UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
https://www.fisheries.noaa.gov/region/southeast

06/26/2020

F/SER31:FI
SERO-2019-00943

Deidra Black
U.S. Department of Homeland Security
Federal Emergency Management Agency Region 6
800 North Loop 288
Denton, Texas 76209

Ref: FEMA-DR-4332-TX-PW-03840, Bayfront Seadrift Fishing Pier Repair, Seadrift, Calhoun County, Texas

Dear Ms. Black:

The enclosed Biological Opinion (Opinion) was prepared by the National Marine Fisheries Service (NMFS), pursuant to Section 7(a)(2) of the Endangered Species Act. The Opinion considers the effects of a proposal by the Federal Emergency Management Agency (FEMA) to fund the repair of a public fishing pier in Calhoun County, Texas. We base this Opinion on project-specific information provided in the consultation package as well as NMFS's review of published literature. This Opinion analyzes the potential for the projects to affect the following species: green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, and loggerhead sea turtle (Northwest Atlantic DPS).

The Bayfront Seadrift Fishing Pier Repair project has been assigned the tracking number SERO-2019-00943 in our new NMFS Environmental Consultation Organizer (ECO). Please reference the ECO tracking number in all future inquiries and reports regarding this Opinion. We look forward to further cooperation with FEMA on other projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Francesca Innocenti, Consultation Biologist, by phone at 727-209-5995, or by email at Francesca.Innocenti@noaa.gov.

Sincerely,

CRABTREE.ROY.E.DR.1365849559 Digitally signed by CRABTREE.ROY.E.DR.1365849559 Date: 2020.06.26 13:15:04 -04'00'

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure: Biological Opinion
File: 1514-22.o

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	Federal Emergency Management Agency
Applicant:	City of Seadrift
Activity:	Bayfront Seadrift Fishing Pier Repair, Seadrift, Calhoun County, Texas Project Number: 10634 PW 3840
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida Tracking Number SERO-2019-00943
Approved by:	CRABTREE.ROY.E.DR.1365849559 Digitally signed by CRABTREE.ROY.E.DR.1365849559 Date: 2020.06.26 13:15:46 -04'00' Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	06/26/2020

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Acronyms and Abbreviations

CFR	Code of Federal Regulations
CPUE	Catch per unit effort
CR	Conservation Recommendations
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DPS	Distinct Population Segment
DTRU	Dry Tortugas Recovery Unit
DWH	*Deepwater Horizon*
ECO	NMFS Environmental Consultation Organizer
ESA	Endangered Species Act
FP	Fibropapillomatosis disease
FR	Federal Register
FWRI	Fish and Wildlife Research Institute
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit
ITS	Incidental Take Statement
NA	North Atlantic
NCWRC	North Carolina Wildlife Resources Commission
NGMRU	Northern Gulf of Mexico Recovery Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
NRU	Northern Recovery Unit
NWA	Northwest Atlantic
Opinion	Biological Opinion
PCB	Polychlorinated Biphenyls
PFC	Perfluorinated Chemicals
PFRU	Peninsular Florida Recovery Unit
PRD	NMFS Protected Resources Division
PRM	Post-release mortality
RPMs	Reasonable and Prudent Measures
SA	South Atlantic
SCDNR	South Carolina Department of Natural Resources
SCL	Straight Carapace length
SERO	NMFS Southeast Regional Office
SEFSC	Southeast Fisheries Science Center
STSSN	Sea Turtle Stranding and Salvage Network
T&Cs	Terms and Conditions
TED	Turtle Exclusion Device
TEWG	Turtle Expert Working Group
U.S.	United States
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

Units of Measure

°C	Degrees Celsius
cm	Centimeter(s)
°F	Degrees Fahrenheit
ft	Foot/feet
ft^2	Square feet
g	Gram(s)
in	Inch(es)
kg	Kilogram(s)
lb	Pound(s)
lin	ft Linear foot/feet
m	Meter(s)
mi	Mile(s)
mm	Millimeter(s)
oz	Ounce(s)

Introduction

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the 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 those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either the National Marine Fisheries Service (NMFS) or the United States Fish and Wildlife Service (USFWS), depending upon the protected species that may be affected.

Consultations on most listed marine species and their designated critical habitat are conducted between the action agency and NMFS. Consultations are concluded after NMFS determines the action is not likely to adversely affect listed species or critical habitats, or issues a Biological Opinion (Opinion) that determines whether a proposed action is likely to jeopardize the continued existence of a federally listed species, or destroy or adversely modify federally designated critical habitat. The Opinion also states the amount or extent of listed species incidental take that may occur and develops nondiscretionary measures that the action agency must take to reduce the effects of said anticipated/authorized take. The Opinion may also recommend discretionary conservation measures. No incidental destruction or adverse modification of critical habitat may be authorized. The issuance of an Opinion detailing NMFS's findings concludes ESA Section 7 consultation.

This document represents NMFS's Opinion based on our review of effects associated with the Federal Emergency Management Agency's (FEMA's) proposal to fund a project to repair a public fishing pier in Calhoun County, Texas. This Opinion analyzes the proposed action's effects on threatened and endangered species and designated critical habitat in accordance with Section 7 of the ESA. We based our Opinion on information provided by FEMA, the Sea Turtle Stranding and Salvage Network (STSSN), and the published literature cited herein.

1. CONSULTATION HISTORY

The following is the consultation history for NMFS Environmental Consultation Organizer (ECO) tracking number SERO-2019-00943, Seadrift Bayfront Seadrift Fishing Pier Repair. On June 7, 2019, NMFS received a request for consultation under Section 7 of the ESA from FEMA in a letter dated June 7, 2019. NMFS requested additional information from FEMA, regarding project details, on October 22, 2019, requested further clarification on February 10, 2020, and received a final response on February 25, 2020. NMFS initiated consultation that day. NMFS requested confirmation of project information on April 8, 2020, and received a full response on April 22, 2020.

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 Proposed Action

The City of Seadrift (the applicant) proposes to repair the Bayfront Pier, through federal funding provided by FEMA, to pre-damaged design, function, and capacity within the existing footprint of the pier with in-kind materials. The proposed work will consist of the replacement and repair of a total of 710.5 square feet (ft^2) of structure; a 13-foot (ft) by 8-ft section of pier and the 50-ft by 12-ft T-head. The contractor will remove the existing pier decking, stringers, headers and damaged piles by using a barge mounted crane or excavator. The proposed overwater area is approximately 3,405 ft^2, and 4.5 ft above the mean water (MHW) line, with no boat slips. All materials removed from the project site will be transported to Victoria Landfill, located inland 30 miles (mi) north of Seadrift.

The original structure has 93 pilings. The applicant will replace approximately 23 (12-in diameter) wood piles via impact hammer using a barge mounted excavator or pile driver. The piles to be replaced were 18 ft long, and the replacement piles will be 25 ft long. The contractor estimates that it will take 50 to 100 strikes per pile to be driven to depth. The contractor also estimates that 3 to 10 piles per day will be installed. Once all the piles have been installed, the contractor will begin installing structural timber supports. The supports will be connected to the piles using stainless steel bolts. The timber decking will be installed on the top of the new supports using stainless steel screws. The spacing between boards will be 1/4 inch (in). Railings will be installed on the new pier section and will also be connected using stainless steel bolts/ screws. Two replacement 40-ft light poles with new lights and wiring will be installed. The total construction schedule is anticipated to take 1 to 3 months, with all days involving in-water work. All work will be performed during daylight hours.

