in recruitment to the adult population (Chaloupka and Limpus 2001). In light of this, two additional Demographic Criteria were developed to ensure a more representative measure of population status was achieved. These criteria are not delineated by recovery unit because individuals from the recovery units mix in the marine environment; therefore, they are applicable to all recovery units. The first of these additional Demographic Criteria assesses trends in abundance on foraging grounds, and the other assesses age-specific trends in strandings relative to age-specific trends in abundance on foraging grounds. For the foraging grounds, a network of index in-water sites, both oceanic and neritic, distributed across the foraging range must be established and monitored to measure abundance. Recovery can be achieved if there is statistical confidence (95%) that a composite estimate of relative abundance from these sites is increasing for at least one generation. For trends in strandings relative to in-water abundance, recovery can be achieved if stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation. Recovery criteria must be met for all recovery units in order for the species to be de-listed (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2008).

Assuming some or all loggerhead sea turtles killed through interactions with the scallop fishery are females, the loss of female loggerhead sea turtles as a result of the proposed action is expected to reduce the reproduction of loggerheads in the NWA DPS compared to the reproductive output of NWA DPS loggerheads in the absence of the proposed action. In addition to being linked to survival, these losses are relevant to the Demographic Recovery Criteria for nests and nesting females. As described in the *Status of the Species*, nesting trends for each of the loggerhead sea turtle recovery units in the NWA DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Assuming that between half (moderate case scenario) and all (worst case scenario) of the loggerhead mortalities from the scallop fishery are adult females, the scallop fishery would remove between 0.11% and 0.21% of the nesting females from the DPS each year (40 to 79 out of the estimated 38,334 adult female loggerheads in the Northwest Atlantic from Richards et al. 2011). A more plausible scenario is that the scallop fishery removes approximately 0.02% or fewer of the total population of loggerheads in the DPS each year, based on the estimate from NMFS (2011) which includes both juvenile and adult life stages in U.S. Atlantic continental shelf waters, of which only a fraction are adult females or individuals of reproductive age. In general, while the loss of a certain number of individuals from a species may have an appreciable reduction on the numbers, reproduction, and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely in the case of the NWA DPS of loggerheads because the species is widely geographically distributed, it is not known to have low levels of genetic diversity, and there are tens to hundreds of thousands of individuals (and possibly more) in the DPS.

In determining whether the authorization of the scallop fishery would reduce appreciably the likelihood of survival and recovery of loggerhead sea turtles, we also considered the PVA for loggerhead sea turtles based on the impacts of the Atlantic sea scallop fishery from 1989-2005(Merrick and Haas 2008). We recognize that this PVA was published in 2008 and new information has become available since its publication. However, this is the most recently available PVA and does provide information to consider in our analysis. This information is considered with the information above to assess the impacts of the current scallop fishery on the NWA DPS of loggerhead sea turtles.

In the 2008 and 2012 Opinions on the scallop fishery (NMFS 2008a, 2012), we determined, based on the data results of the PVA (Merrick and Haas 2008), that the authorization of the scallop fishery would not reduce appreciably the likelihood of survival and recovery of loggerhead sea turtles. At present, we have determined that it is still appropriate to use the results of the 2008 PVA as a benchmark to assess whether the fishery as it currently operates will result in jeopardy for the NWA DPS of loggerhead sea turtles.

The 2008 Atlantic sea scallop PVA estimated quasi-extinction (the point at which so few animals remain that the species/population will inevitably become extinct) likelihoods under conditions with and without fishery effects (Merrick and Haas 2008). Since the PVA was count-based, the only relatively complete and available population time series at the time (nesting beach counts for 1998-2005) was used for the analysis. As such, the analysis focused on the viability of the adult females and did not model the viability of the entire loggerhead population (Merrick and Haas 2008).

The PVA established a baseline using the rate of change of the adult female population (which implicitly included the mortalities from the scallop fishery up to that time), and the 2005 count of adult females estimated from all beaches in the Southeast U.S. based on an extrapolation from nest counts (Merrick and Haas 2008). The rate of change was then adjusted by adding back the scallop fishery interactions (converted to adult female equivalents) and re-running the PVA. The results of these two analyses were then compared. The authors concluded that both the baseline and adjusted baseline (adding back the scallop fishery interactions) had quasi-extinction probabilities of zero (0) at 25, 50, and 75 years, and a probability of 1% at 100 years. Therefore, we concluded that the authorization of the scallop fishery was not likely to appreciably reduce the likelihood of survival and recovery for loggerhead sea turtles in the Northwest Atlantic within the future 100 years (NMFS 2008).

Although the PVA uses data from 1989-2005, and models different effects of the scallop and other Atlantic fisheries on loggerheads than what may occur presently, it is still informative for consideration in this Opinion. The PVA analysis done for the 2008 scallop Opinion and our comparison of its results to the current status and trends of the NWA DPS of loggerheads (in light of effects from the current fishery, other baseline activities, and climate change) supports the conclusion that authorization of the scallop fishery will neither affect the number of nests and nesting females (Demographic Criteria #1) nor the trends in abundance on foraging grounds (Demographic Criteria #2) to the point where there is an appreciable reduction in the species' likelihood of recovery. Based on the rate of change of the adult female population, the PVA determined that there was only a 1% chance that loggerheads in the Atlantic could become quasi-extinct within 100 years either with or without scallop fishery interactions. Again, it should be reiterated that the effects of baseline takes in other fisheries were built into the assumptions underlying the 2008 PVA model. In addition, the Murray (2020a, 2020b) reports as well as data from the Sea Turtle Injury Working Group evidence that the current level of bycatch and mortality in the scallop fishery are less than they were in 2008 when the original PVA was run.

Even amidst ongoing threats to the species such as fishery mortality and climate change, the potential loss of 393 loggerheads from the Northwest Atlantic every five years is not likely to result in any appreciable decline to the NWA DPS. This is due to: (1) the large size of the current nesting population, (2) the fact that the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and short-term trends in some recovery units are increasing, since the time period considered during the PVA, and (4) substantial conservation efforts have been implemented and are underway to address threats.

9.1.2 Leatherback sea turtle

Leatherback sea turtles are listed as endangered under the ESA. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2013). Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed.

Dutton et al. (2013) evaluated the stock structure of leatherbacks in the Atlantic. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton *et al.* 2013). In 2020, seven leatherback populations that met the discreteness and significance criteria of DPSs were identified (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). These include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. The population found within the action is area is the Northwest Atlantic DPS (Figure 11). While NMFS and U.S. FWS concluded that seven populations met the criteria for DPSs, the species continues to be listed at the global level (85 FR 48332, August 10, 2020). Therefore, this analysis considers the range-wide status.

The most recent published assessment, the leatherback status review, estimated that the total index of nesting female abundance for the Northwest Atlantic DPS is 20,659 females (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). This abundance estimate is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG (Marine Turtle Expert Working Group) 2007). The IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation estimated 20,000 mature individuals (male and female) and approximately 23,000 nests per year (data through 2017) with high inter-annual variability in annual nest counts within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). For this analysis, we found that the status review estimate of 20,659 nesting females represents the best available scientific information given that it uses the most comprehensive and recent demographic trends and nesting data.

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG (Marine Turtle Expert Working Group) 2007, Tiwari *et al.* 2013). However, as described in the *Status of the Species,* more recent analyses indicate that the overall trends are negative (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020, Northwest Atlantic Leatherback Working Group 2018, 2019). At the stock level, the Working Group evaluated the Northwest Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The Northwest Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all time periods evaluated, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as recent declines in Guyana, Suriname, and other nesting sites in French Guiana. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). Slight increases in nesting were seen in 2018 and 2019, however, nest counts remain low compared to 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The Northern Caribbean and Western Caribbean stocks have also declined. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent period (2008-2017).

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. This trend is considered to be representative of the DPS (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). While not anticipated to be in the action area, data also indicated that the Southwest Atlantic DPS is declining (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris *et al.* 2017, Santidrián-Tomillo *et al.* 2017, Santidrián-Tomillo *et al.* 2007, Sarti Martínez *et al.* 2007, Tapilatu *et al.* 2013). The IUCN Red List assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles(Tiwari *et al.* 2013). More recently, the leatherback status review estimated the total index of nesting female abundance at 1,277 females for the West Pacific DPS and 755 females for the East Pacific DPS (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). The East Pacific DPS has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace *et al.* 2013). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Most recently, the 2020 status review estimated that the total index of nesting female abundance for the Southwest Indian DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020).

NMFS-approved observers have not recorded any interactions between leatherback sea turtles and scallop dredge or trawl gear. However, leatherback sea turtles may interact with the scallop fishery given that their distribution overlaps with operation of scallop gear and leatherbacks have been observed captured in bottom trawl gear similar to that used in the scallop fishery. Based on information from Murray (2020b) and Linden (2020) on bycatch in trawl fisheries, we estimate that up to one leatherback sea turtle will interact with trawl gear utilized in the scallop fishery every five years. In addition, we anticipate that up to one leatherback will interact with scallop dredge gear every five years, based on the overlap between leatherbacks and the fishery in the action area and known captures of leatherbacks in similar gear types. Up to an additional two sea turtles may interact with fishing vessels utilized in the scallop fishery every five years from any of the four species. For assessing impacts on leatherback sea turtles, we assume that all of these animals could be leatherbacks.

As described in Section 7.2, we anticipate up to two lethal leatherback sea turtle interactions with the scallop fishery every five years (one in dredge and one in trawl gear). We also anticipate that up to two sea turtles of any species may be struck by vessels operating in the scallop fishery over the five year period and that these interactions could be lethal. For the purposes of assessing impacts to leatherbacks, we assume all these vessel interactions are with that species. Therefore, up to four leatherback sea turtles that interact with gear or vessels in the scallop fishery every five years are expected to die or sustain serious injuries leading to death or failure to reproduce.

The lethal removal of up to four leatherback sea turtles every five years will reduce the number of leatherback sea turtles as compared to the number that would have been present in the absence of the proposed action (assuming all other variables remained the same). The lethal interactions could also result in a potential reduction in future reproduction, assuming one or more of these individuals would be female and otherwise survived to reproduce in the future. A leatherback sea turtle will lay multiple nests (clutches) each year. In the Northwest Atlantic DPS, eggs per clutch is 82 for the western Atlantic, and clutch frequency averages 5.5 nests per year (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). Therefore, an adult female leatherback sea turtle can produces hundreds of eggs per nesting season. Although a significant portion of the eggs can be infertile (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020), the annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. Thus, the death of any female leatherbacks that would have otherwise survived to reproduce would eliminate the individual’s and its future offspring’s contribution to future generations. The anticipated lethal interactions are expected to occur anywhere in the action area. Given that these sea turtles generally have large ranges in which they disperse, no reduction in the distribution of leatherback sea turtles is expected from the proposed action. Whether the estimated reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction have relative to current population sizes and trends.

We have determined that the proposed action is not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of leatherback sea turtles in the wild. A maximum of approximately 0.02% of the population (=4 mortalities/20,659 nesting females) is anticipated to be killed through the proposed action every five years. Both males and females and both juvenile and adult leatherbacks are anticipated to potentially interact with gears used in the scallop fishery. It should be noted that the abundance estimate is for nesting females only (i.e., does not include earlier life stages such as juveniles or adult males); therefore, the percent of the population killed is expected to be less than the percentage estimated here. Although the anticipated mortalities would result in a reduction in absolute population numbers, it is not likely this reduction would appreciably reduce the likelihood of survival of this species. If hatchling survival rate to maturity is greater than the mortality in the population, the loss of breeding individuals would be replaced through recruitment of new breeding individuals from successful reproduction of sea turtles unaffected by the proposed action. Considering the number of lethal interactions relative to the population size, we conclude that the proposed action is not likely to have an appreciable effect on overall population trends. In addition, the proposed action is expected to control those impacts by maintaining effort levels consistent with or lower than those that have occurred in previous years.

Fisheries bycatch has been identified as a threat to the Northwest Atlantic DPS of leatherback sea turtles. The Leatherback Working Group noted that leatherback entanglements in vertical line fisheries (e.g., pot gear targeting crab, lobster, conch, fish) in continental shelf waters off New England and Nova Scotia, Canada, were a potential mortality sink that require continued monitoring and bycatch reduction efforts. However, all of the documented fisheries bycatch and mortality has occurred in fisheries not related to the scallop fishery. Across the range of the DPS, thousands of mature individuals are lost annually due to gillnet bycatch (especially off nesting beaches). In particular, drift and bottom-set gillnets off Trinidad are estimated to kill well over 1,000 leatherback sea turtles annually (NMFS 2020). Longline bycatch is also considered to be a widespread threat to the DPS, likely resulting in the loss of thousands of individuals annually.

As explained in the *Environmental Baseline*, although no direct leatherback impacts (*i.e.*, oiled sea turtles or nests) from the Deepwater Horizon oil spill in the northern Gulf of Mexico were observed, some impacts from that event may be expected. However, there is no information to indicate, or basis to conclude, that a significant population-level impact has occurred that would change the species' status to an extent that the expected interactions from this fishery would result in a detectable change in the population status of leatherback sea turtles. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action could be seen as reducing the likelihood of survival and recovery of the species.

As described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to Atlantic leatherbacks. These include measures to reduce the number and severity of leatherback interactions in the U.S. Atlantic longline fisheries and the U.S. South Atlantic and Gulf of Mexico shrimp fisheries. Reducing the number of leatherback sea turtles injured and killed by these activities is expected to increase the number of Atlantic leatherbacks and increase leatherback reproduction in the Atlantic. Since most of these regulatory measures have been in place for several years now, it is likely that current nesting trends reflect the benefit of these measures to Atlantic leatherback sea turtles. There are no new known sources of mortality for leatherback sea turtles in the Atlantic other than potential impacts from the Deepwater Horizon oil spill.

Based on the information provided above, the loss of up to four leatherback sea turtles in the Atlantic every five years as a result of the authorization of the scallop fishery will not appreciably reduce the likelihood of survival for leatherbacks in the Atlantic given the relatively large population size and measures taken to reduce the number of Atlantic leatherback sea turtles injured and killed in the Atlantic Ocean. The scallop fishery has no effects on leatherback sea turtles that occur outside of the Atlantic Ocean. Given that the authorization of the scallop fishery will not appreciably reduce the likelihood of survival for leatherbacks in the Atlantic, it will not appreciably reduce the likelihood of survival of the species.

The recovery plan for Atlantic leatherback sea turtles (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 1992) lists the following recovery objective, which is relevant to the proposed action in this Opinion:

- The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico; St. Croix, U.S. Virgin Islands; and along the east coast of Florida.

The most recent, published IUCN Red List assessment for the Northwest Atlantic Ocean subpopulation of leatherbacks estimated approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019). Although the 2020 leatherback status review concluded that the Northwest Atlantic population exhibits an overall decreasing trend in annual nesting activity (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020), and that it meets the definition of high extinction risk, our confidence in this conclusion is moderate because of its abundance, spatial distribution, and diversity. At this magnitude of nesting abundance, the Northwest Atlantic population is not at a level that places its continued persistence in question as the result of stochastic changes or catastrophic impacts (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2020). From the 1980s until 2017, nesting populations in Puerto Rico, U.S. Virgin Islands, and Florida have shown either a stable or slightly increasing trend (Northwest Atlantic Leatherback Working Group 2019).

The potential loss of four leatherback sea turtles every five years is not likely to have any detectable effect on the above nesting numbers and trends, and therefore, we do not expect that the proposed action will impede progress toward achieving this recovery objective. Nonlethal scallop fishery interactions with these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Since the scallop fishery has no effects on leatherback sea turtles that occur outside of the Atlantic, its authorization will not appreciably reduce the likelihood of recovery for the species. Therefore, we conclude that the proposed action considered in this Opinion—even amidst other ongoing threats to the species including bycatch mortality from other fisheries, other federal actions (i.e., anticipated take issued in other Opinions), and/or and the potential effects of climate change—is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the leatherback sea turtle in the wild, as the number of potential leatherback removals due to the scallop fishery is very small.

9.1.3 Kemp’s ridley sea turtle

Kemp’s ridley sea turtles are listed as a single species classified as endangered under the ESA. Kemp’s ridleys occur in the North Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp’s ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963, NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015, USFWS and NMFS 1992).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with other sea turtles species, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp’s ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females and the age structure of the population, nest counts cannot be used to estimate the total population size (Meylan 1982, Ross 1996) (letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS

Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. It is the best proxy we have for estimating population changes.

Following a significant, unexplained one-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database, unpublished data). In 2013 and 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 nests, and in 2016 overall numbers increased to 18,354 recorded nests. There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm. to NMFS SERO PRD, August 31, 2017 as cited in (NMFS (National Marine Fisheries Service) 2020b)) and decreases observed in 2018 and again in 2019 (Figure 14). In 2019, there were 11,140 nests in Mexico. It is unknown whether this decline is related to resource fluctuation, natural population variability, effects of catastrophic events like the Deepwater Horizon oil spill affecting the nesting cohort, or some other factor. A small nesting population is also emerging in the U.S., primarily in Texas. From 1980-1989, there were an average of 0.2 nests/year at Padre Island National Seashore, rising to 3.4 nests/year from 1990-1999, 44 nests/year from 2000-2009, and 110 nests per year from 2010-2019. There was a record high of 353 nests in 2017 (NPS (National Park Service) 2020). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017 (NMFS (National Marine Fisheries Service) 2020b) and decreases in nesting in 2018 and 2019 (NPS (National Park Service) 2020).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015, TEWG (Marine Turtle Expert Working Group) 2000). Galloway et al. (2016) developed a stock assessment model for Kemp's ridley to evaluate the relative contributions of conservation efforts and other factors toward this species' recovery. Terminal population estimates for 2012 summed over ages 2 to 4, ages 2+, ages 5+, and ages 9+ suggest that the respective female population sizes were 78,043 (SD = 14,683), 152,357 (SD = 25,015), 74,314 (SD =10,460), and 28,113 (SD = 2,987) (Gallaway *et al.* 2016). Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of two years, and a sex ratio of 3.17 females:1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). However, some positive outlooks for the species include recent conservation actions, including the expanded TED requirements in the shrimp fishery (84 FR 70048, December 20, 2019) and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015).

Genetic variability in Kemp's ridley sea turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS (National Marine Fisheries Service) *et al.* 2011). If this holds true, then rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS (National Marine Fisheries Service) *et al.* 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley sea turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton *et al.* 2006).

Kemp's ridley sea turtles have been documented to interact with both dredge and bottom trawl gear in the action area. Based on information from Murray (2020a, 2020b), Linden (2020), and incidental take data from NEFOP, we anticipate up to two Kemp's ridley sea turtles will interact with scallop trawl gear every five years and up to 28 Kemp's ridley sea turtle interactions will occur in dredge gear every five years. Kemp's ridley sea turtles that interact with these two gear types are those that come into contact with or are ultimately captured in the gear. The anticipated number of dredge interactions is based on documented Kemp's ridleys captured in dredge gear from 2015-2019 in Murray (2020a), past dredge interactions summarized in Murray (2011), and other ecological and behavioral information. The trawl interaction estimate for Kemp's ridleys is based on the fleet-wide trawl estimate for the Mid-Atlantic and Georges Bank regions in Murray (2020b) and the scallop fishery apportionment calculated in Linden (2020). An additional two sea turtles may interact with fishing vessels utilized in the scallop fishery every five years. For the purposes of assessing impacts to Kemp's ridleys, we assume all these vessel interactions are with that species.

Based on the lengths of tow times for dredge and bottom trawl fisheries in the action area, captures of Kemp's ridley sea turtles in these gears could result in serious injuries or mortalities due to forced submergence. Currently there are no regulatory controls on tow times in dredge and bottom trawl fisheries. As described in Section 7.2.1.3, of the anticipated interactions every five years, 46% in bottom trawls and either 28% (for the 23 inferred interactions) or 66% (for the five observed interactions) in dredges are expected to lead to mortality. Based upon these percentages, we are assuming that one of the two Kemp's ridley sea turtle interactions in bottom trawl gear and 11 of the 28 interactions in dredge gear over a five-year period could be lethal (for a total of 12 potentially lethal interactions over a five-year period). In addition, up to two sea turtles of any species may be struck and killed by vessels operating in the scallop fishery over the five-year period. Therefore, up to 14 of the 32 Kemp's ridley sea turtles that interact with gear or vessels in the scallop fishery every five years are expected to die or sustain serious injuries leading to death or failure to reproduce. All Kemp's ridleys that interact with the scallop fishery are expected to be immatures, as adult occurrence is generally restricted to the U.S. South Atlantic and Gulf coasts.