Construction Conditions

To minimize potential impacts to ESA-listed species, FEMA will include the following conditions to the grant requirements to be followed by the applicant during construction:

- Prior to the onset of construction activities, the applicant or designated agent will conduct a meeting with all construction staff to discuss identification of the sea turtles and smalltooth sawfish, their protected status, what to do if any are observed within the project area, and applicable penalties that may be imposed if State or Federal regulations are violated. All personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing ESA-listed species.

- All construction personnel must watch for and avoid collision with ESA-listed sea turtles. Vessel operators must avoid potential interactions and operate in accordance with the following protective measures:
    - All vessels associated with the construction project shall operate at "Idle Speed/ No Wake" at all times while operating in water depths where the draft of the vessel provides less than a 4-ft clearance from the bottom and in all depths after a protected species has been observed in and has departed the area.
    - All vessels will follow marked channels and routes using the maximum water depth whenever possible.
    - Operation of any mechanical construction equipment, including vessels, shall cease immediately if a sea turtle is observed within a 50-ft radius of construction equipment or a whale is seen within 500 yards of construction equipment and shall not resume until the species has departed the area of its own volition.
    - If the detection of species is not possible during certain weather conditions (e.g., fog, rain, wind), then in-water operations will cease until weather conditions improve and detection is again feasible.

- The applicant will be required to obtain all applicable Federal, state, and local permits and will comply with conditions set forth in each. These requirements include all State of Texas and USACE permits. Failure to obtain permits or comply with these conditions may jeopardize the applicant's receipt of FEMA funding.

- Siltation barriers shall be made of material in which a sea turtle cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment.

- Any collision(s) with or injury to any ESA-listed sea turtle, marine mammal, or sturgeon occurring during the construction shall be reported immediately to NMFS Southeast Regional Office (SERO) Protected Resources Division (PRD) at (1-727-824-5312) or by email to takereport.nmfsser@noaa.gov. Additionally, the applicant will provide NMFS Galveston (Texas strandings hotline [1-866-TURTLE5]) with all reports in the event that sea turtles are observed in the project area.

To minimize potential impacts to ESA-listed species, FEMA will add the following conditions to the grants to be followed by the applicant or their designated agents post-construction:

- The applicant will post signage, instructing anglers not to dispose of fish carcasses, debris, or remains in the water. There will be no fish cleaning stations associated with the pier. In addition,
    - Fishing line receptacles will be placed along the pier to prevent fishing lines from being disposed of in the ocean or on the beaches, where sea turtles may be entangled. Receptacles will be clearly marked and will be emptied regularly to ensure they do not overfill and that fishing lines are disposed of properly.

- Trash receptacles and fishing line recycling bins will be installed prior to opening the pier for public use.

- Prior to opening the structure for public use, educational signs must be posted in a visible locations and at least at the entrance to and terminal end of the structures, alerting users of listed species in the area. Sign designs and installation methods are provided at the following website: https://www.fisheries.noaa.gov/southeast/consultations/protected-species-educational-signs. The following sign will be posted: 'Save Dolphins, Sea Turtles, and Manta Ray'.

- The applicant will coordinate an agreement with the Texas STSSN Coordinator to assist, as needed, with the rehabilitation of recreational hook-and-line sea turtle captures. Additionally, the applicant will report all sea turtle injuries or captures from the pier to the Texas Sealife Center, 14220 Spid, Corpus Christi, TX 78418, (361) 589-4023.

- The applicant will conduct out-of-water cleanup on an annual basis, removing any trash or debris from around the pier.

- The applicant will conduct in-water pier cleanup on at least an annual basis, removing any derelict tackle or fishing line attached to the pier.

2.2 Proposed Action Area

The Bayfront Seadrift Fishing Pier is located in Seadrift, Calhoun County, Texas (Latitude: 28.40835, Longitude: -96.71679), within San Antonio Bay, adjacent to the Gulf of Mexico. This pier was originally constructed in 2014 by the City of Seadrift with federal grant funding under Coastal Impact Assistance (F12AF01246).

The existing conditions surrounding the pier are silty sand sediment substrate, and normal water quality. The water depth around the pier ranges from approximately 2-3 ft at the seawall to approximately 5 ft at the end of the pier. According to FEMA, there is no documentation of submerged aquatic vegetation within the project area. There are no mangroves, corals or artificial reefs, present in the project area. There will be no dredging activities, and there are no beaches near the pier; the adjacent shoreline has a bulkhead. The Bayfront Seadrift Fishing Pier is public, and historical use indicates that the on average, there are 10 people fishing from the pier at any given time during the weekdays, and 13 people at any given time on the weekends.

The action area is defined by regulation as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations [CFR] 402.02). The action area for the Bayfront Seadrift Fishing Pier project includes the pier footprint and the surrounding water accessible to recreational anglers upon completion of the proposed action (i.e., casting distance or approximately 200 ft).

Figure 1. The Bayfront Seadrift Fishing Pier and surrounding area (Google Earth 2020)

3. STATUS OF THE SPECIES

Table 1 provides the effect determinations for ESA-listed species and distinct population segments (DPSs) FEMA and NMFS believe may be affected by the proposed action.

Table 1. Effects Determinations for Species that May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic [NA] DPS)	T	LAA	LAA
Green (South Atlantic [SA] DPS)	T	LAA	LAA
Kemp's ridley	E	LAA	LAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic [NWA] DPS)	T	LAA	LAA
Hawksbill	E	NLAA	NE

E=endangered; T=threatened; NLAA=may affect, not likely to adversely affect; LAA=likely to adversely affect; NE=no effect

To determine which sea turtle species are most likely to occur within the action area, we reviewed the STSSN inshore stranding data (i.e., stranding data for all areas inside of protected waters) for Zone 19. Zone 19 extends from 28^{o} to 29^{o} North latitude (i.e., from approximately Rockport to Freeport, Texas). Based on this data, we believe green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be affected by recreational fishing that will occur at the pier upon completion of the proposed action (Table 2). We do not believe hawksbill or leatherback sea turtles are likely to be caught on or entangled in recreational hook and line gear at the pier. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas, which are not located within the action area, feeding primarily on encrusting sponges and not baits typically fished from pier. Leatherback sea turtles tend to be pelagic feeders, feeding on jellyfish and not baits typically fished from piers. In addition, there are no reported hook-and-line captures of leatherback or hawksbill sea turtles in the available STSSN stranding data for Zone 19 (Table 2) between 2007 and 2016.

Table 2. Summary of Inshore Sea Turtle STSSN Data for Zone 19, 2007-2016

Species	Stranding Data (All Activities)	Recreational Hook-and-line Captures and Gear Entanglements Only
Green sea turtle	462	22
Hawksbill sea turtle	3	0
Kemp's ridley sea turtle	26	3
Leatherback sea turtle	0	0
Loggerhead sea turtle	18	2

3.1 Potential Routes of Effect Not Likely To Adversely Affect Listed Species

Sea turtles may be injured if struck by equipment or materials during construction activities. However, we believe that this route of effect is extremely unlikely to occur. There is no in-water work associated with this pier repair. Mobile species, such as sea turtles, are able to avoid slow-moving equipment and support vessels and the placement of material. In addition, the applicants' implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*[1] will further reduce the risk by requiring all construction workers to watch for sea turtles. If at any point, an ESA-listed sea turtle species is observed within 50 ft of the work site all construction or operation of any mechanical equipment will cease until the listed species has departed the project area on its own volition. Further, construction will be limited to daylight hours, which will increase the ability of construction workers to see listed species, if present, and avoid interactions with them.

Sea turtles may be injured due to entanglement in improperly discarded fishing gear resulting from future use of the repaired pier after completion of the proposed action. We believe this route of effect is extremely unlikely to occur. The applicant will maintain fishing line recycling receptacles and trashcans with lids at regular intervals along the pier to keep debris out of the water, and we expect that anglers will appropriately dispose of fishing gear when disposal bins

[1] NMFS. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions revised March 23, 2006. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida. https://www.fisheries.noaa.gov/webdam/download/92937961

are available. The receptacles will be clearly marked and will be emptied regularly to ensure they are not overfilled and that fishing lines are disposed of properly. Further, the applicant will perform annual underwater fishing debris cleanup, minimizing the accumulation of fishing line over time. The effect of improperly disposed of and lost/snagged fishing gear is discussed in Section 5.1.1.

The action area contains habitat that may be used by juvenile sea turtles for foraging and development. Sea turtles may be affected by their inability to access the in-water portion of the action area due to their avoidance of construction activities and related noise. We believe any temporary habitat access effects will be unmeasurable, and therefore insignificant, given the absence of seagrass habitat within the action area and the availability of more suitable habitat in the surrounding bays.

Effects to ESA-listed sea turtles as a result of noise created by construction activities can physically injure animals in the action area or change animal behavior in the action area. Injurious effects can occur in 2 ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects interfere with animals migrating, feeding, resting, or reproducing, for example. Our evaluation of effects to listed species as a result of noise created by construction activities is based on the analysis prepared in support of the Opinion for SAJ-82.[2] The noise analysis in this consultation evaluates effects to sea turtles identified by NMFS as potentially affected in the table above.

Based on our noise calculations, the installation of 12-in wood piles by impact hammer will not cause single-strike or peak-pressure injury to sea turtles. The cumulative sound exposure level (cSEL) of multiple pile strikes over the course of a day may cause injury to sea turtles at a radius of up to 30 ft (9 m). In the analysis in SAJ-82 (SAJ-82, Appendix B, Table 6), the noise impact radius of 30 ft (9 m) is based on 10 wood piles driven per day via impact hammer. Thus, the noise radius will be less on days when fewer than 10 wood piles are installed. Nonetheless, due to the mobility of sea turtles, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal's suffering physical injury from noise is extremely unlikely to occur. Even in the unlikely event an animal does not vacate the daily cumulative injurious impact zone, the radius of that area is smaller than the 50-ft radius that will be visually monitored for ESA-listed sea turtles. Construction personnel will cease construction activities if a sea turtle is sighted per NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions.* Thus, we believe the likelihood of any injurious cSEL effects is unlikely to occur. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, impact hammer pile installation of 12-in wood piles could also cause behavioral effects at radii of 151 ft (46 m) for sea turtles. Due to the mobility of sea turtles, we expect them to move away from noise disturbances. Because there is similar habitat

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[2] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

nearby, we believe behavioral effects will be temporary and unmeasurable, and therefore insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods between pile installations and at night. Therefore, we anticipate adverse effects associated with behavioral responses to noise effects will be temporary and incapable of being measured and therefore, insignificant.

3.2 Potential Route of Effect Likely To Adversely Affect Listed Species

NMFS determined the potential route of effect likely to adversely affect sea turtles from the proposed action is the risk of physical injury from recreational hook-and-line interaction resulting from future use of the pier after completion of the proposed action.

Hook-and-line gear commonly used by recreational anglers fishing from fishing piers can adversely affect sea turtles via entanglement, hooking, and trailing line. A more in-depth discussion of the effects of hook-and-line capture to sea turtles is discussed in Section 5.1.

3.3 Status of Sea Turtles

Section 3.3.1 addresses the general threats that confront all sea turtle species. Sections 3.3.2 – 3.3.4 address information on the distribution, life history, population structure, abundance, population trends, and unique threats to each species of sea turtle likely to be adversely affected by the proposed action.

3.3.1 General Threats Faced by All Sea Turtle Species

Sea turtles face numerous natural and man-made threats that shape their status and affect their ability to recover. Many of the threats are either the same or similar in nature for all listed sea turtle species. Those identified in this section are discussed in a general sense for all sea turtles. Threat information specific to a particular species are then discussed in the corresponding Status of the Species where appropriate.

Fisheries

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991, NMFS and USFWS 1992, NMFS and USFWS 1993, NMFS and USFWS 2008, NMFS, USFWS et al. 2011). Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to United States (U.S.) Atlantic pelagic longline fisheries. Sea turtles in the benthic environment in waters off the coastal U.S. are exposed to a suite of other fisheries in federal and state waters. These fishing methods include trawls, gillnets, purse seines, hook-and-line gear (including bottom longlines and vertical lines [e.g., bandit gear, handlines, and rod-reel]), pound nets, and trap fisheries. Refer to the Environmental Baseline for more specific information regarding federal and state managed fisheries affecting sea turtles within the action area). The southeast U.S. shrimp fisheries have historically been the largest fishery threat to benthic sea turtles in the southeastern U.S., and continue to interact with and kill large numbers of sea turtles each year.

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further impeding the ability of sea turtles to survive and recover on a global scale. For example, pelagic stage sea turtles, especially loggerheads and leatherbacks, circumnavigating the Atlantic are susceptible to international longline fisheries including the Azorean, Spanish, and various other fleets (Aguilar, Mas et al. 1994, Bolten, Bjorndal et al. 1994). Bottom longlines and gillnet fishing is known to occur in many foreign waters, including (but not limited to) the northwest Atlantic, western Mediterranean, South America, West Africa, Central America, and the Caribbean. Shrimp trawl fisheries are also occurring off the shores of numerous foreign countries and pose a significant threat to sea turtles similar to the impacts seen in U.S. waters. Many unreported takes or incomplete records by foreign fleets make it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea turtle survival and recovery throughout their respective ranges.

Non-Fishery In-Water Activities

There are also many non-fishery impacts affecting the status of sea turtle species, both in the ocean and on land. In nearshore waters of the U.S., the construction and maintenance of federal navigation channels has been identified as a source of sea turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS 1997). Sea turtles entering coastal or inshore areas have also been affected by entrainment in the cooling-water systems of electrical generating plants. Other nearshore threats include harassment and/or injury resulting from private and commercial vessel operations, military detonations and training exercises, in-water construction activities, and scientific research activities.

Coastal Development and Erosion Control

Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Lutcavage, Plotkin et al. 1997, Bouchard, Moran et al. 1998). These factors may decrease the amount of nesting area available to females and change the natural behaviors of both adults and hatchlings, directly or indirectly, through loss of beach habitat or changing thermal profiles and increasing erosion, respectively (Ackerman 1997, Witherington, Hirama et al. 2003, Witherington, Hirama et al. 2007). In addition, coastal development is usually accompanied by artificial lighting which can alter the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal 1991). In-water erosion control structures such as breakwaters, groins, and jetties can impact nesting females and hatchling as they approach and leave the surf zone or head out to sea by creating physical blockage, concentrating predators, creating longshore currents, and disrupting of wave patterns.