The proposed action would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. Using the estimate of mature animals (22,341) in Wibbels et al. (2019), the loss of 14 animals every five years represents a small fraction (0.06%) of the overall population. The proposed action could also result in a potential reduction in future reproduction, assuming at least some of these individuals would be female and would have survived to reproduce in the future. The loss of adult females could preclude the production of thousands of eggs and hatchlings, of which a small percentage are expected to survive to sexual maturity. Thus, the death of any females that would otherwise have survived to sexual maturity would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. Based upon Murray (2020a, 2020b), lethal interactions are expected to occur primarily in the Mid-Atlantic, although could occur anywhere in the action area as Kemp's ridley sea turtles generally have large ranges in which they disperse and the chances of being captured and subsequently killed in a dredge are greater outside the Mid-Atlantic area (i.e., east of 71°W) where chain mats and TDDs are not required. Thus, no reduction in the distribution of Kemp's ridley sea turtles is expected from these scallop fishery interactions. Whether the reductions in numbers and reproduction of Kemp's ridley sea turtles would appreciably reduce their likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In addition, the species' low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental stochasticity, which are often difficult to predict with any certainty.

It is likely that the Kemp's ridley was the sea turtle species most affected by the Deepwater Horizon oil spill on a population level. In addition, the sea turtle strandings documented in 2010 and 2011 in Alabama, Louisiana, and Mississippi primarily involved Kemp's ridley sea turtles. Necropsy results indicated that mortality was caused by forced submergence, which is commonly associated with fishery interactions (77 FR 27413, May 10, 2012). As described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to Kemp's ridley sea turtles. These include measures implemented to reduce the number and severity of Kemp's ridley sea turtle interactions in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries, the Mid-Atlantic scallop dredge and summer flounder trawl fisheries, large mesh gillnet fisheries in Virginia and North Carolina, and the Virginia pound net fishery. In 2021, the expanded TED requirements in the shrimp trawl fishery will become effective, further reducing impacts to sea turtles.

There are no new known sources of mortality for Kemp's ridley sea turtles other than potential impacts from the Deepwater Horizon oil spill. Nevertheless, the effects on Kemp's ridley sea turtles from the proposed action are not likely to appreciably reduce overall population numbers over time due to current population size, expected recruitment, and the implementation of additional conservation requirements in the shrimp trawl fishery, even in light of the adverse impacts expected to have occurred from the Deepwater Horizon oil spill.

It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population increase in Kemp's ridleys. With the recent nesting data, the population trend has become less clear. Nonetheless, data from 1990 to present continue to support that Kemp's ridley sea turtles have shown a generally increasing nesting trend. Even with reported biennial fluctuations in nesting numbers from Mexican beaches, all years since 2006 have reported over 10,000 nests per year, indicating an increasing population over the previous decades. We have determined that this long-term trend in nesting is likely evidence of a generally increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. These nesting data are indicative of a species with a significant number of sexually mature individuals. Additionally, new measures have been implemented in the shrimp trawl fishery, which will further reduce impacts to the population. The loss of up to 14 Kemp's ridleys every five years is not expected to change the trend in nesting, the distribution of, or the reproduction of Kemp's ridley sea turtles. Therefore, we do not expect the proposed action to cause an appreciable reduction in the likelihood of survival of this species in the wild.

The recovery plan for the Kemp's ridley sea turtle (NMFS (National Marine Fisheries Service) *et al.* 2011) lists the following recovery objectives for downlisting that are relevant to the fisheries assessed in this Opinion:

- Demographic: A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.
- Listing factor: TED regulations, or other equally protective measures, are maintained and enforced in U.S. and Mexican trawl fisheries (*e.g.*, shrimp, summer flounder, whelk) that are known to have an adverse impact on Kemp's ridleys in the Gulf of Mexico and Northwest Atlantic Ocean.

With respect to the demographic recovery objective, the nesting numbers in the most recent three years indicate there were 24,570 nests in 2017, 17,945 in 2018, and 11,090 in 2019 on the main nesting beaches in Mexico. Based on 2.5 clutches/female/season, these numbers represent approximately 9,828 (2017), 7,178 (2018), and 4,436 (2019) nesting females in each season. The number of nests reported annually from 2010 to 2014 declined overall; however, they rebounded in 2015 through 2017, and declined again in 2018 and 2019. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of nesting females is still below the number of 10,000 nesting females per season required for downlisting (NMFS (National Marine Fisheries Service) and U.S. FWS (U.S. Fish and Wildlife Service) 2015). Since we concluded that the potential loss of 14 Kemp's ridley sea turtles every five years is not likely to have any detectable effect on nesting trends, we do not expect the proposed action to impede progress toward achieving this recovery objective. Non-lethal captures of these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, we assert that the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtle recovery in the wild.

In regards to the listing factor recovery criterion, the recovery plan states, "the highest priority needs for Kemp's ridley recovery are to maintain and strengthen the conservation efforts that have proven successful. In the water, successful conservation efforts include maintaining the use of TEDs in fisheries currently required to use them, expanding TED-use to all trawl fisheries of concern, and reducing mortality in gillnet fisheries. Adequate enforcement in both the terrestrial and marine environment also is also noted essential to meeting recovery goals" (NMFS (National Marine Fisheries Service) *et al.* 2011). We are currently undertaking several of these initiatives, which should aid in the recovery of the species. The required use of TEDs in shrimp trawls in the U.S. under sea turtle conservation regulations and in Mexican waters has had dramatic effects on the recovery of Kemp's ridley sea turtles.

Based on the information provided above, the loss of up to 14 Kemp's ridley sea turtles every five years as a result of the authorization of the scallop fishery will not appreciably reduce the likelihood of survival and recovery for Kemp's ridley sea turtles given the long term nesting trend, the population size, and ongoing and future measures (i.e., expanded TED regulations in the shrimp trawl fishery) that reduce the number of Kemp's ridley sea turtles injured and killed.

9.1.4 Green sea turtle – North Atlantic DPS

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As is the case with the other three sea turtle species addressed in this Opinion, North Atlantic DPS green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

There are four regions that support high nesting concentrations in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), the U.S. (Florida), and Cuba. Using data from 48 nesting sites in the North Atlantic DPS, nester abundance was estimated at 167,528 total nesters (Seminoff *et al.* 2015). The years used to generate the estimate varied by nesting site but were between 2005-2012. The largest nesting site (Tortuguero, Costa Rica) hosts 79% of the estimated nesting. It should be noted that not all female green sea turtles nest in a given year (Seminoff *et al.* 2015). Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff *et al.* 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff *et al.* 2015). Nesting sites in Cuba, Mexico, and the U.S. were either stable or increasing (Seminoff *et al.* 2015). More recent data is available for the southeastern U.S. Nest counts at Florida's core index beaches have ranged from less than 300 to almost 41,000 in 2019. The INBS is carried out on a subset of beaches surveyed during the SNBS and is designed to measure trends in nest numbers. The nest trend in Florida shows the typical biennial peaks in abundance and has been increasing (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/; Figure 16). The SNBS is broader but is not appropriate for evaluating trends. In 2019, approximately 53,000 green sea turtle nests were recorded in the SNBS (https://myfwc.com/research/wildlife/sea-turtles/nesting/). Seminoff et al. (2015) estimated total nester abundance for Florida at 8,426 turtles.

NMFS recognizes that the nest count data available for green sea turtles in the Atlantic indicates increased nesting at many sites. However, NMFS also recognizes that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future.

Green sea turtles have been observed to interact with both dredge and bottom trawl gear used in the scallop fishery. Based on information from Murray (2020a, 2020b), Linden (2020), and incidental take data from NEFOP, we anticipate that up to one green sea turtle will interact with scallop trawl gear and up to one green sea turtle will interact with dredge gear every five years. Green sea turtles that interact with these two gear types are those that come into contact with or are ultimately captured in the gear. The anticipated number of dredge interactions is based on the green sea turtle captured in dredge gear from 1997, the overlap between green sea turtles and the fishery in the action area, but its lower likelihood to interact with or capture individuals compared to the other two hard-shelled sea turtle species. The trawl interaction estimate for green sea turtles is based on the fleet-wide trawl estimate for the Mid-Atlantic and Georges Bank regions in Murray (2020b) and the scallop fishery apportionment calculated in Linden (2020). An additional two sea turtles may interact with fishing vessels utilized in the scallop fishery every five years. For the purposes of assessing impacts to the North Atlantic DPS of green sea turtles, we assume all these vessel interactions are with green sea turtles.

Based on the lengths of tow times for dredge and bottom trawl fisheries in the action area, captures of green sea turtles in these gears could result in serious injuries or mortalities due to forced submergence. Currently there are no regulatory controls on tow times in dredge and bottom trawl fisheries. As described in Section 7.2.1.3, of the anticipated interactions, 46% in bottom trawls and 66% in dredges (observed captures) are expected to lead to mortality. As part of a turtle cannot be killed, we are assuming that the one green sea turtle interaction in bottom trawl gear over a five-year period could be lethal as well as the one green sea turtle interaction over five years in dredge gear (for a total of two potentially lethal interactions over a five-year period). In addition, up to two sea turtles of any species may be struck and killed by vessels operating in the scallop fishery over the five-year period. While it is less likely that these will be green sea turtles, for assessing impacts on green sea turtles, we assume that all could be greens. Therefore, up to four green sea turtles that interact with gear or vessels in these fisheries every five years are expected to die or sustain serious injuries leading to death or failure to reproduce.

As described above, it is reasonable to expect that both benthic immature and sexually mature green sea turtles may be captured in dredge and bottom trawl gear as a result of the authorization of the scallop fishery. It is assumed that there is an equal chance of lethally capturing a male or female green sea turtle since available information suggests that both sexes occur in the action area. Lethal interactions would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same.

Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have otherwise survived to reproduce. For example, an adult female green sea turtle lays three clutches of eggs, on average (Seminoff *et al.* 2015), every two to years (Troëng and Chaloupka 2007, Witherington and Ehrhart 1989, Zurita *et al.* 1994). Green sea turtle clutches range from 108 eggs in Costa Rica to 136 eggs in Florida (Seminoff *et al.* 2015, Tiwari *et al.* 2006, Witherington and Ehrhart 1989). A small percentage of the eggs are expected to survive to sexual maturity. A lethal capture of a female green sea turtle in dredge or bottom trawl gear would remove reproductive output from the species. Based upon Murray (2020a, 2020b), lethal interactions are expected to occur primarily in the Mid-Atlantic, although could occur anywhere in the action area as green sea turtles generally have large ranges in which they disperse and the chances of being captured and subsequently killed in a dredge are greater outside the Mid-Atlantic area (i.e., east of 71°W) where chain mats and TDDs are not required. Thus, no reduction in the distribution of green sea turtles is expected from these interactions. Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends.

We have determined that the proposed action is not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of the green sea turtle. Although the anticipated mortalities would result in an instantaneous reduction in absolute population numbers, the U.S. populations of green sea turtles would not be appreciably affected. For a population to remain stable, sea turtles must replace themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the hatchling survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be exceeded through recruitment of new breeding individuals. Since the abundance trend information for green sea turtles is clearly increasing while takes have been occurring, we expect that the lethal interactions attributed to the proposed action will not have any measurable effect on that trend. In addition, the potential loss of four green sea turtles every five years represents an extremely small fraction of the overall population that can be estimated from recent nest count data in Florida and Costa Rica. As described in the *Environmental Baseline*, although the Deepwater Horizon oil spill is expected to have resulted in adverse impacts to green sea turtles, there is no information to indicate, or basis to conclude, that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected interactions from the scallop fishery would result in a detectable change in the population status of green sea turtles in the North Atlantic. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action could be seen as reducing the likelihood of survival and recovery of the species.

As also described in the *Environmental Baseline*, regulatory actions have been taken to reduce anthropogenic effects to green sea turtles in the North Atlantic. These include measures to reduce the number and severity of green sea turtle interactions in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries, the Mid-Atlantic sea scallop dredge and summer flounder trawl fisheries, large mesh gillnet fisheries in Virginia and North Carolina, and the Virginia pound net fishery—all of which are causes of green sea turtle mortality in the North Atlantic. Since most of these regulatory measures have been in place for several years now, it is likely that current nesting trends reflect the benefit of these measures to North Atlantic DPS green sea turtles. Therefore, the current nesting trends for green sea turtles in the North Atlantic are likely to continue to improve as a result of the regulatory actions taken for this and other fisheries. There are no new known sources of mortality for green sea turtles in the North Atlantic other than potential impacts from the Deepwater Horizon oil spill.

The recovery plan for Atlantic green sea turtles (NMFS (National Marine Fisheries Service) and U.S. FWS (U. S. Fish Wildlife Service) 1991) lists the following recovery objectives which are relevant to the proposed action in this Opinion, and must be met over a period of 25 continuous years:

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years;
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

Along the Atlantic coast of eastern central Florida, a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al., 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013, as cited in Seminoff et al. 2015). Nesting has increased substantially over the last 20 years and peaked in 2011 with 15,352 nests statewide (Chaloupka et al., 2008; B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013 as cited in Seminoff et al. 2015). The status review estimated total nester abundance for Florida at 8,426 turtles (Seminoff *et al.* 2015). As described above, sea turtle nesting in Florida is increasing. For the most recent six-year period of SNBS data, there were 5,895 nests in 2014, 37,341 in 2015, 5,393 in 2016, 53,102 in 2017, 4,545 in 2018, and 53,011 in 2019 (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Thus, this recovery criterion continues to be met.

Several actions are being taken to address the second objective; however, there are currently few studies, and no estimates, available that specifically address changes in abundance of individuals on foraging grounds. A study in the central region of the Indian River Lagoon (along the east coast of Florida) found a 661% increase in juvenile green sea turtle capture rates over a 24-year study period from 1982-2006 (Ehrhart *et al.* 2007). Wilcox et al. (1998) found a dramatic increase in the number of green sea turtles captured from the intake canal of the St. Lucie nuclear power plant on Hutchinson Island, Florida, beginning in 1993. During a 17-year period from 1976-1993, green sea turtle captures averaged 24 per year. Green sea turtle catch rates for 1993, 1994, and 1995 were 745%, 804%, and 2,084% above the previous 16-year average annual catch rates (Wilcox *et al.* 1998). In a study of sea turtles incidentally caught in pound net gear fished in inshore waters of Long Island, New York, Morreale and Standora (2005) documented the capture of more than twice as many green sea turtles in 2003 and 2004 with less pound net gear fished, compared to the number of green sea turtles captured in pound net gear in the area during the 1990s. Yet other studies have found no difference in the abundance (decreasing or increasing) of green sea turtles on foraging grounds in the North Atlantic (Bjorndal *et al.* 2005, Epperly *et al.* 2007). Given the clear increases in nesting, however, it is reasonably likely that numbers on foraging grounds have increased.

Based on the information provided above, the loss of up to four green sea turtles every five years from the North Atlantic DPS as a result of the authorization of the scallop fishery will not appreciably reduce the likelihood of survival for green sea turtles in the North Atlantic given that is not expected to measurably affect the increasing nesting trend in Florida, that the population size is relatively large, and that measures to reduce the number of North Atlantic DPS green sea turtles that are injured and killed (which should result in increases to the numbers of green sea turtles in the North Atlantic that would otherwise have not occurred in the absence of those regulatory measures) are in place. Given that the proposed action is not expected to measurably affect the nesting trend, the authorization of the scallop fishery will also not appreciably reduce the likelihood of recovery of green sea turtles in the North Atlantic DPS. The scallop fishery has no adverse effects on green sea turtles that occur outside of the North Atlantic. Therefore, since the authorization of the scallop fishery will not appreciably reduce the likelihood of survival or recovery of green sea turtles in the North Atlantic, the proposed action will not appreciably reduce the likelihood of survival or recovery for the species.

9.1.5 Atlantic sturgeon

As explained above, the proposed action may result in the capture of up to five Atlantic sturgeon every five years and one lethal removal every 20 years. As noted above, these Atlantic sturgeon could either be sub-adults or adults. We have considered the best available information to determine from which DPS these individuals are likely to originate. Using a mixed stock analysis explained above, we have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 71.4%; CB 10.7%; GOM 8.7%; SA 5.6%; Carolina 2.6%; and non-listed Canada (1.0%). Based on this information, the NYB DPS is likely to be the most prevalent DPS in the action area; however, this does not necessarily mean that the five Atlantic sturgeon potentially captured every five years will all come from this DPS. Based on the available mixed stock analysis and genetics data, it is also possible that they could be from the GOM, CB, Carolina, or SA DPSs. As a result, to be conservative we must look at the effects of five interactions every five years (i.e., one average annual interaction), and one lethal interaction every 20 years, as if they came from any of the five DPSs.

Gulf of Maine DPS

The GOM DPS is listed as threatened, and while Atlantic sturgeon occur in several rivers of the Gulf of Maine region, recent spawning has only been physically documented in the Kennebec River. However, spawning is suspected to occur in the Androscoggin, Piscataqua, and Merrimack Rivers. There is currently no census of the number of Atlantic sturgeon in any river nor is any currently available for the entire DPS. NMFS use of the NEAMAP data indicates that the estimated ocean population of GOM DPS Atlantic sturgeon sub-adults and adults is 7,455 individuals. Gulf of Maine 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. The ASMFC stock assessment concluded that the abundance of the Gulf of Maine DPS is “depleted” relative to historical levels. The assessment also concluded that there was a 51% probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium, but there was a 74% probability that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

The proposed action may result in the average annual capture of up to one Atlantic sturgeon from the GOM DPS in scallop dredge or trawl gear, and up to one mortality every 20 years. The Opinion for the ten batched fisheries in the Greater Atlantic estimates the take of up to 615 individuals from the GOM DPS over a five-year period in trawl and gillnet gear, of which up to 75 may be lethal (NMFS 2021b). The Opinion for the Southeastern U.S. shrimp trawl fishery estimates the take of up to two individuals from the GOM DPS over a five-year period and no lethal takes (NMFS 2021a). The Opinion for fisheries (excluding pelagic longline) managed under the Consolidated HMS FMP estimates the take of up to 34 individuals from the GOM DPS over a three-year period (of which eight may be lethal) (NMFS (National Marine Fisheries Service) 2020a). On average, we anticipate that no more than 19 Atlantic sturgeon from the GOM DPS may be removed annually because of federal fisheries (15 from the batched fisheries, three from the HMS fisheries, and one from the scallop fishery), or 0.25% of the adult and sub-adult population in the GOM DPS (i.e., 7,455). This 0.25% is below the estimated 3% federal fishing mortality rate we have determined that the population could likely withstand and still maintain 50% of EPR_{max}. In other words, the fishing mortality from these fisheries alone would likely not result in less than 50% of EPR_{max} for the GOM DPS.

The proposed action may result in the removal of one Atlantic sturgeon that would have been a reproductive adult from the GOM DPS every 20 years, which would reduce the reproductive potential of the DPS. The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. Reproductive potential of other captured and released individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM DPS fish. The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas that may be used by GOM DPS sub-adults or adults. Further, the action is not expected to reduce the river-by-river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary.

Based on the information provided above, the death of up to one GOM DPS Atlantic sturgeon every 20 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment) and recovery of the GOM DPS. The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population to persist, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring.

As a recovery plan has not yet been drafted for Atlantic sturgeon, we evaluated the five listing factors. Recovery is defined as the improvement in status such that listing is no longer appropriate. Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five listing factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon in any geographic area and thus, it will not affect the overall distribution of GOM DPS Atlantic sturgeon. The proposed action will not utilize GOM DPS Atlantic sturgeon for recreational, scientific or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species or affect its continued existence. The proposed action is likely to result in the capture and injury of Atlantic sturgeon and the mortality of no more than one GOM DPS Atlantic sturgeon every 20 years. As explained above, the loss of these individuals and what would have been their progeny is not expected to affect the persistence of the GOM DPS. As the reduction in numbers and future reproduction is not significant, the loss of these individuals is not likely to change the status of GOM DPS Atlantic sturgeon. The effects of the proposed action will not likely delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause the mortality of a significant percentage of the species as a whole and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. 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 can be brought to the point at which they are no longer listed as threatened.

Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one GOM DPS Atlantic sturgeon every 20 years, is not likely to appreciably reduce the survival and recovery of this species.

New York Bight DPS

The NYB DPS is listed as endangered, and while Atlantic sturgeon occur in several rivers in the New York Bight, recent spawning has only been physically documented in the Hudson and Delaware Rivers. The essential physical features necessary to support spawning and recruitment are also present in the in the Connecticut and Housatonic Rivers (82 FR 39160; August 17, 2017). However, there is no current evidence that spawning is occurring nor studies underway to investigate whether spawning is occurring in those rivers, aside from one recent study which found young SA DPS fish in the Connecticut River, which was unexpected to the researchers (Savoy *et al*. 2017). Based on existing data, we expect any NYB DPS Atlantic sturgeon in the action area to originate from the Hudson or Delaware River.

There are no abundance estimates for the entire NYB DPS or for the entirety of either the Hudson River or Delaware River spawning populations. There are, however, some estimates for specific life stages (e.g., natal juvenile abundance, spawning run abundance, and effective population size). Using side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon, Kazyak et al. (2020) estimated the 2014 Hudson River spawning run size to be 466 sturgeon (95% CRI = 310-745). Based on genetic analyses of two different life stages, subadults and natal juveniles, effective population size for the Hudson River spawning population has been estimated to be 198 (95% CI=171.7-230.7; O'Leary et al. 2014) and 156 (95% CI=138.3-176.1) (Waldman *et al.* 2019), while estimates for the Delaware River spawning population from the same studies were 108.7 (95% CI=74.7-186.1) (O'Leary *et al.* 2014) and 40 (95% CI=34.7-46.2) (Waldman *et al.* 2019). The difference in effective population size for the Hudson and Delaware River spawning populations across both studies support that the Hudson River spawning population is the more robust of the two spawning groups. This conclusion is further supported by genetic analyses that demonstrated Atlantic sturgeon originating from the Hudson River spawning population were more prevalent in mixed aggregations than sturgeon originating from the Delaware River spawning population, even when sampling occurred in areas and at times that targeted for adults belonging to the Delaware River spawning population (Wirgin *et al.* 2015a, Wirgin *et al.* 2015b). The Waldman et al. (2019) calculations of maximum effective population size, and comparison of these to four other spawning populations outside of the New York Bight DPS further supports our previous conclusion that the Hudson River spawning population is more robust than the Delaware River spawning population and is likely the most robust of all of the U.S. Atlantic sturgeon spawning populations.

For this opinion, we have estimated adult and sub-adult abundance of the NYB DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall *et al.* 2013, Kocik *et al.* 2013). We concluded that sub-adult and adult abundance of the New York Bight DPS was 34,566 sturgeon based upon the NEAMAP data. This number encompasses many age classes since sub-adults can be as young as two years old when they first enter the marine environment, and adults can live as long as ~60 years (Hilton *et al.* 2016). For example, a study of Atlantic sturgeon captured in the geographic New York Bight determined that 742 of the Atlantic sturgeon captured represented 21 estimated age classes and that, individually, the sturgeon ranged in age from 2 to 35 years old(Dunton *et al.* 2016). The 2017 ASMFC stock assessment determined that abundance of the NYB DPS is "depleted" relative to historical levels (ASMFC (Atlantic States Marine Fisheries Commission) 2017). However, the assessment also determined there is a relatively high probability (75%) that the NYB DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31% probability that mortality for the NYB DPS exceeds the mortality threshold used for the assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

The proposed action may result in the average annual capture of up to one Atlantic sturgeon from the NYB DPS in scallop dredge or trawl gear, and up to one mortality every 20 years. The Opinion for the ten batched fisheries in the Greater Atlantic estimates the take of up to 5,020 individuals from the NYB DPS over a five-year period in trawl and gillnet gear, of which up to 590 may be lethal (NMFS 2021b). The Opinion for the Southeastern U.S. shrimp trawl fishery estimates the take of up to seven individuals from the NYB DPS over a five-year period of which two are expected to be lethal (NMFS 2021a). The Opinion for fisheries (excluding pelagic longline) managed under the Consolidated HMS FMP estimates the take of up to 170 individuals from the NYB DPS over a three-year period (of which 36 may be lethal) (NMFS (National Marine Fisheries Service) 2020a). On average, we anticipate that no more than 132 Atlantic sturgeon from the NYB DPS may be removed annually because of federal fisheries (118 from the batched fisheries, one from the Southeast shrimp trawl fishery, 12 from the HMS fisheries, and one from the scallop fishery), or 0.38% of the adult and sub-adult population in the NYB DPS (i.e., 34,566). This 0.38% is below the estimated 3% federal fishing mortality rate we have determined that the population could likely withstand and still maintain 50% of EPR_{max}. In other words, the fishing mortality from these fisheries alone would likely not result in less than 50% of EPR_{max} for the NYB DPS.

The proposed action may result in the removal of one Atlantic sturgeon that would have been a reproductive adult from the NYB DPS every 20 years, which would reduce the reproductive potential of the DPS. The reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individuals. Reproductive potential of other captured and released individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where NYB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by NYB DPS fish. The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas that may be used by NYB DPS sub-adults or adults. Further, the action is not expected to reduce the river-by-river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary.

Based on the information provided above, the death of up to one NYB DPS Atlantic sturgeon every 20 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment) and recovery of the NYB DPS. The action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population to persist, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring.

As described for the GOM DPS, we evaluated the five listing factors as a recovery plan has not been drafted. The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in a small reduction in the number of NYB DPS Atlantic sturgeon in any geographic area and thus, it will not affect the overall distribution of NYB DPS Atlantic sturgeon. The proposed action will not utilize NYB DPS Atlantic sturgeon for recreational, scientific, or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species or affect its continued existence. The proposed action is likely to result in the capture and injury of Atlantic sturgeon and the mortality of no more than one NYB DPS Atlantic sturgeon every 20 years. As explained above, the loss of these individuals and what would have been their progeny is not expected to affect the persistence of the NYB DPS. As the reduction in numbers and future reproduction is not significant, the loss of these individuals is not likely to change the status of NYB DPS Atlantic sturgeon. The effects of the proposed action will not likely delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause the mortality of a significant percentage of the species as a whole and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. 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 can be brought to the point at which they are no longer listed as threatened.

Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one NYB DPS Atlantic sturgeon every 20 years, is not likely to appreciably reduce the survival and recovery of this species.

Chesapeake Bay DPS

The CB DPS is listed as endangered, and while Atlantic sturgeon occur and may potentially spawn in several rivers of the Chesapeake Bay. There is evidence of spawning in the James River; Pamunkey River, a tributary of the York River; and Marshyhope Creek, a tributary of the Nanticoke River (Balazik and Musick 2015, Hager *et al.* 2014, Kahn *et al.* 2014, NMFS (National Marine Fisheries Service) 2017b, Richardson and Secor 2016). In addition, detections of acoustically-tagged adult Atlantic sturgeon in the Mattaponi and Rappahannock Rivers at the time when spawning occurs in others rivers, and historical evidence for these as well as the Potomac River supports the likelihood of Atlantic sturgeon spawning populations in the Mattaponi, Rappahannock, and Potomac Rivers (NMFS (National Marine Fisheries Service) 2017b).

Chesapeake Bay 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 no census nor enough information to establish a trend for any life stage, for the James River spawning population, or for the DPS as a whole, although the NEAMAP data indicates that the estimated ocean population of CB DPS Atlantic sturgeon is 8,811 sub-adult and adult individuals. The 2017 ASMFC stock assessment determined that abundance of the Chesapeake Bay DPS is "depleted" relative to historical levels (ASMFC 2017). The assessment also determined there is a relatively low probability (36%) that abundance of the CB DPS has increased since the implementation of the 1998 fishing moratorium, and a 30% probability that mortality for the CB DPS exceeds the mortality threshold used for the assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

The proposed action may result in the average annual capture of up to one Atlantic sturgeon from the CB DPS in scallop dredge or trawl gear, and up to one mortality every 20 years. The Opinion for the ten batched fisheries in the Greater Atlantic estimates the take of up to 755 individuals over a five-year period in trawl and gillnet gear, of which up to 85 may be lethal

(NMFS 2021b). The Opinion for the Southeastern U.S. shrimp trawl fishery estimates the take of up to 19 individuals from the CB DPS over a five-year period of which four are expected to be lethal (NMFS 2021a). The Opinion for fisheries (excluding pelagic longline) managed under the Consolidated HMS FMP estimates the take of up to 40 individuals from the CB DPS over a three-year period (of which nine may be lethal) (NMFS (National Marine Fisheries Service) 2020a). On average, we anticipate that no more than 22 Atlantic sturgeon from the CB DPS may be removed annually because of federal fisheries (17 from the batched fisheries, one from the Southeast shrimp trawl fishery, three from the HMS fisheries, and one from the scallop fishery), or 0.25% of the adult and sub-adult population in the CB DPS (i.e., 8,811). This 0.25% is below the estimated 3% federal fishing mortality rate we have determined that the population could likely withstand and still maintain 50% of EPR_{max}. In other words, the fishing mortality from these fisheries alone would likely not result in less than 50% of EPR_{max} for the CB DPS.

The proposed action may result in the removal of one Atlantic sturgeon that would have been a reproductive adult from the CB DPS every 20 years, which would reduce the reproductive potential of the DPS. The reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individuals. Reproductive potential of other captured and released individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CB DPS fish. The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas that may be used by CB DPS sub-adults or adults. Further, the action is not expected to reduce the river-by-river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary.

Based on the information provided above, the death of up to one CB DPS Atlantic sturgeon every 20 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment) and recovery of the of the CB DPS. The action will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population to persist, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring.

As described for the each of the five DPSs, we evaluated the five listing factors as a recovery plan has not been drafted. The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of CB DPS Atlantic sturgeon in any geographic area and thus, it will not affect the overall distribution of CB DPS Atlantic sturgeon. The proposed action will not utilize CB DPS Atlantic sturgeon for recreational, scientific, or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species or affect its continued existence. The proposed action is likely to result in the capture and injury of Atlantic sturgeon and the mortality of no more than one CB DPS Atlantic sturgeon every 20 years. As explained above, the loss of these individuals and what would have been their progeny is not expected to affect the persistence of the CB DPS. As the reduction in numbers and future reproduction is not significant, the loss of these individuals is not likely to change the status of CB DPS Atlantic sturgeon. The effects of the proposed action will not likely delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause the mortality of a significant percentage of the species as a whole and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. 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 can be brought to the point at which they are no longer listed as threatened.

Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one CB DPS Atlantic sturgeon every 20 years, is not likely to appreciably reduce the survival and recovery of this species.

Carolina DPS

The Carolina DPS is listed as endangered and consists of Atlantic sturgeon originating from at least five rivers where spawning is still thought to occur. 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. Historical fishery landings data indicate 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. At the time of listing, the abundance for each river population within the DPS was estimated to have fewer than 300 spawning adults; estimated to be less than 3% of what they were historically (ASSRT 2007). There is currently no census of the number of Atlantic sturgeon in any river nor is any currently available for the entire DPS, although the NEAMAP data indicates that the estimated ocean population of Carolina DPS Atlantic sturgeon, sub-adults and adults, is 1,356 individuals. The 2017 ASMFC stock assessment determined that abundance of the Carolina DPS is “depleted” relative to historical levels (ASMFC 2017). The assessment also determined there is a relatively high probability (67%) that abundance of the Carolina DPS has increased since the implementation of the 1998 fishing moratorium, and a 75% probability that mortality for the Carolina DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

The proposed action may result in the average annual capture of up to one Atlantic sturgeon from the Carolina DPS in scallop dredge or trawl gear, and up to one mortality every 20 years. The Opinion for the ten batched fisheries in the Greater Atlantic estimates the take of up to 180 individuals over a five-year period in trawl and gillnet gear, of which up to 20 may be lethal (NMFS 2021b). The Opinion for the Southeastern U.S. shrimp trawl fishery estimates the take of up to 66 individuals from the Carolina DPS over a five-year period of which 15 are expected to be lethal (NMFS 2021a). The Opinion for HMS fisheries (excluding pelagic longline) managed under the Consolidated HMS FMP estimates the take of up to ten individuals from the

Carolina DPS over a three-year period (of which five may be lethal) (NMFS (National Marine Fisheries Service) 2020a). On average, we anticipate no more than ten Atlantic sturgeon from the Carolina DPS may be removed annually because of federal fisheries (four from the batched fisheries, three from the Southeast shrimp trawl fishery, two from the HMS fisheries, and one from the scallop fishery), or 0.74% of the adult and sub-adult population in the Carolina DPS (i.e., 1,356). This 0.74% is below the estimated 3% federal fishing mortality rate we have determined that the population could likely withstand and still maintain 50% of EPR_{max}. In other words, the fishing mortality from these fisheries alone would likely not result in less than 50% of EPR_{max} for the Carolina DPS.

The proposed action may result in the removal of one Atlantic sturgeon that would have been a reproductive adult from the Carolina DPS every 20 years, which would reduce the reproductive potential of the DPS. The reproductive potential of the Carolina DPS will not be affected in any way other than through a reduction in numbers of individuals. Reproductive potential of other captured and released individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where Carolina DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Carolina DPS fish. The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas that may be used by Carolina DPS sub-adults or adults. Further, the action is not expected to reduce the river-by-river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary.

Based on the information provided above, the death of up to one Carolina DPS Atlantic sturgeon every 20 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment) and recovery of the of the Carolina DPS. The action will not affect Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population to persist, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring.

As described for each of the five DPSs, we evaluated the five listing factors as a recovery plan has not been drafted. The proposed action is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of Carolina DPS Atlantic sturgeon in any geographic area and thus, it will not affect the overall distribution of Carolina DPS Atlantic sturgeon. The proposed action will not utilize Carolina DPS Atlantic sturgeon for recreational, scientific, or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species or affect its continued existence. The proposed action is likely to result in the capture and injury of Atlantic sturgeon and the mortality of no more than one Carolina DPS Atlantic sturgeon every 20 years. As explained above, the loss of these individuals and what would have been their progeny is not expected to affect the persistence of the Carolina DPS. As the reduction in numbers and future reproduction is not significant, the loss of these individuals is not likely to change the status of Carolina DPS Atlantic sturgeon. The effects of the proposed action will not likely delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause the mortality of a significant percentage of the species as a whole and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. 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 Carolina DPS can be brought to the point at which they are no longer listed as threatened.

Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one Carolina DPS Atlantic sturgeon every 20 years, is not likely to appreciably reduce the survival and recovery of this species.

South Atlantic DPS

The SA DPS is listed as endangered and consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. 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 Georgia prior to 1890. At the time of listing, only six spawning subpopulations were thought to have existed in the SA DPS: Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River (including the Oconee and Ocmulgee tributaries), and Satilla River. Three of the spawning subpopulations in the SA DPS are relatively robust and are considered the second (Altamaha River) and third (Combahee/Edisto River) largest spawning subpopulations across all five DPSs. Peterson et al. (2008) estimated the number of spawning adults in the Altamaha River was 324 (95% CI: 143-667) in 2004 and 386 (95% CI: 216-787) in 2005. Bahr and Peterson (2016) estimated the age-1 juvenile abundance in the Savannah River from 2013-2015 at 528 in 2013, 589 in 2014, and 597 in 2015. No census of the number of Atlantic sturgeon in any of the other spawning rivers or for the DPS as a whole is available. However, the NEAMAP data indicates that the estimated ocean population of SA DPS Atlantic sturgeon sub-adults and adults is 14,911 individuals.

The 2017 ASMFC stock assessment determined that abundance of the SA DPS is “depleted” relative to historical levels (ASMFC (Atlantic States Marine Fisheries Commission) 2017). Due to a lack of suitable indices, the assessment was unable to determine the probability that the abundance of the SA DPS has increased since the implementation of the 1998 fishing moratorium. However, it was determined that there is a 40% probability that mortality for the SA DPS exceeds the mortality threshold used for the assessment (ASMFC (Atlantic States Marine Fisheries Commission) 2017).

The proposed action may result in the average annual capture of up to one Atlantic sturgeon from the SA DPS in scallop dredge or trawl gear, and up to one mortality every 20 years. The

Opinion for the ten batched fisheries in the Greater Atlantic estimates the take of up to 395 individuals over a five-year period in trawl and gillnet gear, of which up to 45 year may be lethal (NMFS 2021b). The Opinion for the Southeastern U.S. shrimp trawl fishery estimates the take of up to 103 individuals from the SA DPS over a five-year period of which 24 are expected to be lethal (NMFS 2021a). The Opinion on fisheries (excluding pelagic longline) managed under the Consolidated HMS FMP estimates the take of up to 75 individuals from the SA DPS over a three-year period (of which 19 may be lethal) (NMFS (National Marine Fisheries Service) 2020a). On average, we anticipate no more than 22 Atlantic sturgeon from the SA DPS may be removed annually because of federal fisheries (nine from the batched fisheries, five from the Southeast shrimp trawl fishery, seven from the HMS fisheries, and one from the scallop fishery), or 0.15% of the adult and sub-adult population in the SA DPS (i.e., 14,911). This 0.15% is below the estimated 3% federal fishing mortality rate we have determined that the population could likely withstand and still maintain 50% of EPR_{max}. In other words, the fishing mortality from these fisheries alone would likely not result in less than 50% of EPR_{max} for the SA DPS.

The proposed action may result in the removal of one Atlantic sturgeon that could have been a reproductive adult from the SA DPS every 20 years, which would reduce the reproductive potential of the DPS. The reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individuals. Reproductive potential of other captured and released individuals is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by SA DPS fish. The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas that may be used by SA DPS sub-adults or adults. Further, the action is not expected to reduce the river-by-river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary.

Based on the information provided above, the death of up to one SA DPS Atlantic sturgeon every 20 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment) and recovery of the of the SA DPS. The proposed action will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population to persist, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring.

Recovery is defined as the improvement in status such that listing is no longer appropriate. Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five listing factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

The proposed action is not expected to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of SA DPS Atlantic sturgeon in any geographic area and thus, it will not affect the overall distribution of SA DPS Atlantic sturgeon. The proposed action will not utilize SA DPS Atlantic sturgeon for recreational, scientific, or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect this species, or affect its continued existence. The proposed action is likely to result in the capture and injury of Atlantic sturgeon and the mortality of no more than one SA DPS Atlantic sturgeon every 20 years. As explained above, the loss of these individuals and what would have been their progeny is not expected to affect the persistence of the SA DPS. As the reduction in numbers and future reproduction is not significant, the loss of these individuals is not likely to change the status of SA DPS Atlantic sturgeon. The effects of the proposed action will not likely delay the recovery timeline or otherwise decrease the likelihood of recovery since the action will not cause the mortality of a significant percentage of the species as a whole and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. 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 can be brought to the point at which they are no longer listed as threatened.

Based on the analysis presented herein, the proposed action, resulting in the mortality of one SA DPS Atlantic sturgeon every 20 years, is not likely to appreciably reduce the survival and recovery of this species.

10.0 CONCLUSION

After reviewing the current status of the species, the environmental baseline and cumulative effects in the action area, and the effects of the authorization of the scallop fishery under the Scallop FMP, it is our biological opinion that the proposed action may adversely affect, but is not likely to jeopardize, the continued existence of NWA DPS loggerhead, leatherback, Kemp's ridley, and North Atlantic DPS green sea turtles, or the GOM, NYB, CB, Carolina, and SA DPSs of Atlantic sturgeon. It is also our biological opinion that the proposed action is not likely to adversely affect shortnose sturgeon, the Gulf of Maine DPS of Atlantic salmon, hawksbill sea turtles, North Atlantic right whales, fin whales, sei whales, blue whales, sperm whales, giant manta rays, oceanic white-tip sharks, or designated critical habitats for North Atlantic right whales and NWA DPS loggerhead sea turtles.

11.0 INCIDENTAL TAKE STATEMENT (INCLUDING RPMS, T&CS, AND TAKE MONITORING PROTOCOL)

11.1 Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, unless a special exemption has been granted. Take is defined as "to harass, harm, pursue, hunt, shoot, 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 execution 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)). A "person" is defined in part as any entity subject to the jurisdiction of the United States, including an individual, corporation, officer, employee, department or instrument of the Federal government (see 16 U.S.C. 1532(13)). Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and the purpose of carrying out an otherwise lawful activity 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 (ITS). In issuing ITSs, NMFS takes no position on whether an action is an "otherwise lawful activity."