Environmental Contamination

Multiple municipal, industrial, and household sources, as well as atmospheric transport, introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g., dichlorodiphenyltrichloroethane [DDT], polychlorinated biphenyls [PCB], and perfluorinated chemicals [PFC]), and others that may cause adverse health effects to sea turtles (Iwata, Tanabe et al. 1993, Grant and Ross 2002, Garrett 2004, Hartwell 2004). Acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges may directly injure individuals through skin contact with oils (Geraci 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area.

The April 20, 2010, explosion of Deepwater Horizon (DWH) oil rig affected sea turtles in the Gulf of Mexico. An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2015). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. Information on the spill impacts to individual sea turtle species is presented in the Status of the Species sections for each species.

Marine debris is a continuing problem for sea turtles. Sea turtles living in the pelagic environment commonly eat or become entangled in marine debris (e.g., tar balls, plastic bags/pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts where debris and their natural food items converge. This is especially problematic for sea turtles that spend all or significant portions of their life cycle in the pelagic environment (i.e., leatherbacks, juvenile loggerheads, and juvenile green turtles).

Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov).

Climate change impacts on sea turtles currently cannot be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of sea turtles may result (NMFS and USFWS 2007). In sea turtles, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35 degrees Celsius (°C) (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007).

The effects from increased temperatures may be intensified on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and USFWS 2007). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Daniels, White et al. 1993, Fish, Cote et al. 2005, Baker, Littnan et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis, Baker et al. 2006, Baker, Littnan et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen [DO] levels, nutrient distribution, etc.) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc.) which could ultimately affect the primary foraging areas of sea turtles.

Other Threats

Predation by various land predators is a threat to developing nests and emerging hatchlings. The major natural predators of sea turtle nests are mammals, including raccoons, dogs, pigs, skunks, and badgers. Emergent hatchlings are preyed upon by these mammals as well as ghost crabs, laughing gulls, and the exotic South American fire ant (*Solenopsis invicta*). In addition to natural predation, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS 2008).

Diseases, toxic blooms from algae and other microorganisms, and cold stunning events are additional sources of mortality that can range from local and limited to wide-scale and impacting hundreds or thousands of animals.

3.3.2 Status of Green Sea Turtle – North Atlantic and South Atlantic DPSs

The green sea turtle was originally listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered. On April 6, 2016, the original listing was replaced with the listing of 11 distinct population segments (DPSs) (81 FR 20057 2016) (Figure 2). The Mediterranean, Central West Pacific, and Central South Pacific DPSs were listed as endangered. The North Atlantic, South Atlantic, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific DPSs were listed as threatened. For the purposes of this consultation, only the South Atlantic DPS (SA DPS) and North Atlantic DPS (NA DPS) will be considered, as they are the only two DPSs with individuals occurring in the Atlantic and Gulf of Mexico waters of the United States.

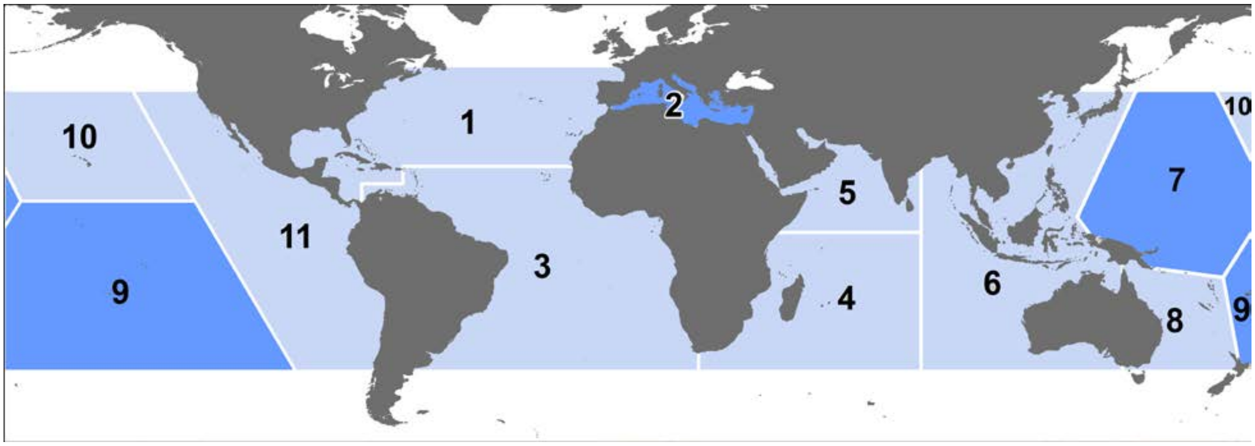

Figure 2. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. East Pacific.

Species Description and Distribution

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) with a straight carapace length of greater than 3.3 ft (1 m). Green sea turtles have a smooth carapace with 4 pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface, although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, or brown and black in starburst or irregular patterns (Lagueux 2001).

With the exception of post-hatchlings, green sea turtles live in nearshore tropical and subtropical waters where they generally feed on marine algae and seagrasses. They have specific foraging grounds and may make large migrations between these forage sites and natal beaches for nesting (Hays, Åkesson et al. 2001). Green sea turtles nest on sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands in more than 80 countries worldwide (Hirth 1997). The 2 largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica (part of the NA DPS), and Raine Island, on the Pacific coast of Australia along the Great Barrier Reef.

Differences in mitochondrial DNA properties of green sea turtles from different nesting regions indicate there are genetic subpopulations (Bowen, Meylan et al. 1992, FitzSimmons, Farrington et al. 2006). Despite the genetic differences, sea turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. Within U.S. waters individuals from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, two small-scale studies provide an insight into the degree of mixing on the foraging grounds. An analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley, Singel et al. 2007). On the Atlantic coast of Florida, a study on the foraging grounds off Hutchinson Island found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting assemblage, which is part of the SA DPS (Bass and Witzell 2000). All of the individuals in both studies were benthic juveniles. Available information on green turtle migratory behavior indicates that long distance dispersal is only seen for juvenile turtles. This suggests that larger adult-sized turtles return to forage within the region of their natal rookeries, thereby limiting the potential for gene flow across larger scales (Monzón-Argüello, López-Jurado et al. 2010). While all of the mainland U.S. nesting individuals are part of the NA DPS, the U.S. Caribbean nesting assemblages are split between the NA and SA DPS. Nesters in Puerto Rico are part of the NA DPS, while those in the U.S. Virgin Islands are part of the SA DPS. We do not currently have information on what percent of individuals on the U.S. Caribbean foraging grounds come from which DPS.

North Atlantic DPS Distribution

The NA DPS boundary is illustrated in Figure 2. Four regions support nesting concentrations of particular interest in the NA DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. By far the most important nesting concentration for green turtles in this DPS is Tortuguero, Costa Rica. Nesting also occurs in the Bahamas, Belize, Cayman Islands, Dominican Republic, Haiti, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico, Turks and Caicos Islands, and North Carolina, South Carolina, Georgia, and Texas, U.S.A. In the eastern North Atlantic, nesting has been reported in Mauritania (Fretey 2001).