The prohibitions against incidental take are currently in effect for all four species of sea turtles and all five DPSs of Atlantic sturgeon. When a proposed federal action is found to be consistent with section 7(a)(2) of the ESA, section 7(b)(4) of the ESA requires NMFS or the U.S. FWS to issue a statement specifying the impact of incidental taking, if any. It also states that reasonable and prudent measures (RPMs) necessary to minimize impacts of any incidental take be provided along with implementing terms and conditions (T&Cs). The measures described below are non-discretionary and must, therefore, be undertaken in order for the exemption in section 7(o)(2) to apply. Failure to implement the T&Cs through enforceable measures may result in a lapse of the protective coverage of section 7(o)(2).

NMFS anticipates the following incidental takes of sea turtles and Atlantic sturgeon may occur in the future because of the proposed action. The level of takes occurring annually is variable and influenced by sea temperatures, species abundances, fishing effort, and other factors that are difficult to predict. Because of this variability, it is unlikely that all species evaluated in this Opinion will be consistently impacted year after year. For example, some years may have no observed or otherwise documented interactions and, thus, no estimated take will occur. As a result, monitoring the scallop fishery using one-year (annual) estimated take levels is largely impractical. For these reasons, and based on our experience monitoring this and other fisheries, we have determined that a five-year time period is appropriate for meaningful monitoring of take with respect to the ITS. In order to most effectively monitor impacts of the scallop fishery on sea turtles, the takes exempted for loggerheads in dredge gear and all sea turtle species in trawl gear are over a consecutive five-year period. For leatherback, Kemp's ridley, and green sea turtles in dredge gear, the takes exempted are over a rolling five-year period. For Atlantic sturgeon, the anticipated take is for all five DPSs over a rolling five-year period across both gear types combined. Table 23 displays the total estimated take of these species over five years. In the case of Atlantic sturgeon, lethal take is specified over a 20 year period, as noted in the table.

Table 23: Exempted takes of sea turtles and Atlantic sturgeon in the scallop fishery over a five-year period. For Kemp's ridley, leatherback, and green sea turtles in dredge gear, the ITS will be monitoring via observed captures over a five-year period as model-based estimates of observable and inferred takes are not available.

	Total Take	**Lethal Take**
	Sea Turtles	
Loggerhead, NWA DPS	Dredge: 1,095 Trawl: 13	Dredge: 385 Trawl: 6
Leatherback	Dredge: 1 (observed) Trawl: 1	Dredge: 1 (observed) Trawl: 1
Kemp's ridley	Dredge: 28 (5 observed) Trawl: 2	Dredge: 11 (4 observed) Trawl: 1
Green, North Atlantic DPS	Dredge: 1 (observed) Trawl: 1	Dredge: 1 (observed) Trawl: 1
Any combination of turtle species	Vessel strike: 2	Vessel strike: 2
	ESA-listed Fish	
Atlantic sturgeon, any combination of five listed DPSs	Dredge and trawl (combined): 5	Dredge and trawl (combined): 1 every 20 years

11.2 Reasonable and Prudent Measures

NMFS has determined that the following Reasonable and Prudent Measures (RPMs) and associated Terms and Conditions (T&Cs) are necessary and appropriate to minimize and monitor impacts of the incidental take on sea turtles and the five DPSs of Atlantic sturgeon resulting from the proposed action (Table 24). In order to be exempt from prohibitions of section 9 of the ESA and regulations issued pursuant to section 4(d), NMFS must comply with the following T&Cs, which implement the RPMs. These T&Cs are non-discretionary. Any taking that is in compliance with the T&Cs specified in this ITS shall not be considered a prohibited taking of the species concerned (ESA section 7(o)(2)).

The RPMs, with their implementing T&Cs, are designed to minimize and monitor the impact of the incidental take resulting from the proposed action. Specifically, these RPMs and T&Cs will keep us informed of when and where sea turtle and Atlantic sturgeon interactions are taking place as well as how scallop fishery and environmental conditions may affect the abundance, density, distribution, and interaction rate of those species. The third column below explains why each of these RPMs and T&Cs are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the proposed action.

In order to effectively monitor the effects of the proposed action, it is necessary to monitor the impacts of the action to document the amount of incidental take (i.e., the number of sea turtles and Atlantic sturgeon captured, injured, or killed) and to assess any sea turtles or Atlantic sturgeon that are captured during this monitoring. Monitoring provides information on the characteristics of sea turtles and Atlantic sturgeon encountered and provides data which will help develop more effective measures to avoid future interactions with ESA-listed species. We do not anticipate any additional injury or mortality to be caused by handling, assessing, and ultimately releasing sea turtles and Atlantic sturgeon as required in the RPMs listed below.

Table 24. RPMs, Terms and Conditions, and justifications.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
<u>RPM 1: GEAR RESEARCH</u>: • NMFS must continue to work with the scallop fishing industry and its partners to first review and then, if needed, promote, fund, or conduct research on gear design and potential modifications to reduce incidental takes of ESA-listed species, and the severity of interactions that occur. • Since fishing characteristics and behavior vary amongst scallop permit categories, gear sectors, and management areas, NMFS must annually assess research to better characterize different components of the scallop fishery and the nature of their interactions with ESA-listed species.	• NMFS must develop and evaluate gear research priorities and information needs for ESA-listed species included in the ITS annually. • NMFS must continue to review past modifications to scallop dredge gear and their effects on sea turtles and Atlantic sturgeon. • NMFS must continue to review observer reports of sea turtle interactions in scallop dredge and bottom trawl gear to determine if modifications in gear design may be needed due to changes in the way sea turtles interact with and behave around the gear. This could include changes to chain mat and TDD specifications for dredge gear or investigations into the use of TEDs in bottom trawl gear.	RPM 1 and the accompanying Terms and Conditions specify the need for continued gear research and evaluation, as well as further investigation and implementation of results to aid in bycatch reduction of sea turtles and Atlantic sturgeon observed captured in scallop dredge and bottom trawl gear. This is essential for reducing the severity and possibly the level of incidental takes associated with the scallop fishing industry while maintaining sustainable fishing practices. Improving our knowledge of the scallop fishery, and potentially modifying current fishing practices and gear specifications, when paired with updated information on how and why interactions are most likely to occur, are essential for the long-term reduction of impacts on sea turtles and Atlantic sturgeon.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
RPM 2: ECOLOGICAL STUDIES: • NMFS must continue to review available data to determine whether there are areas, conditions, or behaviors (both fishing and species-specific) within the action area where sea turtle and Atlantic sturgeon interactions with scallop dredge and bottom trawl gear are more likely to occur. • NMFS must investigate current and alternative methods to estimate takes of sea turtles and Atlantic sturgeon in the scallop fishery as well as other correlations between interactions in dredge and bottom trawl gear.	• NMFS must continue to review all available data on the observed/documented take of sea turtles and Atlantic sturgeon in the scallop fishery and other suitable information (*e.g.*, data on observed interactions with other fisheries, species distribution and behavioral information from surveys and satellite telemetry studies, or captures during fisheries research surveys in the area where the scallop fishery operates) to attempt to identify correlations with environmental conditions or other drivers of incidental take within the action area. This could include, but is not limited to, research to understand seasonal movements, vertical habitat utilization, and the status and range of sea turtle and Atlantic sturgeon populations in response to climate change. • If correlations with environmental conditions or other drivers of incidental take are identified, NMFS must take appropriate action to reduce sea turtle and Atlantic sturgeon interactions and/or their impacts. One example could be alterations to the timing and extent of the chain mat and TDD regulations due to new ecological information. • NMFS must test the assumptions of the NEFSC's five-year bycatch estimation model for scallop dredge gear (i.e., that interactions between sea turtles and dredge gear in times and areas where they overlap continue to occur below the surface at the same rate as when chain mats were not required [Murray 2015a]) by comparing past incidental take data and information from the scallop dredge fishery to that from bottom trawl fisheries and fisheries research surveys (e.g., NEFSC and NEAMAP trawl surveys) in the action area.	RPM 2 and the accompanying Terms and Conditions specify the importance of using current data already available to reduce the incidental bycatch and increase survivability of sea turtles and Atlantic sturgeon. Temporal and spatial data can provide insight on where these interactions are most likely to occur, and can be paired with modifications to fishing practices and gear as described in RPM 1 to minimize the respective incidental capture and mortality of sea turtles and Atlantic sturgeon. In addition, testing the assumptions of the NEFSC's five-year bycatch estimation model will allow us to determine its future utility in monitoring and assessing sea turtle takes in both dredge and bottom trawl gear.

Reasonable and Prudent Measures (RPMs) | **Terms and Conditions (T&Cs)** | **Justifications for RPMs and T&Cs**

RPM 3: HANDLING

- NMFS must ensure that any bycaught sea turtles and Atlantic sturgeon are handled in such a way as to minimize stress to the animal and increase its survival rate.
- For sea turtles in a comatose or lethargic state, NMFS requires that they must be retained on board, handled, resuscitated, and released according to the established procedures, as practicable and in consideration of best practices for safe vessel and fishing operations.

Terms and Conditions (T&Cs)

- NMFS must distribute information to permit holders in the scallop fishery specifying handling and resuscitation requirements they must undertake for any bycaught sea turtles and Atlantic sturgeon.
- As new information becomes available, NMFS must update its protected species handling and release protocols.
- NMFS requires that vessel operators follow the sea turtle handling and resuscitation requirements at 50 CFR 223.206. Operators must bring comatose sea turtles aboard and perform resuscitation according to the regulations. If an observer is present, observer protocols will be followed, including bringing fresh dead animals to shore when feasible.

Justifications for RPMs and T&Cs

RPM 3 and the accompanying Terms and Conditions describe the importance of specific handling and resuscitation requirements in order to increase survivorship of sea turtles and Atlantic sturgeon. Minimizing the stress of an animal that was involved in an incidental take increases its chances of survival post-release. By creating protocols that can be easily accessed by fishermen who may encounter these species in the scallop fishery, NMFS and the industry can reduce the severity of the interaction and minimize potential long-term impacts on the animal, such as stress-related complications and mortality.

RPM 4: MONITORING 1:

- NMFS must ensure that monitoring and reporting of any sea turtles and Atlantic sturgeon encountered in gear used in the scallop fishery: (1) detects any adverse effects such as serious injury or mortality; (2) detects whether the anticipated level of take has occurred or been exceeded; and (3) includes the collection of necessary biological and life history data from individual encounters (e.g., species ID, date, location, size measurements, genetic information, photos/video).

Terms and Conditions (T&Cs)

- NMFS must continue to place observers onboard scallop dredge and bottom trawl vessels to document fishing effort characteristics and incidental bycatch to monitor, document, and report incidental takes of sea turtles and Atlantic sturgeon.
- NMFS must continue to compile an annual omnibus report of observed sea turtle and Atlantic sturgeon takes in New England and Mid-Atlantic fisheries, including trips where scallops are landed, by May 31st each year.
- NMFS must continue to produce updated bycatch estimates for sea turtles in dredge and bottom trawl gear within the action area at a minimum every five years.
- NEFOP and IFS observers must continue to tag and take tissue samples (under their ESA section 10 permit) from incidentally captured sea turtles. The NEFSC will be the clearinghouse for any genetic samples of sea turtles taken by observers.
- NEFOP and IFS observers must also take genetic samples (i.e., fin clips or scales) of all incidentally captured Atlantic sturgeon according to the current observer protocols. Samples will be sent to the appropriate NMFS line office or research partner for analysis.

Justifications for RPMs and T&Cs

RPM 4 and the accompanying Terms and Conditions highlight the importance of monitoring scallop fishery activities to predict what impacts future changes could have. With many different factors impacting the fishery, effort and areas fished can fluctuate over the course of a few years. NMFS must track vessel strikes and bycatch of ESA-listed species in the scallop fishery in order to identify potential impacts and make adjustments to management, as necessary.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
<u>RPM 5: MONITORING 2</u>: • NMFS must continue efforts to investigate and understand the mortality of observed sea turtles interacting with dredge and bottom trawl gear in the scallop fishery.	• NMFS must continue to annually evaluate observed takes of sea turtles using the post-interaction mortality criteria for these species. NMFS has defined criteria for estimating sea turtle post-interaction mortality in various gear types using available scientific studies in conjunction with veterinary and other expert opinion, primarily based on animal behavior and the presence and severity of injuries. NMFS will continue to apply these criteria to data collected by observers onboard commercial fishing vessels using scallop dredge and bottom trawl gear.	RPM 5 and the accompanying Term and Condition specify the need for close monitoring of post-interaction mortality rates for observed sea turtles interacting with scallop dredge and bottom trawl gear. Using post-interaction mortality criteria created by experts in the field, NMFS can use the best available data annually to detect trends in these interactions, estimated mortality rates, and if there are potential modifications that can be made to gears used in the fishery or the handling and release protocols for sea turtles.
<u>RPM 6: OUTREACH</u>: • NMFS must continue to engage in outreach efforts with commercial fishermen regarding vessel strikes of ESA-listed species as well as the proper installation and use of chain mats and TDDs on their scallop dredges and the proper reporting of the gear code on commercial fishing logs.	• NMFS must continue to conduct outreach to scallop fishermen on reducing risks to protected species due to incidental bycatch and vessel strikes. • NMFS must distribute information to scallop permit holders specifying the chain mat and TDD regulations and be prepared to provide them assistance to resolve issues that may cause chain mats or any components of the TDD to be rigged improperly or malfunction. • NMFS must continue to conduct outreach to scallop fishermen encouraging them to record the appropriate gear code on VTR fishing logs which reflects the specific type of dredge they are using ('DRS' for a standard dredge with no chain mats, 'DSC' for a standard dredge with chain mats, 'DTS' for a deflector dredge with no chain mats, and 'DTC' for a deflector dredge with chain mats).	RPM 6 and the accompanying Terms and Conditions are necessary and appropriate because they allow us to ensure that modified gear requirements and vessel speed guidelines are being followed by the fishing industry so that the quantity and/or severity of sea turtle takes can be minimized to the extent possible. Any outreach activities will be done in a manner that minimizes any increase in costs or any decrease in efficiency of the scallop fishery, representing only a minor change to the action. Accurate recording of the different dredge gear codes by scallop fishermen will help improve the NEFSC's sea turtle bycatch estimation process.
<u>RPM 7: POPULATION ASSESSMENTS</u> • NMFS must continue efforts to develop population evaluation assessment tools.	• NMFS must continue to support the development of the NEFSC's updated loggerhead PVA and other population assessment tools.	RPM 7 and the accompanying Term and Condition specify the need for supporting the development of tools needed to assess and monitor the impact of the scallop and other fisheries on ESA-listed species populations.

11.3 Monitoring Protocols

Sea Turtle Monitoring

NMFS must continue to monitor levels of sea turtle interactions in the scallop fishery. Fisheries observer data, and their incorporation into statistical models (e.g., generalized additive models as used in Murray [2011, 2015a, 2015b] and Warden [2011] and stratified ratio estimator models as used in Murray [2020a, 2020b]) are being used as the principal means to estimate sea turtle bycatch rates in the scallop fishery and to monitor incidental take levels. At present, and due to reasons explained below, the NEFSC produces statistically robust sea turtle bycatch estimates for scallop dredge and bottom trawl gear on five-year rotational cycles. NMFS must continue to use fisheries observer data and the NEFSC-produced bycatch estimates to monitor sea turtle bycatch in scallop dredge and bottom trawl gear that is authorized by the Scallop FMP, though the role of observers and use of fishery dependent data will differ for each gear type.

For the purposes of monitoring this ITS for the dredge and bottom trawl components of the fishery, we will continue to rely upon records from the NEFOP and IFS programs as the primary means of collecting incidental take information. For loggerhead sea turtles in dredge gear and all four sea turtles in bottom trawl gear, the take estimates described in this Opinion were generated using a statistical model that is not feasible to conduct on an annual basis due to the data needs; length of time to develop, review, and finalize the estimates; and methodology, as explained below.

In its discussion of sea turtle bycatch estimation, Murray (2009) explains that "to directly compare future levels of loggerhead bycatch to the average annual estimates and [95%] confidence intervals [CIs] reported in this paper, these future estimates would also need to be 5-year averages." This necessity is reiterated in the Warden (2011) trawl bycatch analysis for loggerhead sea turtles, which states that "if these interaction estimates are updated approximately every five years, then future levels of loggerhead interactions can be evaluated by comparing the average annual estimates and CIs reported in this paper to the future average annual estimates and CIs." Therefore, for the following reasons, we will implement a five-year monitoring framework for loggerhead sea turtles in scallop dredge gear and all four sea turtle species in bottom trawl gear rather than producing and monitoring an annual estimate:

- As we mentioned throughout the Opinion, observed sea turtle interactions are rare, and we often need to pool data across years to have enough data to produce a robust estimate of total interactions.
- Annual estimates are unlikely to change considerably such that they affect the population assessments. When the population is large compared to the incidental take and mortality levels, frequent (e.g., annual) monitoring is not likely to produce results that are substantially different from the previous assessment. Less frequent but more comprehensive assessments, which explicitly address uncertainty, may provide more reliable information (Warden et al. 2015).

Although we review raw data on the number of observed sea turtle takes in the scallop dredge and bottom trawl fisheries as they are documented and verified (usually on a time lag of at least three months per the NEFOP's data quality control and assurance procedures), we cannot produce reliable short-term take estimates using them, because observed sea turtle takes are rare events dependent on a wide range of human and natural factors that vary greatly over short time periods (i.e., less than a year). Examples of human factors include variation in the number of vessels fishing, time spent fishing, percent observer coverage, regulatory regimes, market forces, etc. Natural factors include changes in oceanographic conditions such as water temperature, distribution of prey, weather conditions, shifting distributions and abundance of sea turtles, etc. Typically, the number of takes observed in a short time period (i.e., one year), when considered with the factors identified above, means that the observed takes cannot be extrapolated to estimate the total number of takes with good precision. Nor do the raw data provide a large enough sample size to identify any exceedances of the incidental take level. In the scallop dredge fishery in particular, there are often zero (0) observed takes in a given year, likely due to the fact that chain mats and TDDs are designed to prevent most sea turtles from becoming entrained and interactions that occur are not observable (i.e., they occur underwater). Therefore, there is little information to estimate the total number of takes within a short time frame.

For all of the foregoing reasons, we will rely on the statistical methods in Murray (2020a, 2020b) and Linden (2020), which we have determined represent the best available scientific and commercial data for sea turtle bycatch estimation, to re-estimate takes of loggerheads in the scallop dredge fishery and takes of all four species in the scallop bottom trawl fishery assessed in this Opinion approximately every five years.

The NEFSC has committed to producing its next five-year trawl bycatch estimate in 2025 and its next five-year dredge bycatch estimate in 2026. With respect to leatherback, Kemp's ridley, and green sea turtle interactions in the scallop dredge fishery, we do not have nor have we been able to produce five-year bycatch estimates due to the small sample size of observed captures to this point. Thus, the occasional NEFOP reports of observed takes are the best available scientific information, and reviewing the raw numbers of observed takes over a rolling five year period is the best available method for monitoring the incidental take level of these species in dredge gear at this time. Thus, we will continue to rely on such data for monitoring takes of these three species in scallop dredges, and using additional information, we have attempted to quantify and assess the anticipated number of interactions (not just observable captures) likely to occur between these species and scallop dredge gear over a five-year period in the effects and jeopardy analyses.

To address the Court's concerns in its latest remand order, we have removed the dredge effort proxy from our ITS and monitoring scheme and will dedicate future monitoring efforts to five-year bycatch estimation methods, which estimate the total number of observable and unobserved/quantifiable (i.e., inferred) interactions. We have determined that these methods represent the best available science to monitor sea turtle takes in the scallop dredge fishery for the following reasons. First, by using the five-year bycatch estimates we are directly measuring take rather than using a proxy. Since the five-year bycatch estimation methodology utilizes observed sea turtle interactions to predict total interactions, it avoids having to rely on a proxy (dredge effort) to determine whether anticipated takes have been exceeded. This approach, therefore, avoids any assumptions or misinterpretations that there is a linear relationship between dredge effort and total estimated interactions, which was a point of contention and confusion with the dredge effort surrogate for a number of years. Finally, with each additional year we will have more years of available data to assess and incorporate into the model and this increase in data will continue to improve the model's ability to predict interactions.

In summary, the 2020 version of the bycatch estimation model for scallop dredge gear has greater predictive certainty than prior versions of the model, and that is largely due to: (1) the extended time period of data available to estimate sea turtle interaction rates in the fishery and (2) the use of stratified ratio estimators, which have the advantage of being computationally simple with general application to many other types of sampling designs (Murray 2020a). As a result of this increased predictive certainty, we have determined that this model represents the best available science for monitoring scallop fishery impacts on loggerhead sea turtles.

In the event a future five-year scallop dredge or bottom trawl estimate indicates that the amount of interactions or mortalities over that period has exceeded the estimate from the Murray (2020a, 2020b) and Linden (2020) analyses, consultation will be reinitiated immediately. Similarly, if the number of NEFOP reported takes for Kemp's ridley, leatherback, or green sea turtles in scallop dredge gear exceeds the ITS over any future rolling five-year period, consultation will be reinitiated immediately. [14]

Atlantic Sturgeon Monitoring

For the purposes of monitoring this ITS for the five DPSs of Atlantic sturgeon, we will continue to use fisheries observers from the NEFOP and IFS programs as the primary means of collecting incidental take information in the scallop dredge and bottom trawl fisheries. We will track incidental takes attributable to the scallop fishery over a rolling five-year period as part of our omnibus data reviews with the NEFSC as we are doing for Kemp's ridley, leatherback, and green sea turtles in dredge gear. As the anticipated take of Atlantic sturgeon is rare and based on information to be collected and reviewed over a several year period, we will quantify and assess incidental takes in the scallop fishery over a rolling five-year period unless the incidental take level or number of lethal takes anticipated is reached before the next five-year period ends. In the event that occurs, consultation will be reinitiated immediately. We will also use other available information (e.g., changes in fishing effort, changes in species distribution and behavior, etc.) to monitor scallop fishery impacts on Atlantic sturgeon going forward.

[14] Even though we are exempting up to 23 unobservable takes of Kemp's ridleys over a five-year period (for a total of 28), we will reinitiate consultation if the number of observed takes exceeds five over a five-year period, or if the next NEFSC bycatch estimate for dredge gear is able to produce an estimate for Kemp's ridleys which exceeds 28 over five years. In other words, if the ITS for observed Kemp's ridley takes is exceeded over a five-year period, we will assume that the level of unobserved takes for that period has been exceeded as well.

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 ESA-listed species or critical habitat, to help implement recovery plans, or to develop information. The following additional measures are recommended regarding incidental take and ESA-listed species conservation:

1. NMFS should develop guidance for fishing practices that minimize bycatch of Atlantic sturgeon, including handling and release procedures using different gears, and produce education and outreach materials about safe handling and release.

2. NMFS should also review its policies and protocols for the processing of genetic samples to determine what can be done to improve the efficiency and speed for obtaining results of genetic samples taken from all incidentally taken sea turtles and Atlantic sturgeon.

3. NMFS should work with states to minimize take and its impacts in state permitted activities and encourage the states to seek authorization for incidental take that is otherwise unavoidable.

4. NMFS should continue to create education and outreach materials to communicate conservation messages for ESA-listed species through social media, websites, magazines, and print to federal agencies, local communities, and non-governmental organizations.

5. NMFS should explore the methods and feasibility for authorizing fishermen to tag incidentally-captured Atlantic sturgeon with a Passive Integrated Transponder (PIT) tag.

6. NMFS should explore how to provide PIT tag readers to fishermen when and where their fishing efforts overlap with expected sturgeon aggregations areas.

7. NMFS should continue to work with the NEFMC to assess trends in the fishery in relation to effort distribution by time and area; landings by port, permit, and gear type; scallop biomass and recruitment amongst Mid-Atlantic and Georges Bank access areas; and stock assessment/bycatch reduction priorities. All of these factors likely influence when and where most scallop fishermen fish and in turn how susceptible sea turtles and Atlantic sturgeon will be to interactions.

8. NMFS should further investigate the applicability and potential utility of electronic monitoring in the scallop and other fisheries in the action area where interactions of rarely bycaught species are anticipated. Information on scallop fishing effort and listed

species' presence may allow for discrete management efforts that could further reduce the effects of these fisheries on those species and further recovery efforts.

13.0 REINITIATING CONSULTATION

This concludes formal consultation on the authorization of the Atlantic sea scallop fishery under the Scallop FMP. 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 exempted in this Opinion 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 exempted in this Opinion is exceeded, NMFS GARFO must immediately request reinitiation of formal consultation.

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APPENDIX A

Recent Murray (2020a, 2020b) bycatch estimate papers and Linden (2020) apportionment

Estimated loggerhead (*Caretta caretta*) interactions in the Mid-Atlantic scallop dredge fishery, 2015-2019

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Abstract

This paper reports total loggerhead (*Caretta caretta*) turtle interactions, adult equivalent interactions, and mortality in the Atlantic sea scallop (*Placopecten magellanicus*) fishery from 2015-2019 using data collected by the Northeast Fisheries Observer Program. Most vessels fishing with dredges in the Atlantic sea scallop fishery are required to use chain mats and turtle deflector dredges (TDDs) when fishing west of 71°W from May 1 – November 30. These gear modifications are designed to exclude turtles from being captured in the dredge bag or cutting bar frame, rendering many interactions to be "unobservable". From 2015-2019, only 4 loggerhead interactions were observed in scallop dredge gear when an observer was on-watch. To estimate loggerhead interaction rates in the fishery, observer data from 2015-2019 were pooled with data from 2001-2014. Rates from the pooled time period were then applied to Vessel Trip Report (VTR) fishing effort from 2015-2019 to estimate observable and unobservable yet quantifiable interactions. Interaction rates were estimated with a ratio estimator, where rates were stratified by Ecological Production Unit, season, and whether dredges were 'modified' (having a chain mat and/or a TDD) or 'standard' (no chain mat or TDD). The average annual observable turtle interactions in the Mid-Atlantic scallop dredge fishery, plus unobserved, quantifiable interactions, from 2015-2019 was 155 loggerheads per year (CV = 0.27, 95% CI: 99-219), of which 53 were lethal. The 155 interactions equates to 31 adult equivalents per year and 11 adult equivalent mortalities.

Introduction

The United States (US) Mid-Atlantic region is important foraging habitat for the Northwest Atlantic distinct population segment of loggerhead sea turtle (*Caretta caretta*) in summer months (Griffin et al. 2013, Patel et al. 2016, Winton et al. 2018). This region is also prime habitat for Atlantic sea scallops (*Placopecten magellanicus*), and interactions between scallop dredge fishing activity and loggerhead turtles, and occasionally Kemp's ridley turtles

(*Lepidochelys kempii*), have been documented for several years (Murray 2011, 2015). All sea turtles in the United States are protected under the Endangered Species Act (ESA), so any interaction between a sea turtle and commercial fishing gear is considered a "take" under the Act, defined as, "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA, 1973).

To help minimize the impact of fishery interactions on sea turtles in the Atlantic scallop dredge fishery, modifications to dredge gear are required in certain times and areas. Chain mats and Turtle Deflector Dredges (TDDs) must be used when fishing for scallops in waters west of 71° W longitude, from the shoreline to the outer boundary of the Exclusive Economic Zone, from May 1 through November 30 (80 FR 22119, April 21, 2015). A properly configured chain mat consists of a grid of horizontal and vertical chains connected together in a specific form to prevent turtles from entering the dredge bag (50 CFR § 223.206), while the TDD consists of specific modifications to the dredge frame (77 FR 20728 April 6, 2012) to allow turtles to go up and over the dredge frame rather than be caught underneath it. Together, the use of chain mats and TDDs increase the conservation benefit to turtles, because chain mats help reduce the impact to turtles from water column interactions, while the TDD helps reduce the impact to turtles from benthic interactions.

The chain mat requirements apply to any vessel with a sea scallop dredge and required to have a federal Atlantic sea scallop fishery permit; the TDD requirements apply to any limited access scallop vessel using a dredge, regardless of dredge size or vessel permit category, or any limited access Individual Fishing Quota scallop vessel fishing with a dredge width of 10.5 ft (3.2

m) or greater. Chain mats have been required in the fishery since 25 September 2006; TDDs have been required since 1 May 2013. Since the implementation of the chain mat and TDD regulations, the number of observed turtles captured in scallop dredge gear has decreased (Murray 2015).

While the chain mat and TDD are expected to reduce impacts to turtles, they do not eliminate takes because subsurface interactions with the gear could still be occurring. Turtles could come in contact with the gear but are not brought to the surface where they can be observed, as a result of the gear modifications. Some of these "unobservable" interactions can be quantified (Warden and Murray 2011), and in this paper these unobservable and quantifiable interactions are called "inferred" interactions.

To help assess the impact of scallop dredge fishing activity on turtle populations, information is needed on the anticipated magnitude of sea turtle interactions in commercial dredge fishing gear. This analysis estimates the total number of loggerhead interactions (observable and inferred) and mortalities which occurred in the Atlantic scallop dredge fishery from 2015 to 2019. Estimated interactions and mortalities are also expressed in terms of adult-equivalent losses. Adult equivalency translates the loss of individual turtles into the number of adults expected based on chances of the individual surviving to adulthood and reproducing. Compared to individual losses, monitoring adult-equivalent losses from fisheries interactions can be a more informative metric to assess population-level impacts (Haas 2010; Warden et al. 2015).

Methods

The extent of the study region was defined by the boundaries of the Mid-Atlantic Ecological Production Unit (EPU), characterized by distinct patterns in oceanographic properties, fish distributions, and primary production (Ecosystems Assessment Report 2012) (Figure 1). Within the Mid-Atlantic, loggerhead interaction rates were further stratified by season (May-December) and whether dredges were equipped with a chain mat and/or TDD ('modified' dredge) or without a chain mat and/or TDD ('standard' dredge). Dredges with chain mats have a different observed interaction rate compared to standard dredges (Murray 2011). They were grouped with dredges that have a TDD because there is no information on interaction rates with dredges that only have TDDs (Murray 2015), and most observed hauls with modified dredges in the Mid-Atlantic EPU had both a chain mat and a TDD (80%). Only 4 loggerhead interactions were observed from 2015 – 2019, so observer data from 2001 – 2014 were pooled with data collected from 2015 – 2019 to derive sea turtle interaction rates. Interaction rates were not estimated for Kemp's ridley turtles, because there were only 2 Kemp's ridley turtles observed in the Mid-Atlantic (and 1 on Georges Bank) in the entire pooled time series. Loggerhead interaction rates were applied to commercial dredge fishing effort from 2015-2019, to estimate the total number of loggerhead interactions from 2015-2019.

Data Sources

Observer Data

From May – December, 2015-2019, Northeast Fisheries Science Center observers aboard commercial scallop dredge vessels observed 67,402 fishing hours in the Mid-Atlantic, which was roughly 6% of total dredge fishing effort (Table 1). “Fishing hour” was the total amount of hours a dredge was in the water. Dredge fishing hours per haul were calculated from observer data as:

Dredge fishing hours per haul = number of dredges * average haul duration

Observable interaction rates were estimated based on turtles reported via standard Northeast Fisheries Observer Program (NEFOP) sampling protocols when an observer was “on-watch,” i.e., systematically collecting data on the haul characteristics, the catch, and details of any protected species interaction. Observable interaction rates were based on turtles either captured in or on the dredge gear, or observed interacting with the gear. Observers may collect data opportunistically when they are “off-watch,” but these data are not used in the calculation of interaction rates because it is not known what fraction of off-watch interactions are reported.

Commercial Data

Mandatory Vessel Trip Reports (VTRs) completed by commercial scallop fishermen from 2015 to 2019 provided a measure of total fishing effort. Effort from VTRs was considered to be a census of scallop dredge fishing activity because VTR reporting is mandatory in the fishery and also enforced via Vessel Monitoring Systems. Dredge fishing hours per trip (*t*) were calculated from VTRs as:

$$Dredge\ hrs_t = No.of\ dredges_t\ x\ Avg\ haul\ duration\ x\ no.of\ hauls_t$$

Trips were coded for chain mat or TDD usage based on scallop fishery regulations rather than the required VTR gear code (‘DSC’ for chain mats and ‘DTC’ or ‘DTS’ for TDDs) because an examination of VTRs with matching observer reports revealed that some trips with modified dredges were still using the standard dredge code ('DRS'). Therefore, this analysis assumed 100% compliance with the chain mat and TDD regulations. Chain mats are required on all scallop dredge vessels fishing west of 71°W during 1 May to 30 November; TDDs are required on all scallop dredge vessels fishing with a limited access (LA) permit fishing west of 71°W during 1 May to 30 November, as well as vessels fishing limited access general category (LAGC) permit fishing in this area and time with a dredge width greater than 10.5ft. Because VTRs do not record permit type, the amount of landed scallops was used as a proxy for permit type. Vessels fishing with a LAGC permit are limited to catching 600 lbs scallops plus observer compensation (see Amendment 15 to the Scallop Fishery Management Plan), which has varied over the years from 150-400 lbs/trip. Therefore, all dredge trips were coded as using a chain mat if they fished west of 71°W during 1 May to 30 November; additionally, vessels were coded as having both a chain mat and TDD if they fished in this time and area and captured >1000 lbs scallop meat (LA vessels), or captured <=1000 lbs scallop meat (LAGC vessels) and fished a dredge greater than 10.5ft. Based on these criteria, 70% of trips fishing in the Mid-Atlantic used modified dredges, vs 27% had the criteria been based on VTR gear codes.

<u>Loggerhead Interaction Rates</u>

Rates were stratified based on fishing practices found to be historically correlated with loggerhead interaction rates and scallop dredge gear (use of a chain mat or TDD) (Murray 2011, 2015) and the seasonal occurrence of loggerheads in the Mid-Atlantic (May to December) (Winton et al. 2018). Within the May – December period, rates were stratified into whether vessels used standard dredges (no turtle chain mat or TDD) or modified dredges (turtle chain mat and/or TDD). Because some form of modified dredge has been required from May – November in the Mid-Atlantic dredge fishery since 2006, the interaction rate for standard dredges is mostly informed by conditions in the earlier part of the 2001-2019 time series.

Within each stratum (*j*), observable interaction rates (*R*) were defined as:

$$\boldsymbol{R_j = \sum \frac{observed\ turtles_j}{observed\ dredge\ hours_j}}$$

where n = the number of observed NEFOP hauls

Bootstrap resampling was used to estimate uncertainty (coefficient of variation [CV] and confidence intervals [CIs]) around interaction rates within each stratum, with trips as the resampling unit (Orphanides and Hatch 2017). Bootstrap replicates were generated by resampling trips with replacement 1000 times from the original observer dataset, and then bycatch rates within each stratum were computed for each replicate. The 95% CI for the bycatch rates were computed from the upper 97.5% and lower 2.5% quartiles of the bootstrap replicates. To combine the modified (*m*) and standard (*s*) dredge CVs, an overall CV was calculated as:

$$\text{Overall CV} = \sqrt{\frac{CV_m^2 + CV_s^2}{2}}$$

Total Interactions

Observable interaction rates within each stratum were applied to VTR trip effort to estimate total observable loggerhead interactions. Inferred interactions were estimated by applying the interaction rate in standard dredges to dredges with chain mats and TDDs (Murray 2011, 2015). This assumes that interactions between turtles and dredges in times and areas where they overlap continue to occur below the surface at the same rate as when chain mats and TDDs were not required, but these modifications prevented the turtles from being captured and subsequently seen by an observer. Total interactions were the sum of observable and inferred interactions.

Mortality Rates

Different mortality rates were applied to the total estimated observable and inferred interactions. A 66% mortality rate was applied to estimated observable interactions, per evaluations by the Serious Injury Working Group (methods in Upite et al. 2018) for data from 2006-2019. This time series of evaluations is the longest currently available. A 28% mortality rate was applied to inferred interactions, based on experimental trials (Smolowitz et al. 2010) and the latest Sea Scallop Biological Opinion (NMFS, 2012).

Adult Equivalency

Adult equivalent loggerhead interactions were estimated based on the methods in Murray (2011, 2015). Observed loggerheads from 2001-2019 were grouped into size classes based on 6 loggerhead life stages (TEWG 2009), and RVs were assigned to each respective stage class based on Wallace et al. (2008). These stage classes (sizes, RV values) were as follows: Stage 1 (<=16.2 cm CCL , 0.002); Stage II (>16.21 – 60.45 cm CCL, 0.008); Stage III (>60.45 cm – 75.72 cm CCL, 0.040); Stage IVa (>75.72 – 88.61 cm CCL , 0.124); Stage IVb (>88.61 – 101.5 cm CCL, 0.547); and Stage V (>101.5 cm CCL, 1.0).

The number of estimated adult equivalent (AEI) loggerhead interactions over all 6 life stages and all 5 years (2015-2019) was calculated as:

$$AEI = \sum_{j=1}^{5} \sum_{i=1}^{6} T_j * P_i * RV_i$$

where: T = total estimated loggerhead interactions in dredge gear in year *j*

P = the proportion of loggerheads observed in life stage *i,* based on all turtles observed from 2001-2019

RV_i = the reproductive value for life stage *i*.

Adult equivalent mortality (AEM) was computed using the same mortality rates as those for estimated interactions.

Results

<u>Observed Loggerhead Interactions</u>

From 2015-2019, observers recorded 4 loggerhead interactions in scallop dredge gear (Table 2, Figure 1). Three additional loggerheads and an unidentified species were observed but were removed from the analysis because these interactions could either not be attributed to the dredge fishing event, or the interaction occurred while the observer was off-watch. With the exception of 1 loggerhead that was captured in a standard dredge, the turtles were captured in dredges with a chain mat or TDD, and found inside the chain bag. Some of the chain mat gear configurations were not properly configured and may have contributed to the turtles being captured (Table 3). Two Kemp's ridley turtles were also observed, and were captured in modified gear. All turtles were observed in the Mid-Atlantic region, from July to December.

<u>Loggerhead Interaction Rates</u>

Loggerhead interactions in scallop dredge gear have not been observed outside of the Mid-Atlantic nor from January to April, so interaction rates are only reported here for 2 different dredge types within the Mid-Atlantic from May to December (Table 3). In the expanded sampling frame from 2001-2019, 45 turtles were observed in standard dredges over 74,187 hours, for a rate of 0.0006 (CV=0.18) turtles per fishing hour. In dredges equipped with a chain mat or TDD, 10 turtles were observed over 161,090 hours, for a rate of 0.00006 (CV=0.33) turtles per fishing hour. Therefore, the observable interaction rate in modified dredges was roughly 1/10th the interaction rate in standard dredges.

<u>Total Interactions, Adult Equivalency, and Mortality</u>

From 2015-2019, the average number of total observable and inferred interactions was 155 turtles/year (CV = 0.27, 95% CI: 99-219), of which 53 were estimated to result in mortality (Table 4). The total number of interactions is equivalent to 31 adults, and 11 adult mortalities.

Discussion

The expanded sampling frame in this analysis increased the sample size of loggerhead turtle interaction events amongst standard and modified dredges, such that interaction rates could be computed between the two different designs. In the last analysis of loggerhead interactions in dredge gear from 2009-2014 (Murray 2015), there was only 1 take after 2009 and no observed takes of turtles in dredges with TDDs. Despite pooling data with observer data back to 2001 in the last analysis, interaction rates were still poorly estimated because there were very little data to estimate differences in interaction rates after 2009. As a result there was high uncertainty around estimated bycatch, and annual CVs were close to or exceeded 1.0 in some cases (Murray 2015).

The average annual amount of estimated loggerhead interactions from 2009-2014 was 22 loggerheads, versus 155 from 2015-2019. The estimated number of interactions in 2015-2019 is higher than in 2009-2014 for a number of reasons. In this analysis, rates are computed without respect to year over a 19 year time period; in the 2009-2014 analysis, year was included as a variable in the interaction rate model to help account for changes in dredge types used in the Mid-Atlantic after 2008. As a result, this current analysis borrows information from the earlier part of the time series (2001-2008) to inform the interaction rate in standard style dredges. This rate was used to compute the number of “inferred” interactions, so there are a larger number of inferred interactions than estimated from 2009-2014. Pooling data across years improves (lowers) the CV around the interaction rates because there are more takes to estimate the rates; however, it assumes that the interaction rates between loggerheads and scallop dredge gear are constant across years. Observer coverage has been steady (~3-6%) since 2001, and there is no evidence to suggest that loggerhead abundance has changed in the Mid-Atlantic since 2001 (Ceriani et al. 2019). However, the density of loggerheads may change from year to year on the Mid-Atlantic foraging grounds (Ceriani et al. 2017), which could cause inter-annual variation in observed bycatch rates.