The complete nesting range of NA DPS green sea turtles within the southeastern United States includes sandy beaches between Texas and North Carolina, as well as Puerto Rico (NMFS and USFWS 1991, Dow, Eckert et al. 2007). The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994, Meylan, Schroeder et al. 1995). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard south through Broward counties.

In U.S. Atlantic and Gulf of Mexico waters, green sea turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Hildebrand 1982, Doughty 1984, Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart 1992, Wershoven and Wershoven 1992). The summer developmental habitat for green sea turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

South Atlantic DPS Distribution

The SA DPS boundary is shown in Figure 2, and includes the U.S. Virgin Islands in the Caribbean. The SA DPS nesting sites can be roughly divided into four regions: western Africa, Ascension Island, Brazil, and the South Atlantic Caribbean (including Colombia, the Guianas, and Aves Island in addition to the numerous small, island nesting sites).

The in-water range of the SA DPS is widespread. In the eastern South Atlantic, significant sea turtle habitats have been identified, including green turtle feeding grounds in Corisco Bay, Equatorial Guinea/Gabon (Formia 1999); Congo; Mussulo Bay, Angola (Carr and Carr 1991); as well as Principe Island. Juvenile and adult green turtles utilize foraging areas throughout the Caribbean areas of the South Atlantic, often resulting in interactions with fisheries occurring in those same waters (Dow, Eckert et al. 2007). Juvenile green turtles from multiple rookeries also frequently utilize the nearshore waters off Brazil as foraging grounds as evidenced from the frequent captures by fisheries (Marcovaldi, Gifforni et al. 2009, Lima, Melo et al. 2010, López-Barrera, Longo et al. 2012). Genetic analysis of green turtles on the foraging grounds off Ubatuba and Almofala, Brazil show mixed stocks coming primarily from Ascension, Suriname and Trindade as a secondary source, but also Aves, and even sometimes Costa Rica (North Atlantic DPS)(Naro-Maciel, Becker et al. 2007, Naro-Maciel, Bondioli et al. 2012). While no nesting occurs as far south as Uruguay and Argentina, both have important foraging grounds for South Atlantic green turtles (López-Mendilaharsu, Estrades et al. 2006, Lezama 2009, Gonzalez Carman, Alvarez et al. 2011, Prosdocimi, González Carman et al. 2012, Rivas-Zinno 2012).

Life History Information

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches and along migratory routes. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982, Frazer and Ehrhart 1985) every 2-4 years while males are known to reproduce every year (Balazs 1983). In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 1989). During the nesting season, females nest at approximately 2-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart 1996). Clutch size often varies among subpopulations, but mean clutch size is approximately 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart 1989). Eggs incubate for approximately 2 months before hatching. Hatchling green sea turtles are approximately 2 inches (5 cm) in length and weigh approximately 0.9 ounces (25 grams). Survivorship at any particular nesting site is greatly influenced by the level of man-made stressors, with the more pristine and less disturbed nesting sites (e.g., along the Great Barrier Reef in Australia) showing higher survivorship values than nesting sites known to be highly disturbed (e.g., Nicaragua) (Campell and Lagueux 2005, Chaloupka and Limpus 2005).

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. This early oceanic phase remains one of the most poorly understood aspects of green sea turtle life history (NMFS and USFWS 2007). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 inches (1-5 cm) per year (Green 1993), which may be attributed to their largely herbivorous, low-net energy diet (Bjorndal 1982). At approximately 8-10 inches

(20-25 cm) carapace length, juveniles leave the pelagic environment and enter nearshore developmental habitats such as protected lagoons and open coastal areas rich in sea grass and marine algae. Growth studies using skeletochronology indicate that green sea turtles in the western Atlantic shift from the oceanic phase to nearshore developmental habitats after approximately 5-6 years (Zug and Glor 1998, Bresette, Scarpino et al. 2006). Within the developmental habitats, juveniles begin the switch to a more herbivorous diet, and by adulthood feed almost exclusively on seagrasses and algae (Rebel 1974), although some populations are known to also feed heavily on invertebrates (Carballo, Olabarria et al. 2002). Green sea turtles mature slowly, requiring 20-50 years to reach sexual maturity (Chaloupka and Musick 1997, Hirth 1997).

While in coastal habitats, green sea turtles exhibit site fidelity to specific foraging and nesting grounds, and it is clear they are capable of “homing in” on these sites if displaced (McMichael, Carthy et al. 2003). Reproductive migrations of Florida green sea turtles have been identified through flipper tagging and/or satellite telemetry. Based on these studies, the majority of adult female Florida green sea turtles are believed to reside in nearshore foraging areas throughout the Florida Keys and in the waters southwest of Cape Sable, and some post-nesting turtles also reside in Bahamian waters as well (NMFS and USFWS 2007).

Status and Population Dynamics

Accurate population estimates for marine turtles do not exist because of the difficulty in sampling turtles over their geographic ranges and within their marine environments. Nonetheless, researchers have used nesting data to study trends in reproducing sea turtles over time. A summary of nesting trends and nester abundance is provided in the most recent status review for the species (Seminoff, Allen et al. 2015), with information for each of the DPSs.

<u>North Atlantic DPS</u>

The NA DPS is the largest of the 11 green turtle DPSs, with an estimated nester abundance of over 167,000 adult females from 73 nesting sites. Overall this DPS is also the most data rich. Eight of the sites have high levels of abundance (i.e., <1000 nesters), located in Costa Rica, Cuba, Mexico, and Florida. All major nesting populations demonstrate long-term increases in abundance (Seminoff, Allen et al. 2015).

Quintana Roo, Mexico, accounts for approximately 11% of nesting for the DPS (Seminoff, Allen et al. 2015). In the early 1980s, approximately 875 nests/year were deposited, but by 2000 this increased to over 1,500 nests/year (NMFS and USFWS 2007). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, CIQROO, unpublished data, 2013, in Seminoff et al. 2015).

Tortuguero, Costa Rica is by far the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff, Allen et al. 2015). Nesting at Tortuguero appears to have been increasing since the 1970’s, when monitoring began. For instance, from 1971-1975 there were approximately 41,250 average annual emergences documented and this number increased to an average of 72,200 emergences from 1992-1996 (Bjorndal, Wetherall et al. 1999). Troëng and

Rankin (2005) collected nest counts from 1999-2003 and also reported increasing trends in the population consistent with the earlier studies, with nest count data suggesting 17,402-37,290 nesting females per year (NMFS and USFWS 2007). Modeling by Chaloupka, Work et al. (2008) using data sets of 25 years or more resulted in an estimate of the Tortuguero, Costa Rica population's growing at 4.9% annually.

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (Meylan, Schroeder et al. 1994, Weishampel, Bagley et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan, Schroeder et al. 1995). Green sea turtle nesting is documented annually on beaches of North Carolina, South Carolina, and Georgia, though nesting is found in low quantities (up to tens of nests) (nesting databases maintained on www.seaturtle.org).

Florida accounts for approximately 5% of nesting for this DPS (Seminoff, Allen et al. 2015). In Florida, index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989, the pattern of green sea turtle nesting has generally shown biennial peaks in abundance with a positive trend during the 10 years of regular monitoring (Figure 3). According to data collected from Florida's index nesting beach survey from 1989-2018, green sea turtle nest counts across Florida have increased dramatically, from a low of 267 in the early 1990s to a high of 38,954 in 2017. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011, and a return to the trend of biennial peaks in abundance thereafter (Figure 3). Modeling by Chaloupka, Work et al. (2008) using data sets of 25 years or more resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9% at that time. Increases have been even more rapid in recent years.