Estimated interactions may be also be higher because there was more fishing effort on average in the Mid-Atlantic compared to 2009-2014. There was roughly 50,000 more dredge hours fished on average in the Mid-Atlantic region[1] from May – December during 2015-2019 compared to 2009-2014. In particular, dredge fishing effort in 2016 was the highest since 2009, as a result of annual fishing specifications that pushed effort into the Mid-Atlantic, among other factors.

Estimated interactions could be higher in 2015-2019 compared to 2009-2014 because the boundaries of the 'Mid-Atlantic' were slightly enlarged in this analysis. I chose the new boundary so that the study region was defined by ecological properties rather than regulatory lines (i.e. turtle chain mat rule), and is consistent across other analyses of gear types (i.e. gillnets, bottom trawls) interacting with loggerheads in the region (Murray 2020, 2018). However, the change in the geographic region did not increase the number of interactions in a significant way because there was not much more fishing effort in the enlarged boundary; had the previous

[1] As defined by the boundaries of the 2009-2014 analysis, which was west of 71°W and south of 42°N

bounds of the Mid-Atlantic been used (i.e. west of 71°W and south of 42°N), the number of estimated interactions in 2015-2019 would have changed by 3 animals.

Lastly, estimated interactions may have changed as a result of the method used to estimate interaction rates. A stratified ratio estimator was used in this analysis to compute observed interaction rates, whereas in previous years a generalized additive model (GAM) was used to estimate rates as a function of gear and environmental covariates (Murray 2011, 2015). Ratio estimators have the advantage of being computationally simple with general application to many sampling designs (Cochran 1977) and can yield results similar to those using GAMs or generalized linear models (GLM) if ratio estimators are stratified based on the same explanatory variables in a GAM or GLM model (Murray 2007, 2013; Orphanides 2009). To validate this, both a GLM and a GAM were also used to estimate interaction rates in this analysis. The GLM, which specified loggerhead interaction rates in the Mid-Atlantic from May to December as a function of gear modifications, yielded the same results as the ratio estimator. The GAM specified loggerhead interaction rates as a function of SST, depth, and gear modifications, the same model used in (Murray 2011). The GAM resulted in an average annual increase in the total number of estimated loggerheads from 2015 to 2019 by 30 animals, and was within the 95% confidence limits of the number of interactions predicted by the ratio estimator. Therefore, the reasons explained above likely influenced the estimated number of interactions from 2015 to 2019 compared to 2009 to 2014, rather than the choice to use a ratio estimator.

Observable interactions remain low in the scallop dredge fishery (25 on average from 2015-2019) because the chain mat and deflector dredge reduce the likelihood that turtles are captured and brought on board. While subsurface interactions are estimated to still be occurring, the impact to turtles is reduced because the mortality rate of modified dredges (28%) is estimated to be lower than the observable mortality rate (66%). The average annual mortality of loggerheads from 2015 to 2019 was 54, but would have been almost double that (107) without dredge modifications.

Continued outreach is needed to encourage fishers to record the appropriate gear code on VTR fishing logs which reflects the type of dredge they are using. This analysis labelled VTR trips as using a form of modified gear based on regulatory requirements and assumptions of 100% compliance, rather than using the prescribed gear codes which appeared to be underutilized. As a result, significantly more effort was labelled to have 'modified' versus 'standard' dredge gear which in turn influenced the total number of estimated interactions. Accurate recording of the different dredge gear codes ('DSC' for chain mats, 'DTS' for deflector dredges, or 'DTC' for both chain mat and deflector dredges) will help improve the estimation process.

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Table 1. Mid-Atlantic scallop dredge Vessel Trip Report (VTR) fishing effort & observer sampling, 2015-2019. Cc = Loggerhead (*Caretta caretta*); Lk = Kemp's ridley (*Lepidochelys kempii*)

Year	Observed Dredge Hours (full year)	Observed Dredge Hours (May-Dec)	VTR Dredge Hours (full year)	VTR Dredge Hours (May-Dec)	% Observer Coverage (May-Dec) (Dredge Hours)	Number of Observed Turtle Interactions
2015	17,421	12,262	281,395	213,355	5.7%	1 Cc; 1 Lk
2016	31,394	24,987	477,853	418,013	6.0%	0 Cc; 1 Lk
2017	23,579	15,696	383,875	271,725	5.8%	0 Cc; 0 Lk
2018	12,300	6,665	216,588	131,864	5.0%	2 Cc; 0 Lk
2019	9,741	7,792	173,967	133,300	5.8%	1 Cc; 0 Lk
Total	**94,435**	**67,402**	**1,533,678**	**1,168,257**	**5.8%**	**4 Cc; 2 Lk**

Table 2. Turtle Interactions in Scallop Dredge Gear 2015-2019. Animals listed in the shaded cells were removed from the bycatch rate analysis because takes could either not be attributed to the fishery or occurred during an off-watch haul. Lk = Kemp's ridley (*Lepidochelys kempii*); Cc = Loggerhead (*Caretta caretta*)

Species	Year	Month	Modified dredge (Y/N)	Entanglement Situation	Animal Condition	Curved carapace length (cm)/Width	Observer Notes
Lk	2015	10	Y	Turtle caught inside dredge chain bag	Alive	29.0/NA	
Cc	2015	12	Y	Turtle caught inside dredge chain bag	Alive	70.0/69.0	"Chain mat configuration was neither standard nor turtle chains"
Lk	2016	11	Y	Turtle caught inside dredge chain bag	Alive	33.0/32.0	
Cc	2018	08	N	Turtle caught inside dredge bag	Alive	88.0/83.5	
Cc	2018	10	Y	Turtle caught inside dredge chain bag	Alive	89.0/NA	Turtle chain shackles detached. "TDD dredge with chains connecting center bale bar to frame"
Cc	2019	07	Y	Turtle caught inside dredge chain bag	Alive	139.5/99.1	
Cc	2016	07	Y	Entangled in different fishing gear	Moderately decomposed		Turtle entangled in gillnet
Cc	2016	08	Y	Turtle caught inside dredge chain bag	Severely decomposed		"5th rock chain detached at 1st tickler, and 6th rock chain at sweep were detached which was probably why dredge caught dead turtle"
Cc	2017	08	Y	Turtle caught inside dredge chain bag	Alive		Event occurred during an off-watch haul
Unk	2017	09	Y	Entangled in different fishing gear	Dead – state of decomposition unknown		Captain reported turtle wrapped in gillnet gear

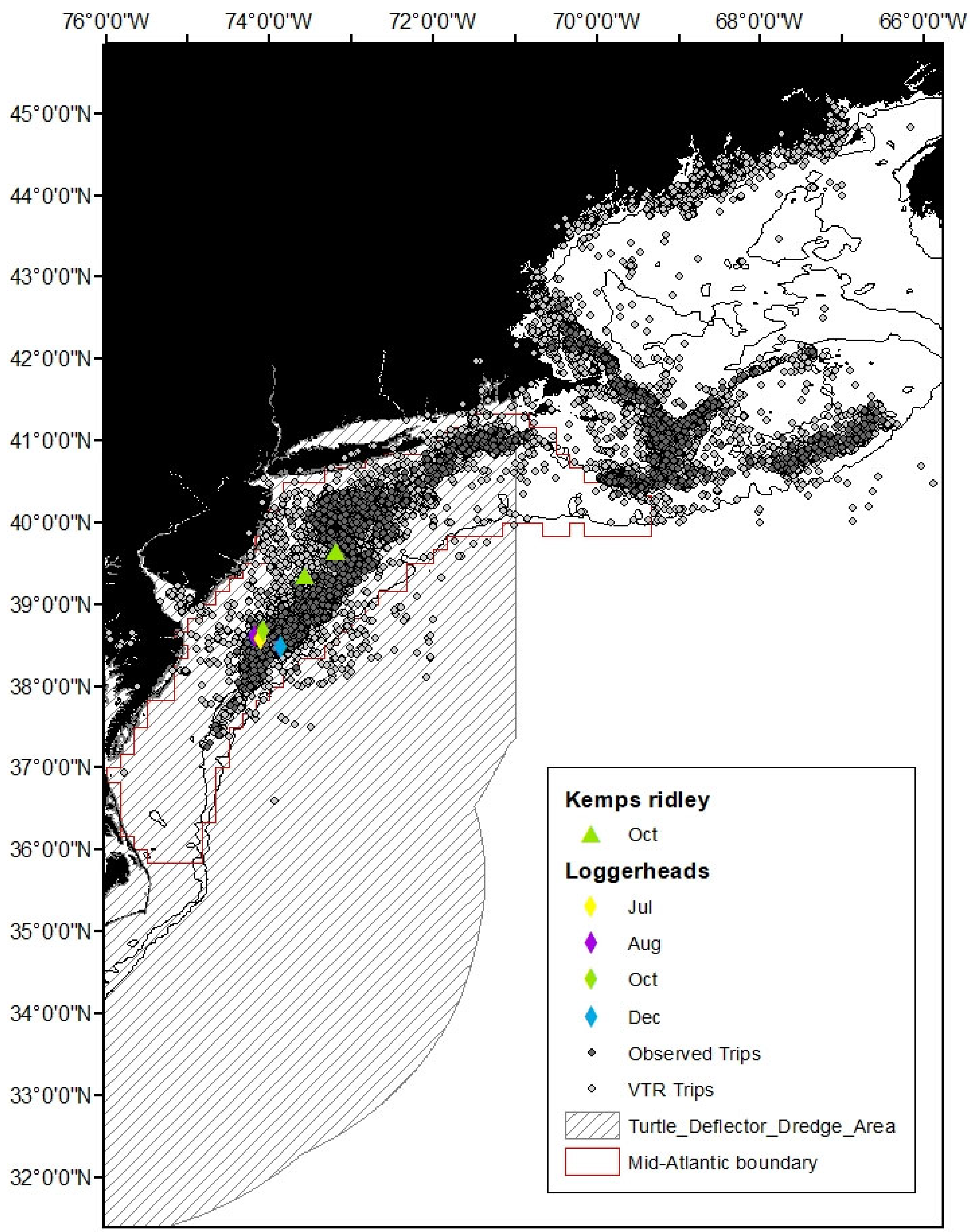
Table 3. Expanded sampling frame to derive observable interaction rates in the Mid-Atlantic from May – December, 2001-2019. A modified dredge means a dredge that is equipped with a chain mat and/or turtle deflector dredge. CV = Coefficient of variation

	Standard dredge	**Modified dredge**
Observed dredge hours	74,187	161,090
Number of loggerhead interactions	45	10
Interaction rate (turtles/dredge hour)	0.00060658	0.00006208
CV around Interaction rate	0.18	0.33

Table 4. Estimated loggerhead interactions each year in the Mid-Atlantic scallop dredge fishery from May – December, based on observed rates in the fishery from 2001-2019. CI = Confidence Interval; AEI = Adult Equivalent Interactions; AEM = Adult Equivalent Mortality

Year	**Observable interactions (95% CI)**	**Inferred interactions (95% CI)**	**Total interactions (95% CI)**	**Total mortality**	**AEI**	**AEM**
2015	22 (11-34)	120 (79-167)	142 (90-201)	48	28	10
2016	43 (22-67)	235 (154-326)	278 (177-393)	94	55	19
2017	25 (12-39)	156 (103-217)	181 (115-256)	60	36	12
2018	17 (10-26)	70 (46-97)	87 (56-123)	31	17	6
2019	21 (12-31)	67 (44-93)	88 (56-124)	32	17	6
Average annual interactions	**25 (13-39)**	**130 (85-180)**	**155 (99-219)**	**53**	**31**	**11**

Figure 1. Observed and Vessel Trip Report (VTR) scallop dredge trips from 2015-2019, including observed turtle interactions. Boundaries of the Mid-Atlantic Ecological Production Unit and the turtle chain mat and turtle deflector dredge requirements are shown.



NOAA Technical Memorandum NMFS-NE-260

Estimated Magnitude of Sea Turtle Interactions and Mortality in US Bottom Trawl Gear, 2014-2018

US DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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Estimated Magnitude of Sea Turtle Interactions and Mortality in US Bottom Trawl Gear, 2014-2018

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ABSTRACT

This paper reports total estimated interactions and mortalities of loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) sea turtles in bottom otter trawl gear operating in the US Mid-Atlantic and Georges Bank regions from 2014-2018. Interaction rates for each turtle species were estimated with stratified ratio estimators, where rates were stratified by Ecological Production Unit (Georges Bank and Mid-Atlantic), latitude zone, season, and depth. In the Mid-Atlantic region, a total of 571 loggerhead (CV = 0.29, 95% CI = 318-997), 46 Kemp's ridley (CV = 0.45, 95% CI = 10-88), 16 green (CV = 0.73, 95% CI = 0-44), and 20 leatherback (CV = 0.72, 95% CI = 0-50) turtle interactions were estimated to have occurred in bottom trawl gear over the 5 year period. On Georges Bank, 12 loggerheads (CV = 0.70, 95% CI = 0-31) and 6 leatherback (CV = 1.0, 95% CI = 0-20) interactions were estimated to have occurred. Approximately 272 loggerhead interactions, 23 Kemp's ridley interactions, 8 green interactions, and 13 leatherback interactions resulted in mortality over the 5 year period. Roughly 2,668 sea days would be needed annually to monitor loggerhead interactions with 30% precision across bottom trawl fleets in the Mid-Atlantic, based on results of this analysis. Monitoring levels were not estimated for Kemp's ridley, leatherback, or green turtles in this analysis, nor for loggerheads on Georges Bank, because of their low probability of capture. Monitoring for these other turtles and on Georges Bank would still occur, but the targeted level of monitoring would be driven by other marine species groups.

INTRODUCTION

All sea turtles in the United States (US) are protected under the Endangered Species Act (ESA). To assess the impact of US commercial fishing on turtle populations which overlap fishing activity in space and time, information is needed on the anticipated magnitude of sea turtle interactions in commercial fishing gear. The US Mid-Atlantic region is important foraging habitat for loggerhead (*Caretta caretta*) turtles in summer months (Griffin et al. 2013; Patel et al. 2016). Predicted densities of loggerheads vary over the Northeast Continental Shelf from late spring to early fall as animals migrate into and out of the region from Cape Hatteras and points farther south (Winton et al. 2018). Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) turtles also inhabit parts of the Mid-Atlantic or Georges Bank throughout the year (Morreale et al. 2005; TEWG 2000, 2007). During these times sea turtles interact with a variety of commercial gear types (Murray 2018, 2015a, 2015b). For instance, from 2009–2013, roughly 230 loggerheads were estimated to have interacted with bottom trawl gear each year, of which 96 were estimated to result in mortality (Murray 2015b).

In this analysis, an incidental "interaction" between turtles and commercial gear is synonymous with an ESA take, defined as, "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA 1973). Generally, these interactions include animals that are brought onboard the fishing vessel by the gear or that interact with the gear at the surface, but some interactions also occur subsurface or away from view (Warden and Murray 2011). This analysis also reports a portion of these unobservable interactions, which in this case are animals that escape through a turtle excluder device (TED) (Murray 2015b). TEDs are required on summer flounder trawlers (50 CFR 222.102) in certain times and areas in the summer flounder/sea-turtle protection area between Cape Charles, VA, and the North Carolina/South Carolina border (Figure 1 in U.S. Department of Commerce 1996).

To help assess the impact of removals on the population, estimated interactions and mortalities for loggerheads are also expressed in terms of adult-equivalent losses. Adult equivalency translates the loss of individual turtles into the number of adults expected based on chances of the individual surviving to adulthood and reproducing. Compared to individual losses, monitoring adult-equivalent losses from fisheries interactions can be a more informative metric to assess population-level impacts (Haas 2010; Warden et al. 2015) and allows for a common currency to compare the impacts of removals across life stages or different gear types.

This paper reports the total estimated interactions and mortalities of sea turtles in bottom otter trawl gear operating in the US Mid-Atlantic and Georges Bank regions from 2014-2018. A portion of the interactions includes an estimate of the number of turtles escaping through a TED. Turtle species include: the Northwest Atlantic distinct population segment of loggerhead sea turtle, Kemp's ridley, leatherback, and green turtle. In addition, this paper reports the monitoring levels necessary in future sampling years to estimate interaction rates between loggerheads and commercial fishing gear with a 30% precision goal.

METHODS

Data Sources

Observer Data

Data collected by Northeast Fisheries Observer Program (NEFOP) observers and at-sea monitors (ASM) aboard vessels using bottom trawl gear[1] from 2014 through 2018 were used to compute interaction rates of loggerhead, Kemp's ridley, leatherback, and green turtles. In this analysis, a total of 5,227 days fished was observed from 2014-2018 in bottom trawl fisheries in the Georges Bank and Mid-Atlantic, which represented 13% of commercial trawl fishing effort across both regions (Table 1; Figure 1). In the Georges Bank region, NEFOP data comprised 54% of observed days fished, and ASM data comprised 46%; in the Mid-Atlantic region, NEFOP data comprised 92% of observed days fished, and ASM data comprised 8%. In the area where NEFOP and ASM coverage overlapped (north of 39ºN), there were no major differences in the seasons or depth zones where NEFOP and ASM sampling occurred (Figures 2 and 3).

Commercial Data

Mandatory Vessel Trip Reports (VTRs) completed by commercial trawl fishermen from 2014 - 2018 provided a measure of total fishing effort. Effort was expressed as the amount of fishing time in units of 24 hour periods (days fished), computed as:

$$(\text{Average tow time [hrs] per haul} * \text{number of hauls})/24$$

Vessels using bottom trawl gear completed a total of 38,724 days fished from 2014-2018 in the Georges Bank and Mid-Atlantic regions.

[1] Takes in the southern Mid-Atlantic shrimp twin trawl fishery were not included in this analysis because takes in this fishery are estimated by the Southeast region, and NE observers no longer observe this fishery. This gear was identified as (Observer Database System [OBDBS] negear code = 050 and nettype = 33, 34, or 35), or negear code = 450.

Interaction Rates

Interaction rates for each turtle species were estimated with stratified ratio estimators. This method differs from previous approaches (Murray 2015b; Warden 2011), where rates were estimated with generalized additive models (GAMs). Ratio estimators have the advantage of being computationally simple with general application to many sampling designs (Cochran 1977) and can yield results similar to those using GAMs or generalized linear models (GLM) if ratio estimators are stratified based on the same explanatory variables in a GAM or GLM model (Murray 2007, 2013; Orphanides 2009).

Observer and commercial data were stratified by Ecological Production Unit (Georges Bank and Mid-Atlantic), latitude zone, season, and depth, based on factors associated with loggerhead bycatch rates in previous trawl bycatch analyses (latitude, sea surface temperature, depth) (Murray 2015b, 2006; Warden 2011). Within the Mid-Atlantic Ecological Production Unit (EPU), latitude zones included: Northern (>=37ºN to the Mid-Atlantic boundary), Middle (>37ºN and <39ºN), and Southern (<=37ºN). Season was used as a proxy for sea surface temperature [SST] and defined as summer (July – October) or winter (November – June). Depth groups were defined as shallow (<= 50m) or deep (> 50m). Within the Georges Bank Ecological Production Unit, rates were stratified by only season and depth groups. While only a few interactions occurred in the Georges Bank region, I stratified it as a separate region for a number of reasons: (1) each ecological region is characterized by distinct patterns in oceanographic properties, fish distributions, and primary production (Ecosystem Assessment Report 2012); (2) previous analyses of turtle interactions delineated the "Mid-Atlantic" with the same boundaries, and my stratification facilitates comparisons across time series; and (3) observer coverage is allocated separately across fleets operating in the Mid-Atlantic versus Northeast regions, of which Georges Bank is a part.

There have been no previous bycatch analyses of sea turtle species besides loggerheads to inform a stratification scheme for this analysis. The stratification for loggerheads was maintained for the other turtle species (Kemp's ridley, leatherback, green) because it was assumed to capture the temporal and spatial presence of each species on the Northeast continental shelf.

Within each stratum (*j*), interaction rates (*R*) were defined as:

$$\boldsymbol{R}_{\boldsymbol{j}} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \frac{\boldsymbol{observed\ turtles_j}}{\boldsymbol{observed\ days\ fished_j}}$$

where n = the number of observed NEFOP and ASM hauls

Bootstrap resampling was used to estimate uncertainty (coefficient of variation [CV] and confidence intervals [CIs]) around interaction rates within each stratum, with trips as the resampling unit (Orphanides and Hatch 2017). Bootstrap replicates were generated by resampling trips with replacement 1000 times from the original observer dataset, and then bycatch rates within each stratum were computed for each replicate. The 95% CI for the bycatch rates were computed from the upper 97.5% and lower 2.5% quartiles of the bootstrap replicates. CVs and CIs for combined strata within the Mid-Atlantic and Georges Bank regions were also obtained in the same manner through the summation of stratum-specific bycatch estimates.

Excluder devices

Hauls that used TEDs were excluded from the analysis (n=55, or 0.11% of observed hauls) because they are designed to have different catch rates of turtles and there were no observed turtles on hauls with TEDs to allow for estimation of an observable interaction rate. Therefore, the bycatch rate reflected only the observable, non-TED interaction rate. It is not required that fishers report use of a TED on VTR logbooks, so VTR trips were assumed to be using a TED if they were operating within the times and areas of the sea turtle/summer flounder protection area during seasons when TEDs are required and if they landed more than 45kg (100 lbs) of summer flounder (*Paralichthys dentatus*) (CFR 222.102) (105 trips, or 0.13% of VTR trips).

Total Estimated Interactions/Mortality

Within each stratum, observed interaction rates were multiplied by total days fished from VTR trips to calculate the estimated number of turtle interactions. For VTR trips with TEDs, estimated interactions of hard-shelled turtle species were proportioned into observable interactions (those that passed through the TED into the cod end), and unobservable/quantifiable interactions (those that escaped out through the TED opening). On TED trips in each stratum, observable interactions were 3% of total estimated interactions, and unobservable/quantifiable interactions were 97% of total estimated interactions, based on a 97% experimental exclusion rate (Watson 1981).

Total observable mortalities were estimated by applying the mortality rate (50%)[2] for turtles observed in trawl gear interactions from the most recent time series available (2013-2017, in Upite et al. 2018) to the total estimated observable interactions. The mortality rate for unobservable yet quantifiable interactions was assumed to be 0% (Murray 2015b).

Adult Equivalency for Loggerheads

To estimate adult equivalent loggerhead interactions, each observed take with a curved carapace measurement was assigned reproductive value (RV) based on slow-growth high fecundity RVs in Wallace (2008). RVs represent the contribution of individuals within an age-class to current and future reproduction, taking into account age-structured survival rates and current and future fecundity. The estimated interactions on each VTR trip were then multiplied by the average RV for the trip's latitude zone (<= 37ºN: RV = 0.56 [n=5]; > 37ºN and < 39ºN: RV = 0.26 [n=7]; >= 39ºN: RV = 0.12 [n=26]) (Murray 2015b; Warden 2011). Total interactions of other turtle species were not translated into adult equivalency because RV values for these other species are not known.

Estimated Sea Day Needs

Prior to estimating observer coverage needs for future fishing years, the probability of encountering each turtle species in either the Georges Bank or Mid-Atlantic region was estimated by using results of this analysis. This approach is necessary to ensure that observer coverage in the upcoming year is not driven by imprecise estimates of interaction rates owing to an extremely rare event (US Dep of Commerce 2019a). The probability of observing 1 or more turtle species, assuming a Poisson distribution (Smith 1999), was estimated for varying amounts of observer

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[2] This rate is slightly higher than the mean mortality rate in trawl gear reported for 2013-2017 (48%) because takes in shrimp twin trawl gear were excluded to be consistent with this analysis.

coverage based on the average annual number of interactions and VTR trips using bottom trawl gear in each respective region from 2014-2018. A similar evaluation was conducted for observer coverage in Mid-Atlantic sink gillnet fleets (US Dep of Commerce 2019a); sea days were only estimated and allocated for monitoring a turtle species in gillnet gear if there was >50% probability of observing 5 or more turtles over 800 trips in a year.

In this study, if the probability of encounter met this same threshold, then the sea days needed to monitor turtle interaction rates were estimated. Uncertainty (CVs) around the interaction rates were used to estimate the number of observer sea days needed in 2020 to achieve 30% CV precision around the interaction rate. A 30% precision goal has been recommended by the National Working Group on Bycatch (NMFS 2004) and is the standard used for sea day estimation needs under the Standard Bycatch Reporting Methodology Omnibus Amendment (Wigley et al. 2012).

The number of observed sea days needed to achieve a 30% coefficient of variation (CV) around interaction rates from 2014-2018 were computed as:

$$n_{proj} = (CV_{obs} * \sqrt{n_{obs}}/CV_{proj})^2$$

where n_{proj}= the number of projected trips (converted to sea days[3]); CV_{obs} = the precision levels around estimated interaction rates in this analysis; n_{obs}= the observed number of trips underlying the interaction rates; and CV_{proj} = the projected precision levels.

RESULTS

Characteristics of Observed Turtle Interactions

From 2014-2018, NEFOP observers documented 50 loggerhead turtle interactions in bottom trawl gear, 48 of which occurred in the Mid-Atlantic (Table 1; Figure 1)[4]. No turtles were documented by at-sea monitors. Observers also recorded 5 Kemp's ridley turtles, 3 leatherback turtles, and 2 green turtles. Eighty-three percent of the observed interactions occurred between July – October. Observers recorded the following range of curved carapace lengths (CCL) and carapace widths (W) for each species: loggerheads: 51.0-119.0 cm CCL (n = 38) and 48.3 – 80.0 cm W; Kemp's ridley: 22.7-29.7 cm CCL (n = 3) and 23.0-29.2 cm W; leatherbacks: 142.0 and 223.0 cm CCL (n = 2) and 91.5 and 153.0 cm W; green: 25.6 and 31.0 cm CCL (n=2) and 22.2 and 26.8 cm W.

Interaction Rates

The highest loggerhead interaction rate (0.43 turtles/day fished) was in waters south of 37ºN from November – June in waters deeper than 50m (Table 2; Figure 4). However, the greatest

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[3] The conversion from trips to sea days used 2.3 mean days absent/trip, and 1 day absent = 1 sea day. Conversions were based on characteristics of VTR trawl trips in the Mid-Atlantic from 2014 – 2018.

[4] One of these included a turtle that could not be identified to species, but for this analysis it was presumed to be a loggerhead based on characteristics described by observers. The observer noted it was "dark brown, tannish with 5 vertebral scutes and an estimated length of 91cm."

number of estimated interactions occurred in the Mid-Atlantic region north of 39ºN, from July – October in waters less than 50m deep (Figure 4) because of a greater amount of commercial effort in this stratum compared to those farther south. Within each stratum, interaction rates for non-loggerhead species were lower than those for loggerheads (Table 2).

Total Estimated Interactions / Adult Equivalents

Loggerheads

From 2014-2018, 12 (CV = 0.70, 95% CI = 0-31 in GB) and 571 (CV = 0.29, 95% CI = 318-997 in MA) loggerheads were estimated to have interacted with bottom trawl gear (Table 3). The total number of turtle interactions across both regions was equivalent to 182 adults. An estimated 272 turtles (87 adult equivalents) were estimated to have died from these interactions. In the Mid-Atlantic, 38 loggerheads were estimated to have been excluded by TEDs.

Non-loggerheads

From 2014-2018, 46 (CV = 0.45, 95% CI = 10-88) Kemp's ridley and 16 (CV = 0.73, 95% CI = 0-44) green turtles were estimated to have interacted with bottom trawl gear in the Mid-Atlantic, of which 23 and 8 resulted in mortality, respectively. There were 0 turtles estimated to have been excluded by TEDs. In addition, 6 (CV = 1.0, 95% CI = 0-20) and 20 (CV = 0.72, 95% CI = 0-50) leatherback interactions were estimated to have occurred on Georges Bank and in the Mid-Atlantic, which resulted in 13 mortalities.

Estimated Sea Day Needs

Monitoring levels were not estimated for Kemp's ridley, leatherback, or green turtles in this analysis, nor for loggerheads on Georges Bank because there was <50% probability of observing 5 or more turtles over 800 trips in a year (Figures 5 and 6). Roughly 2,668 sea days would be needed annually to monitor loggerhead interactions with 30% precision across bottom trawl fleets in the Mid-Atlantic, based on results of this analysis.

DISCUSSION

The estimated number of interactions of loggerhead turtles in Mid-Atlantic bottom trawl gear has reduced from 353 per year from 2005-2008 (Warden 2011), to 231 per year from 2009-2013 (Murray 2015b), to 114 per year from 2014-2018. Since this is the first reported estimate of turtle interactions on Georges Bank, comparisons to previous time series are not possible. In this analysis, the highest number of estimated interactions occurred north of 39°N, which is farther north than in previous years. Interaction rates were highest in the southern Mid-Atlantic (south of 37°N), as they were in previous years (Murray 2015b; Warden 2011).

Unlike previous analyses, this analysis reports total estimated interactions of non-loggerhead turtle species in bottom trawl gear, as well as interactions outside of the Mid-Atlantic. In the past, total interactions for a species or within an ecological region were not estimated if there were too few observed events to support the modeling approach taken in the analysis (Murray 2015b). Total interactions of non-loggerhead species and on Georges Bank are reported here by using a different approach (a stratified ratio-estimator), though uncertainty around the rates are relatively high because there were so few observed turtles. Precision around turtle interaction rates may improve depending on levels of observer coverage and the abundance and distribution of turtles in the strata.

Observer coverage to monitor turtle interactions is typically integrated with coverage to monitor 14 assemblages of fish and invertebrate species across 38 fishing fleets in the Mid-Atlantic region (US Dept of Commer 2019b). In this analysis I only estimate the monitoring levels needed to achieve 30% precision around the interaction rates for loggerheads. This method means that for non-loggerhead species, monitoring will still occur, albeit not at levels that aim for 30% precision. This approach tries to balance coverage needs for a variety of marine species, directed at the more commonly discarded species. Non-loggerhead species in the Mid-Atlantic and all turtle species on Georges Bank were filtered from the estimated sea day needs because they did not meet the threshold that there be >50% probability of observing 5 or more turtles over 800 trips in a year. This threshold was recommended by the Standardized Bycatch Reporting Methodology Fishery Management Action Team (US Dep of Commerce, 2019a).

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Table 1. Observed days fished, Vessel Trip Reports (VTR) days fished, and observed turtle species in bottom trawl gear 2014-2018 in the Mid-Atlantic (MA) and Georges Bank (GB) regions. Cc = Loggerhead (*Caretta caretta*); Lk = Kemp's ridley (*Lepidochelys kempii*); Dc=Leatherback (*Dermochelys coriacea*); Cm=Green (*Chelonia mydas*).

Year	Region	Observed Days Fished	VTR Days Fished	% Observer Coverage	Observed Cc	Observed Lk	Observed Dc	Observed Cm
2014	GB	548	2,637	21%	1	0	0	0
	MA	710	6,547	11%	20	1	0	1
2015	GB	445	2,501	18%	0	0	0	0
	MA	547	5,786	9%	10	3	0	1
2016	GB	257	1,909	13%	0	0	0	0
	MA	624	5,791	11%	7	0	1	0
2017	GB	352	1,750	20%	1	0	1	0
	MA	768	5,159	15%	4	0	0	0
2018	GB	233	1,514	15%	0	0	0	0
	MA	743	5,130	14%	7	1	1	0
Total	GB	1,835	10,311	18%	2	0	1	0
	MA	3,392	28,413	12%	48	5	2	2
Total		5,227	38,724	13%	50	5	3	2

Table 2. Stratified interaction rates and coefficient of variation (CV) for each turtle species in bottom trawl gear 2014-2018. Only those strata with non-zero interaction rates are listed. MA = Mid-Atlantic; GB = Georges Bank. Cc = loggerhead (*Caretta caretta*); Lk = Kemp's ridley (*Lepidochelys kempii*); Dc = leatherback (*Dermochelys coriacea*); Cm = green (*Chelonia mydas*).

Region	Latitude Zone	Season	Depth	Cc rate (CV)	Lk rate (CV)	Dc rate (CV)	Cm rate (CV)
GB	N/A	July – Oct	<= 50m	0.004 (0.70)	0	0.002 (1.0)	0
MA North	>=39ºN	July – Oct	<= 50m	0.025 (0.24)	0.006 (0.49)	0.003 (0.72)	0.002 (1.0)
	>=39ºN	July – Oct	> 50m	0.050 (0.33)	0	0	0
	>=39ºN	Nov-Jun	<= 50m	0.003 (0.71)	0	0	0
	>=39ºN	Nov-Jun	> 50m	0.001 (0.68)	0	0	0
MA Mid	>37ºN & <39ºN	July – Oct	<= 50m	0.259 (0.52)	0.052 (1.02)	0	0.052 (1.0)
	>37ºN & <39ºN	July – Oct	> 50m	0.022 (0.55)	0	0	0
	>37ºN & <39ºN	Nov – Jun	> 50m	0.003 (0.99)	0	0	0
MA South	<=39ºN	Nov – Jun	<= 50m	0.231 (1.01)	0	0	0
	<=39ºN	Nov – Jun	> 50m	0.428 (0.68)	0	0	0

Table 3. Total estimated turtle interactions in bottom trawl gear 2014-2018 in the Georges Bank (GB) and Mid-Atlantic (MA) regions. Cc = loggerhead (*Caretta caretta*); Lk = Kemp's ridley (*Lepidochelys kempii*); Dc = leatherback (*Dermochelys coriacea*); Cm = green (*Chelonia mydas*). Values in brackets represent the additional amount of estimated interactions where turtles escaped out of a turtle excluder device (TED) opening. CV = Coefficient of variation, CI = 95% confidence interval.

Year		Total Cc Interactions	Total Lk Interactions	Total Dc Interactions	Total Cm Interactions
2014	GB	3	0	1	0
	MA	140 [13]	12	5	5
2015	GB	3	0	2	0
	MA	126 [6]	10	5	3
2016	GB	1	0	1	0
	MA	110 [11]	8	3	3
2017	GB	3	0	1	0
	MA	84 [4]	8	4	2
2018	GB	2	0	1	0
	MA	73 [4]	8	3	3
Total (CV, 95% CI)	GB	12 (0.70, 0-31)	0	6 (1.0, 0-20)	0
	MA	571 (0.29, 318-997)	46 (0.45, 10-88)	20 (0.72, 0-50)	16 (0.73, 0-44)
Average Annual (95% CI)	GB	2 (0-6)	0	1 (0-4)	0
	MA	114 (64-199)	9 (2-18)	4 (0-10)	3 (0-9)

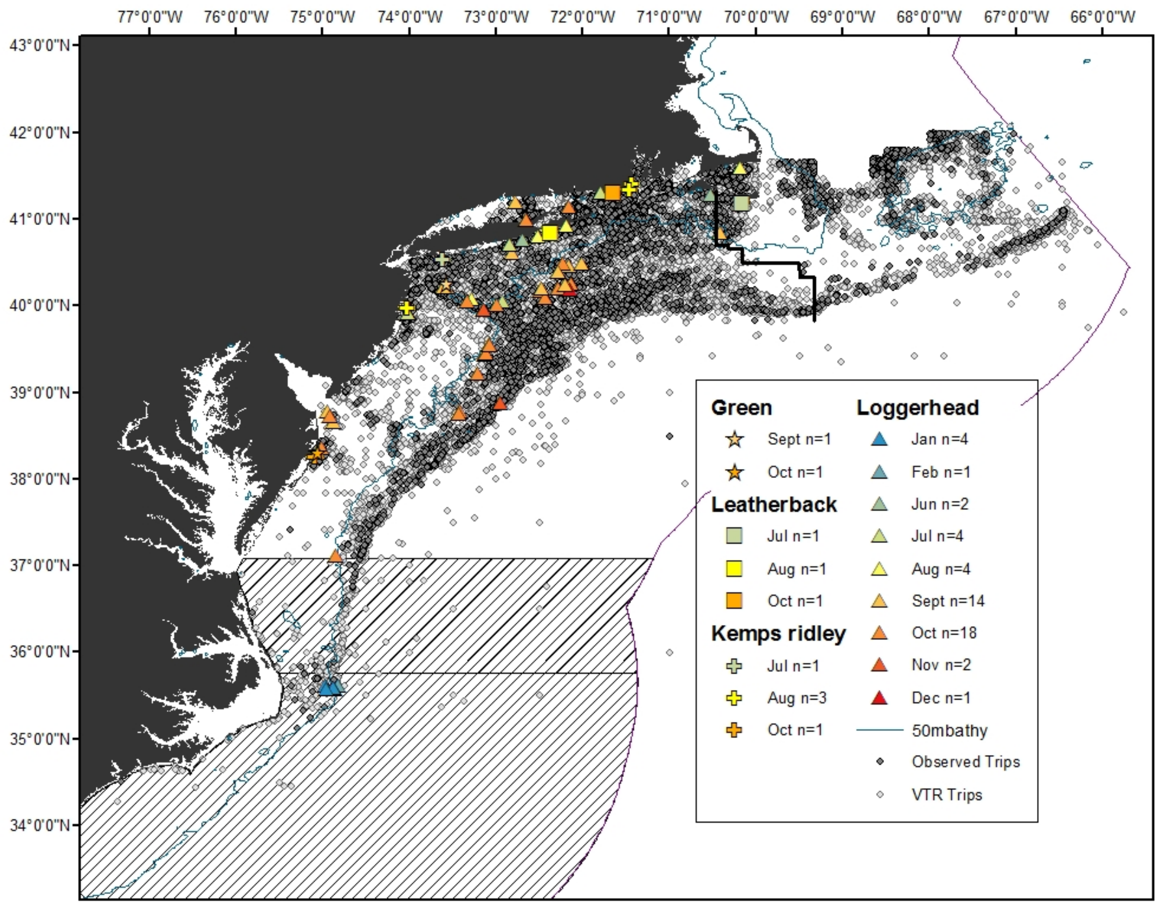

Figure 1. Observed loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) turtle interactions, observed trips, and commercial trips in US bottom trawl gear from 2014 to 2018 throughout Georges Bank and the Mid-Atlantic. The boundary between the Georges Bank and Mid-Atlantic Ecological Production Units is shown by the solid black line. The hatched lines depict the summer flounder/sea turtle protection area.

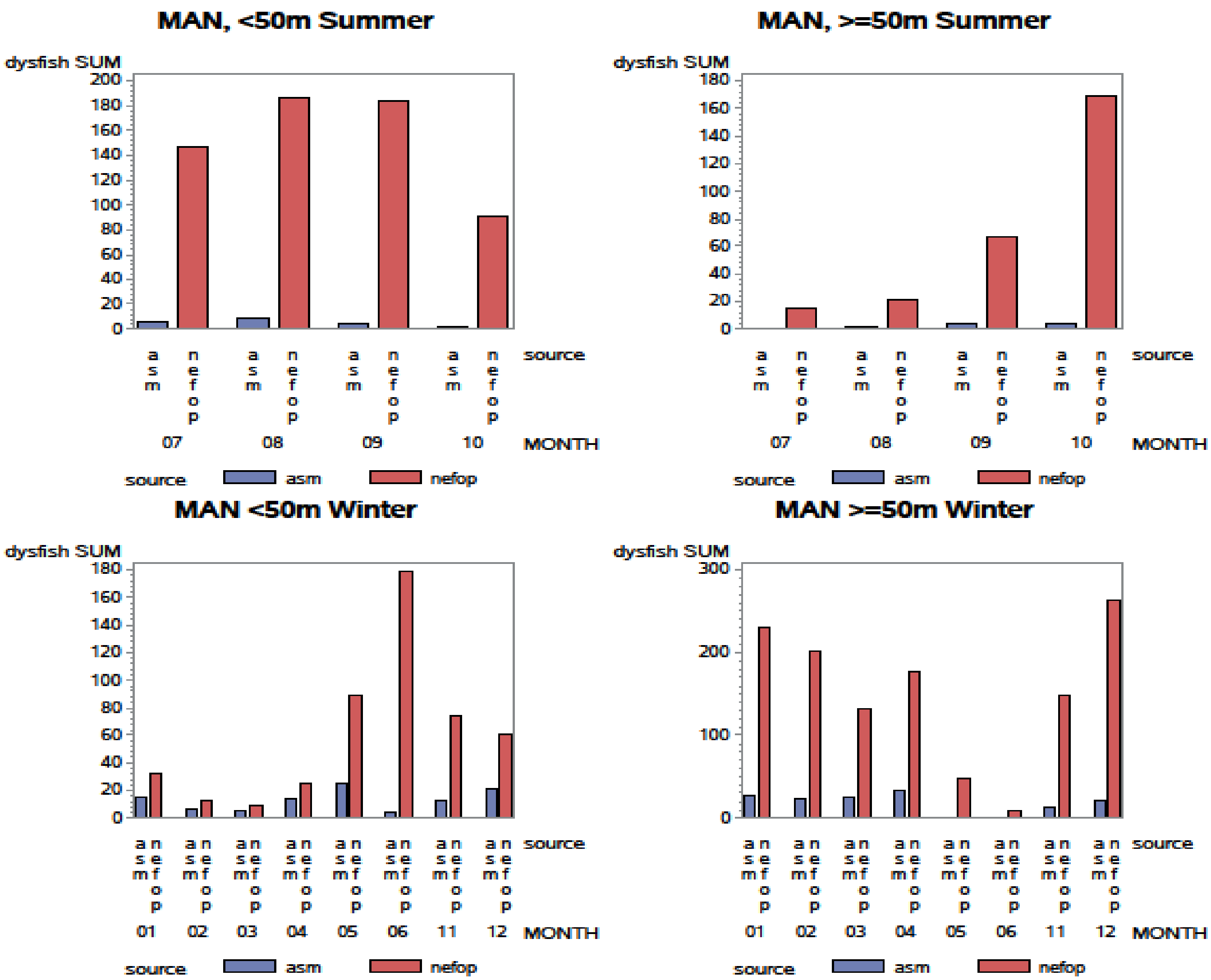

Figure 2. Spatial and temporal distribution of Northeast Fisheries Observer Program (NEFOP) and at-sea monitors (ASM) monitoring effort (days fished) in bottom trawl fisheries, 2014-2018. “MAN” = Mid-Atlantic North (>39N to Georges Bank line), dysfish = days fished.