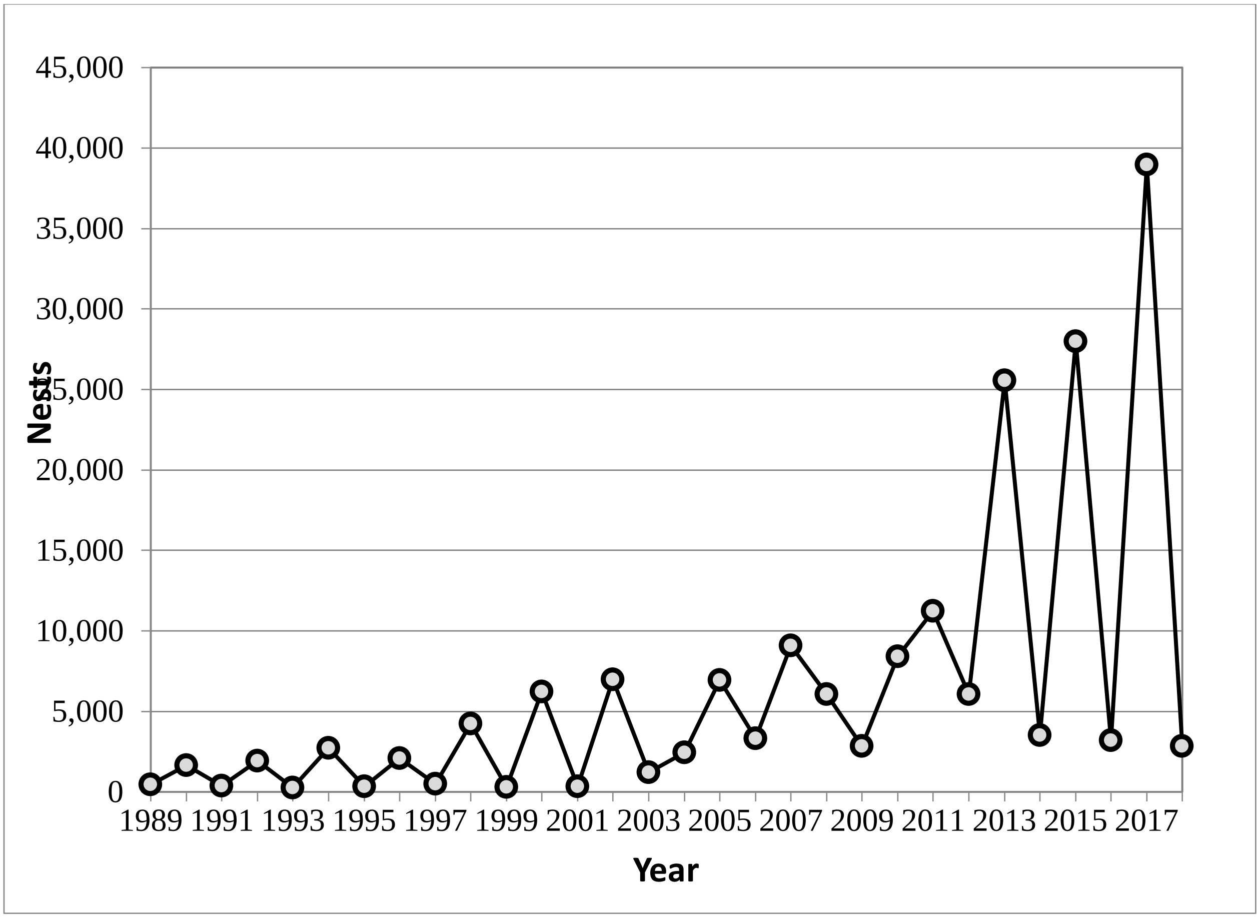

Figure 3. Green sea turtle nesting at Florida index beaches since 1989

Similar to the nesting trend found in Florida, in-water studies in Florida have also recorded increases in green turtle captures at the Indian River Lagoon site, with a 661 percent increase over 24 years (Ehrhart, Redfoot et al. 2007), and the St Lucie Power Plant site, with a significant increase in the annual rate of capture of immature green turtles (SCL<90 cm) from 1977 to 2002 or 26 years (3,557 green turtles total; M. Bressette, Inwater Research Group, unpubl. data; (Witherington, Bresette et al. 2006).

South Atlantic DPS

The SA DPS is large, estimated at over 63,000 nesters, but data availability is poor. More than half of the 51 identified nesting sites (37) did not have sufficient data to estimate number of nesters or trends (Seminoff, Allen et al. 2015). This includes some sites, such as beaches in French Guiana, which are suspected to have large numbers of nesters. Therefore, while the estimated number of nesters may be substantially underestimated, we also do not know the population trends at those data-poor beaches. However, while the lack of data was a concern due to increased uncertainty, the overall trend of the SA DPS was not considered to be a major concern as some of the largest nesting beaches such as Ascension Island (United Kingdom), Aves Island (Venezuela), and Galibi (Suriname) appear to be increasing. Others such as Trindade (Brazil), Atol das Rocas (Brazil), and Poilão (Guinea-Bissau) and the rest of Guinea-Bissau seem to be stable or do not have sufficient data to make a determination. Bioko (Equatorial Guinea) appears to be in decline but has less nesting than the other primary sites (Seminoff, Allen et al. 2015).

In the U.S., nesting of SA DPS green turtles occurs on the beaches of the U.S. Virgin Islands, primarily on Buck Island. There is insufficient data to determine a trend for Buck Island nesting, and it is a smaller rookery, with approximately 63 total nesters utilizing the beach (Seminoff, Allen et al. 2015).

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of the species for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. Green sea turtles also face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (e.g., plastics, petroleum products, petrochemicals), ecosystem alterations (e.g., nesting beach development, beach nourishment and shoreline stabilization, vegetation changes), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.3.1.

In addition to general threats, green sea turtles are susceptible to natural mortality from Fibropapillomatosis (FP) disease. FP results in the growth of tumors on soft external tissues (flippers, neck, tail, etc.), the carapace, the eyes, the mouth, and internal organs (gastrointestinal tract, heart, lungs, etc.) of turtles (Jacobson, Mansell et al. 1989, Herbst 1994, Aguirre, Balazs et al. 2002). These tumors range in size from 0.04 inches (0.1 cm) to greater than 11.81 inches (30 cm) in diameter and may affect swimming, vision, feeding, and organ function (Jacobson, Mansell et al. 1989, Herbst 1994, Aguirre, Balazs et al. 2002). Presently, scientists are unsure of the exact mechanism causing this disease, though it is believed to be related to both an infectious agent, such as a virus (Herbst, Jacobson et al. 1995), and environmental conditions (e.g., habitat degradation, pollution, low wave energy, and shallow water (Foley, Schroeder et al. 2005). FP is cosmopolitan, but it has been found to affect large numbers of animals in specific areas, including Hawaii and Florida (Jacobson 1990, Jacobson, Simpson Jr. et al. 1991, Herbst 1994).