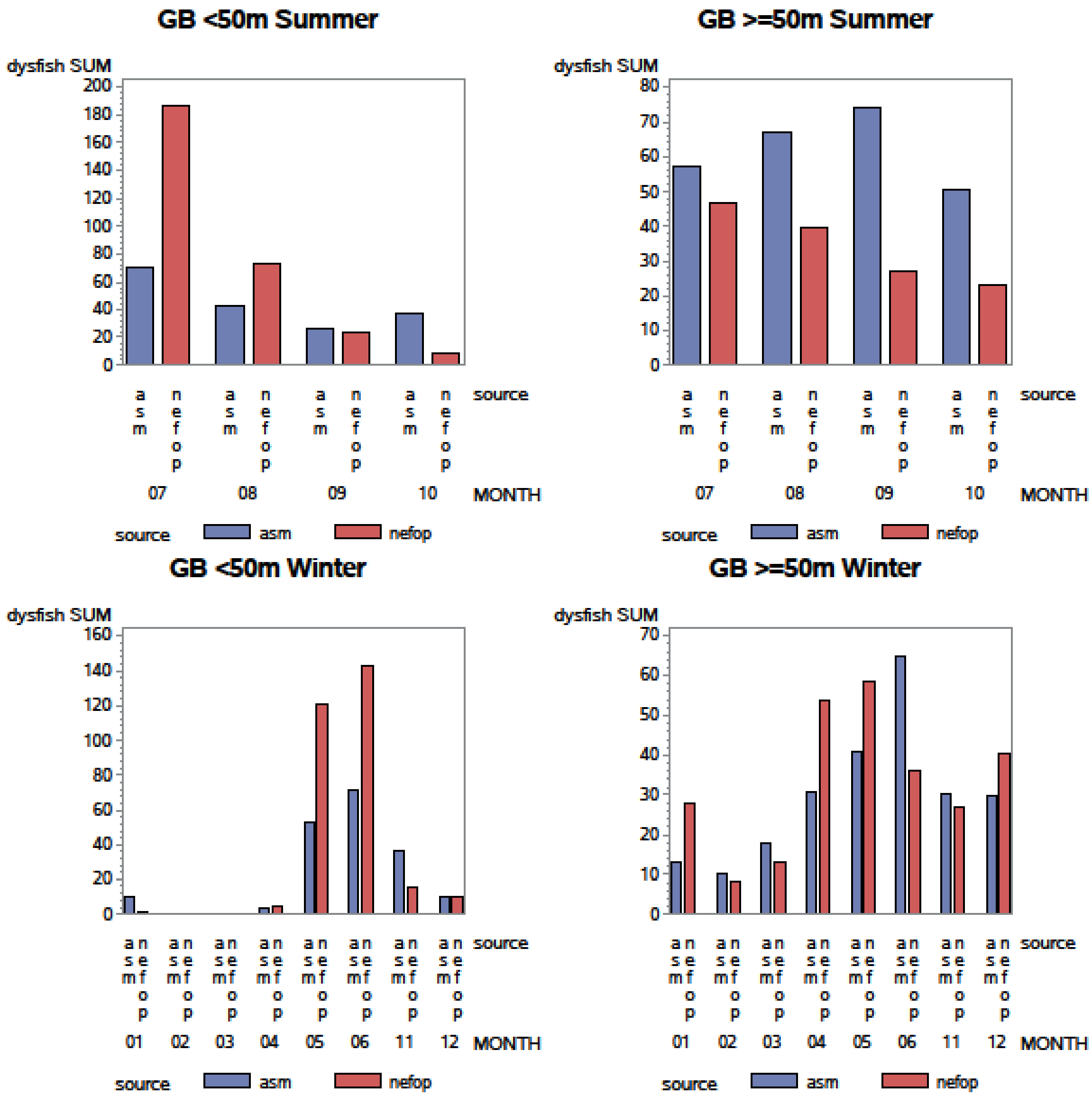

Figure 3. Spatial and temporal distribution of Northeast Fisheries Observer Program (NEFOP) and at-sea monitors (ASM) monitoring effort (days fished) in bottom trawl fisheries, 2014-2018. GB = Georges Bank, dysfish = days fished.

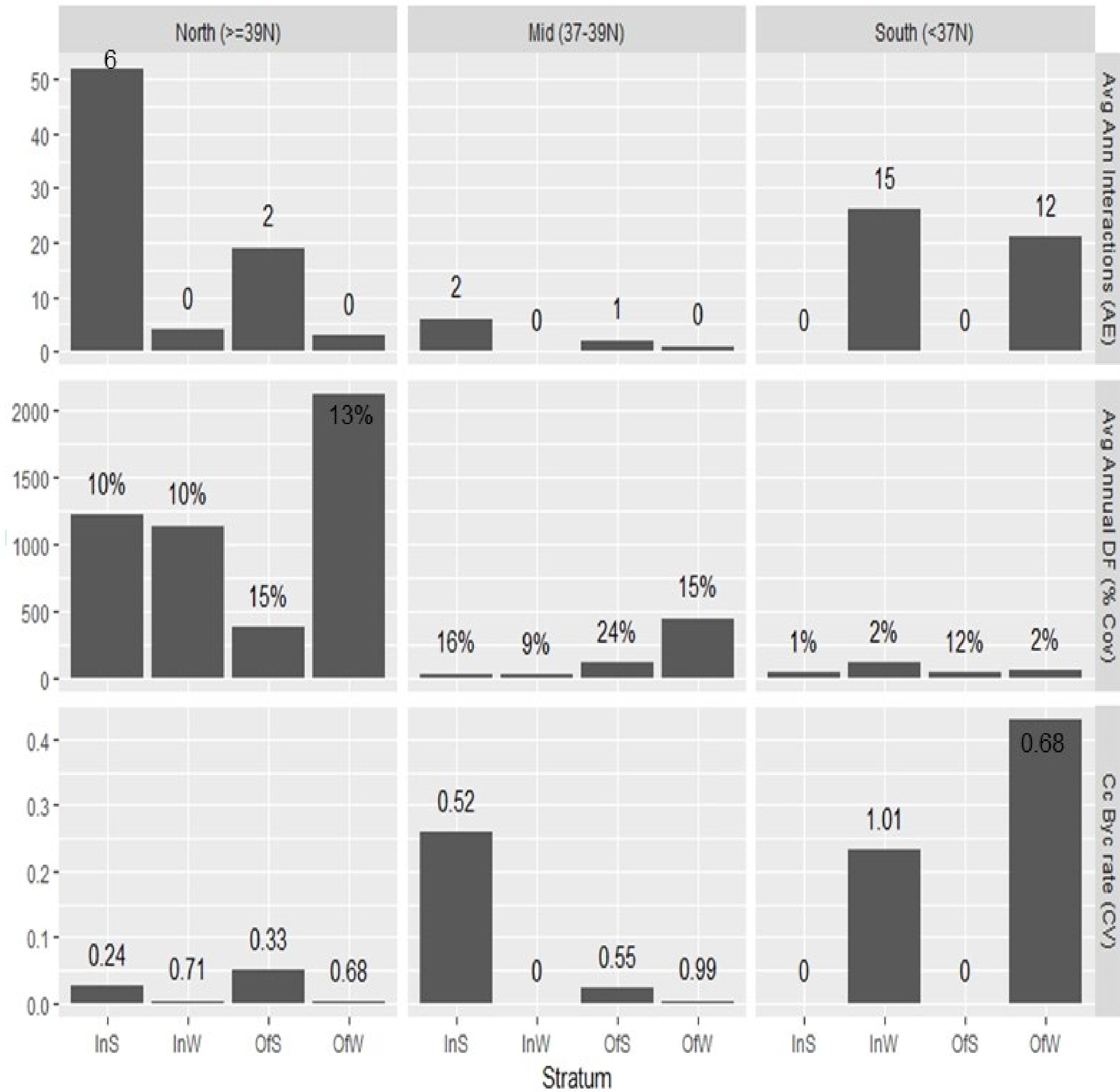

Figure 4. Average annual loggerhead (*Caretta caretta*) interactions (observable plus unobservable/quantifiable); average annual commercial effort; and loggerhead bycatch rates in Mid-Atlantic bottom trawl gear from 2014-2018, stratified by latitude zone, depth, and season. "InS": <= 50m July-Oct; "InW": <= 50m Nov-Jun; "OfS": > 50m July-Oct; "OfW": > 50m Nov-Jun. Values above the columns within each row: Adult Equivalent Interactions (AE); % Observer Coverage (in terms of days fished); Coefficient of Variation (CV).

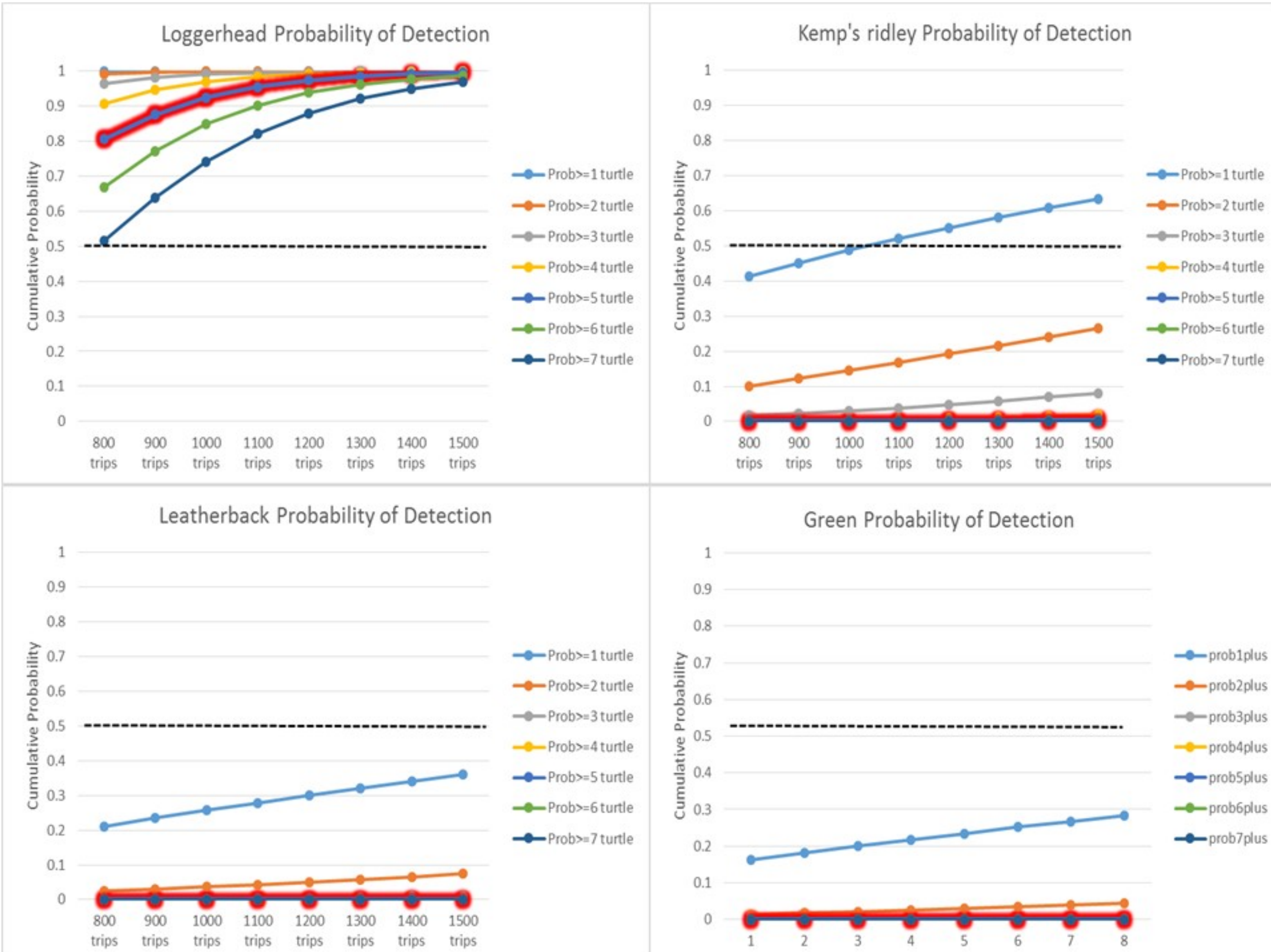

Figure 5. Cumulative probability of detecting numbers of loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) sea turtles given various levels of annual observer coverage in bottom trawl gear, based on annual levels of commercial effort and total interactions in the Mid-Atlantic 2014-2018. Species are filtered from the sea day estimation if there is < 50% probability (dashed horizontal line) of observing >= 5 turtles (red highlighted line) over 800 trips in a year (US Dep of Commerce 2019a).

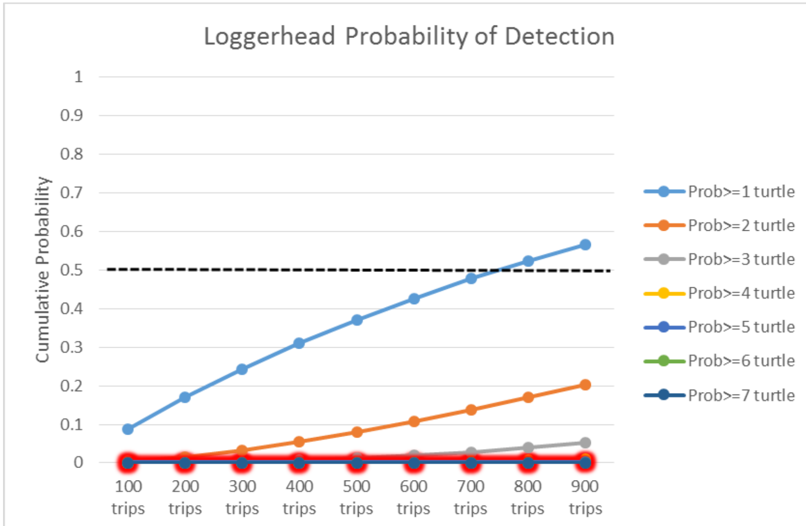

Figure 6. Cumulative probability of detecting numbers of loggerheads (*Caretta caretta*) given various levels of annual observer coverage in bottom trawl gear, based on annual levels of commercial effort and total interactions on Georges Bank 2014-2018.

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Sea turtle interactions and mortality in scallop trawls

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16 January 2020

Here we estimate turtle bycatch in the scallop trawl fleet during 2014–2018 using effort data from Vessel Trip Reports (VTRs) and estimated interaction rates from the Northeast Fisheries Science Center (NEFSC). Currently, the NEFSC estimates total turtle takes as part of standard bycatch monitoring (e.g., Murray 2018) and recently reported takes for all bottom trawls (Murray 2020). The 2020 Biological Opinion (BiOp) does not examine the scallop fishery and, thus, requires an approximation of turtle takes that is independent of that attributed to scallop trawls.

Scallop trawl effort

Table 1 reports the effort in days fished from VTRs for vessels that declared into the scallop fishery and indicated a gear type of scallop trawl ("OTC"). Stratification is consistent with that used for turtle bycatch estimation by NEFSC (Murray 2020). Ecological Production Units (EPU) include Georges Bank (GB) and the Mid-Atlantic (MAB), with the latter further seperated by latitude zones North (>39°N), Mid (<39°N and >37°N), and South (<37°N).

The calculation of days fished followed that used by Murray (2020) as the product of average tow time (hrs) and number of hauls, expressed in units of 24 hour time periods.

Table 1: Scallop trawl effort in the Greater Atlantic during 2014-2018.

EPU	Season	Depth	Days.fished
GB	July-Oct	<=50m	0.000
GB	July-Oct	>50m	11.476
GB	Nov-Jun	<=50m	0.000
GB	Nov-Jun	>50m	7.066
MAB North	July-Oct	<=50m	59.842
MAB North	July-Oct	>50m	31.128
MAB North	Nov-Jun	<=50m	65.396
MAB North	Nov-Jun	>50m	38.424
MAB Mid	July-Oct	<=50m	2.625
MAB Mid	July-Oct	>50m	17.962
MAB Mid	Nov-Jun	<=50m	11.081
MAB Mid	Nov-Jun	>50m	47.781
MAB South	July-Oct	<=50m	1.000
MAB South	July-Oct	>50m	0.615
MAB South	Nov-Jun	<=50m	0.000
MAB South	Nov-Jun	>50m	4.896

Turtle interaction rates

Table 2 from Murray (2020) is reproduced below, with the interaction rate means and coefficients of variation (CVs) for each species as estimated from observer data.

We used the reported rates to estimate a mean total take attributed to scallop trawls for each species, with 95% confidence intervals approximated from the CVs.

Table 2: Stratified interaction rate means (r) and CVs for each turtle species in bottom trawl gear 2014–2018. Species include Loggerhead (Cc), Kemp's ridley (Lk), Leatherback (Dc), and Green (Cm) turtles.

			r				CV(r)			
EPU	Season	Depth	Cc	Lk	Dc	Cm	Cc	Lk	Dc	Cm
GB	July-Oct	<=50m	0.004	0.000	0.002	0.000	0.70	0.00	1.00	0.00
GB	July-Oct	>50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
GB	Nov-Jun	<=50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
GB	Nov-Jun	>50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
MAB North	July-Oct	<=50m	0.025	0.006	0.003	0.002	0.24	0.49	0.72	1.00
MAB North	July-Oct	>50m	0.050	0.000	0.000	0.000	0.33	0.00	0.00	0.00
MAB North	Nov-Jun	<=50m	0.003	0.000	0.000	0.000	0.71	0.00	0.00	0.00
MAB North	Nov-Jun	>50m	0.001	0.000	0.000	0.000	0.68	0.00	0.00	0.00
MAB Mid	July-Oct	<=50m	0.259	0.052	0.000	0.052	0.52	1.02	0.00	1.01
MAB Mid	July-Oct	>50m	0.022	0.022	0.000	0.000	0.55	0.00	0.00	0.00
MAB Mid	Nov-Jun	<=50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
MAB Mid	Nov-Jun	>50m	0.003	0.000	0.000	0.000	0.99	0.00	0.00	0.00
MAB South	July-Oct	<=50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
MAB South	July-Oct	>50m	0.000	0.000	0.000	0.000	0.00	0.00	0.00	0.00
MAB South	Nov-Jun	<=50m	0.231	0.000	0.000	0.000	1.01	0.00	0.00	0.00
MAB South	Nov-Jun	>50m	0.428	0.000	0.000	0.000	0.68	0.00	0.00	0.00

Table 3: Estimated turtle takes attributed to scallop trawls 2014–2018. Mean with lower and upper 95% confidence intervals presented for each species.

Species	mean	lower	upper
Cc	6.60	1.34	12.83
Lk	0.89	0.41	1.51
Dc	0.18	0.00	0.43
Cm	0.26	0.00	0.76

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