Cold-stunning is another natural threat to green sea turtles. Although it is not considered a major source of mortality in most cases, as temperatures fall below 46.4°-50°F (8°-10°C) turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989). During January 2010, an unusually large cold-stunning event in the southeastern United States resulted in around 4,600 sea turtles, mostly greens, found cold-stunned, and hundreds found dead or dying. A large cold-stunning event occurred in the western Gulf of Mexico in February 2011, resulting in approximately 1,650 green sea turtles found cold-stunned in Texas. Of these, approximately 620 were found dead or died after stranding, while approximately 1,030 turtles were rehabilitated and released. During this same time frame, approximately 340 green sea turtles were found cold-stunned in Mexico, though approximately 300 of those were subsequently rehabilitated and released.

Whereas oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH spill on green sea turtles are considered here. Impacts to green sea turtles occurred to offshore small juveniles only. A total of 154,000 small juvenile greens (36.6% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. A large number of small juveniles were removed from the population, as 57,300 small juvenile greens are estimated to have died as a result of the exposure. A total of 4 nests (580 eggs) were also translocated during response efforts, with 455 hatchlings released (the fate of which is unknown) (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources, which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

While green turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of Mexico at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of Mexico were reduced as a result of the Deepwater Horizon oil spill of 2010 (DWH), the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event, as well as the impacts being primarily to smaller juveniles (lower reproductive value than adults and large juveniles), reduces the impact to the overall population. It is unclear what impact these losses may have caused on a population level, but it is not expected to have had a large impact on the population trajectory moving forward. However, recovery of green turtle numbers equivalent to what was lost in the northern Gulf of Mexico as a result of the spill will likely take decades of sustained efforts to reduce the existing threats and enhance survivorship of multiple life stages (DWH Trustees 2015).

3.3.3 Status of Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970, under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Internationally, the Kemp's ridley is considered the most endangered sea turtle (Zwinenberg 1977, Groombridge 1982, TEWG 2000).

Species Description and Distribution

The Kemp's ridley sea turtle is the smallest of all sea turtles. Adults generally weigh less than 100 lb (45 kg) and have a carapace length of around 2.1 ft (65 cm). Adult Kemp's ridley shells are almost as wide as they are long. Coloration changes significantly during development from the grey-black dorsum and plastron of hatchlings, a grey-black dorsum with a yellowish-white plastron as post-pelagic juveniles, and then to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. There are 2 pairs of prefrontal scales on the head, 5 vertebral scutes, usually 5 pairs of costal scutes, and generally 12 pairs of marginal scutes on the carapace. In each bridge adjoining the plastron to the carapace, there are 4 scutes, each of which is perforated by a pore.

Kemp's ridley habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft (37 m) deep, although they can also be found in deeper offshore waters. These areas support the primary prey species of the Kemp's ridley sea turtle, which consist of swimming crabs, but may also include fish, jellyfish, and an array of mollusks.

The primary range of Kemp's ridley sea turtles is within the Gulf of Mexico basin, though they also occur in coastal and offshore waters of the U.S. Atlantic Ocean. Juvenile Kemp's ridley sea turtles, possibly carried by oceanic currents, have been recorded as far north as Nova Scotia. Historic records indicate a nesting range from Mustang Island, Texas, in the north to Veracruz, Mexico, in the south. Kemp's ridley sea turtles have recently been nesting along the Atlantic Coast of the United States, with nests recorded from beaches in Florida, Georgia, and the Carolinas. In 2012, the first Kemp's ridley sea turtle nest was recorded in Virginia. The Kemp's ridley nesting population had been exponentially increasing prior to the recent low nesting years, which may indicate that the population had been experiencing a similar increase. Additional nesting data in the coming years will be required to determine what the recent nesting decline means for the population trajectory.

Life History Information

Kemp's ridley sea turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. After 45-58 days of embryonic development, the hatchlings emerge and swim offshore into deeper, ocean water where they feed and grow until returning at a larger size. Hatchlings generally range from 1.65-1.89 in (42-48 mm) straight carapace length (SCL), 1.26-1.73 in (32-44 mm) in width, and 0.3-0.4 lb (15-20 g) in weight. Their return to nearshore coastal habitats typically occurs around 2 years of age (Ogren 1989), although the time spent in the oceanic zone may vary from 1-4 years or perhaps more (TEWG 2000). Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but they move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

The average rates of growth may vary by location, but generally fall within 2.2-2.9 ± 2.4 in per year (5.5-7.5 ± 6.2 cm/year) (Schmid and Woodhead 2000, Schmid and Barichivich 2006). Age to sexual maturity ranges greatly from 5-16 years, though NMFS et al. (2011) determined the best estimate of age to maturity for Kemp's ridley sea turtles was 12 years. It is unlikely that most adults grow very much after maturity. While some sea turtles nest annually, the weighted mean remigration rate for Kemp's ridley sea turtles is approximately 2 years. Nesting generally occurs from April to July. Females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994).

Population Dynamics

Of the 7 species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the beaches of Rancho Nuevo, Mexico (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s, however, nesting numbers from Rancho Nuevo and adjacent Mexican beaches were below 1,000, with a low of 702 nests in 1985. Yet, nesting steadily increased through the 1990s, and then accelerated during the first decade of the twenty-first century (Figure 4), which indicates the species is recovering.

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. More recent data, however, indicated an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017), but nesting for 2018 has declined to 17,945 (Gladys Porter Zoo data presentation by J. Pena, 2018). At this time, it is unclear whether the increases and declines in nesting seen over the past decade represents a population oscillating around an equilibrium point or if nesting will decline or increase in the future.

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data). 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.

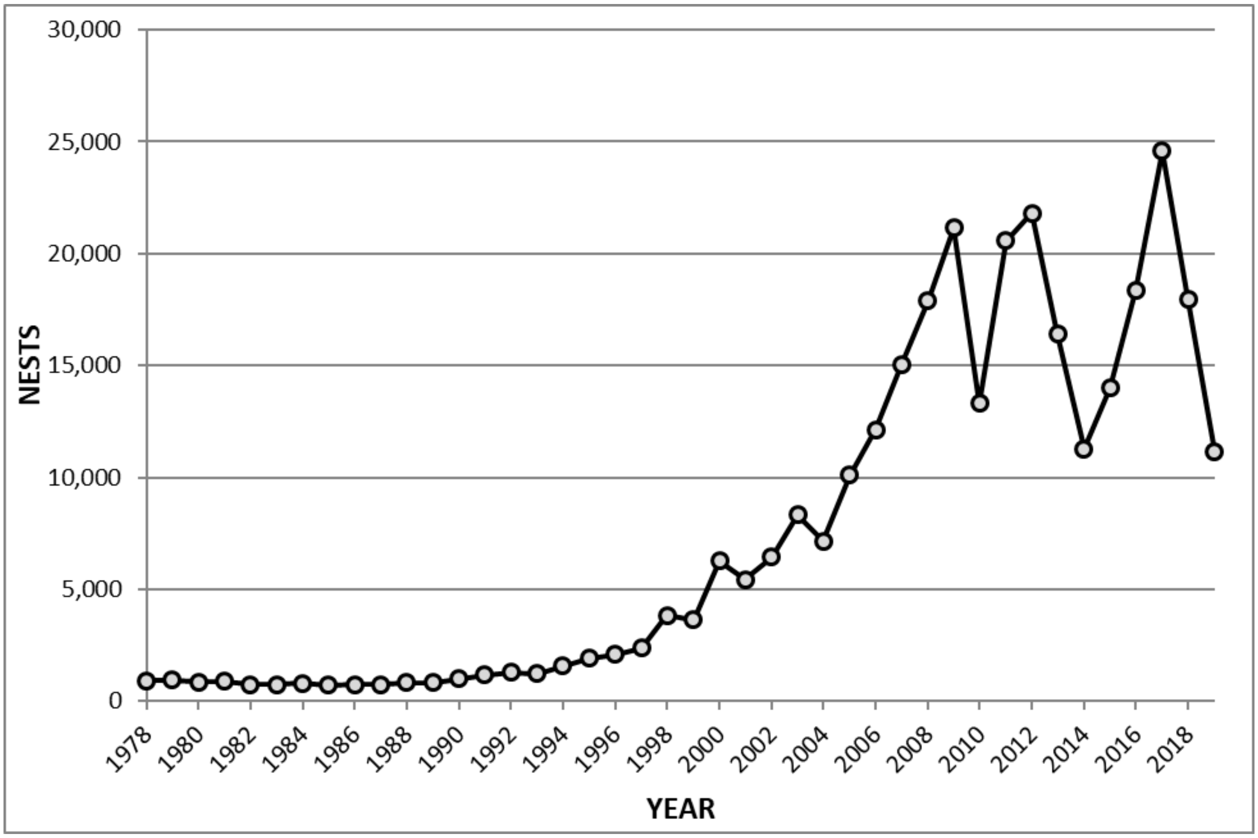

Figure 4. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019)

Through modelling, Heppell et al. (2005) predicted the population is expected to increase at least 12-16% per year and could reach at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011) produced an updated model that predicted the population to increase 19% per year and to attain at least 10,000 females nesting on Mexico beaches by 2011. Approximately 25,000 nests would be needed for an estimate of 10,000 nesters on the beach, based on an average 2.5 nests/nesting female. While counts did not reach 25,000 nests by 2015, it is clear that the population has increased over the long term. The increases in Kemp's ridley sea turtle nesting over the last 2 decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998, TEWG 2000). While these results are encouraging, the species' limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all factors which are often difficult to predict with any certainty. Additionally, the significant nesting declines observed in 2010 and 2013-2014 potentially indicate a serious population-level impact, and there is cause for concern regarding the ongoing recovery trajectory.

Threats

Kemp's ridley sea turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.3.1; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact Kemp's ridley sea turtles.

As Kemp's ridley sea turtles continue to recover and nesting *arribadas*[3] are increasingly established, bacterial and fungal pathogens in nests are also likely to increase. Bacterial and fungal pathogen impacts have been well documented in the large arribadas of the olive ridley at Nancite in Costa Rica (Mo 1988). In some years, and on some sections of the beach, the hatching success can be as low as 5% (Mo 1988). As the Kemp's ridley nest density at Rancho Nuevo and adjacent beaches continues to increase, appropriate monitoring of emergence success will be necessary to determine if there are any density-dependent effects.

Since 2010, we have documented (via the Sea Turtle Stranding and Salvage Network data, https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtle-stranding-and-salvage-network) elevated sea turtle strandings in the Northern Gulf of Mexico, particularly throughout the Mississippi Sound area. For example, in the first 3 weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87%) of which were Kemp's ridley sea turtles. During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters alone. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) having occurred from March through July, 390 (86%) of which were Kemp's ridley sea turtles. During 2012, a total of 384 sea turtles were reported from Louisiana, Mississippi, and Alabama waters. Of these reported strandings, 343 (89%) were Kemp's ridley sea turtles. During 2014, a total of 285 sea turtles were reported from Louisiana, Mississippi, and Alabama waters, though the data is incomplete. Of these reported strandings, 229 (80%) were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively. It should be noted that stranding coverage has increased considerably due to the DWH oil spill event.

Nonetheless, considering that strandings typically represent only a small fraction of actual mortality, these stranding events potentially represent a serious impact to the recovery and survival of the local sea turtle populations. While a definitive cause for these strandings has not been identified, necropsy results indicate a significant number of stranded turtles from these events likely perished due to forced submergence, which is commonly associated with fishery interactions (B. Stacy, NMFS, pers. comm. to M. Barnette, NMFS PRD, March 2012). Yet, available information indicates fishery effort was extremely limited during the stranding events. The fact that 80% or more of all Louisiana, Mississippi, and Alabama stranded sea turtles in the past 5 years were Kemp's ridleys is notable; however, this could simply be a function of the

[3] *Arribada* is the Spanish word for "arrival" and is the term used for massive synchronized nesting within the genus *Lepidochelys.*

species' preference for shallow, inshore waters coupled with increased population abundance, as reflected in recent Kemp's ridley nesting increases.

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl fisheries beginning in 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fisheries. All but a single sea turtle were identified as Kemp's ridleys (1 sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small juvenile specimens, ranging from 7.6-19.0 in (19.4-48.3 cm) curved carapace length (CCL). Subsequent years of observation noted additional captures in the skimmer trawl fisheries, including some mortalities. The small average size of encountered Kemp's ridleys introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum 4-in bar spacing of TEDs currently required in the shrimp fisheries. Due to this issue, a proposed 2012 rule to require 4-in bar spacing TEDs in the skimmer trawl fisheries (77 FR 27411) was not implemented. Following additional gear testing, however, we proposed a new rule in 2016 (81 FR 91097) to require TEDs with 3-inch (in) bar spacing for all vessels using skimmer trawls, pusher-head trawls, or wing nets. Ultimately, we published a final rule on December 20, 2019 (84 FR 70048), that requires all skimmer trawl vessels 40 feet and greater in length to use TEDs designed to exclude small sea turtles in their nets effective April 1, 2021. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf of Mexico may continue to be an issue of concern for the species, and one that may potentially slow the rate of recovery for Kemp's ridley sea turtles.

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact stemming from the DWH oil spill event of any sea turtle species. Impacts to Kemp's ridley sea turtles occurred to offshore small juveniles, as well as large juveniles and adults. Loss of hatchling production resulting from injury to adult turtles was also estimated for this species. Injuries to adult turtles of other species, such as loggerheads, certainly would have resulted in unrealized nests and hatchlings to those species as well. Yet, the calculation of unrealized nests and hatchlings was limited to Kemp's ridleys for several reasons. All Kemp's ridleys in the Gulf belong to the same population (NMFS, USFWS et al. 2011), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf of Mexico throughout their lives (DWH Trustees 2016).

A total of 217,000 small juvenile Kemp's ridleys (51.5% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. That means approximately half of all small juvenile Kemp's ridleys from the total population estimate of 430,000 oceanic small juveniles were exposed to oil. Furthermore, a large number of small juveniles were removed from the population, as up to 90,300 small juveniles Kemp's ridleys are estimated to have died as a direct result of the exposure. Therefore, as much as 20% of the small oceanic juveniles of this species were killed during that year. Impacts to large juveniles (>3 years old) and adults were also high. An estimated 21,990 such individuals were exposed to oil (about 22% of the total estimated population for those age classes); of those, 3,110 mortalities were estimated (or 3% of the population for those age classes). The loss of near-reproductive and reproductive-stage females would have contributed to some extent to the decline in total nesting abundance observed between 2011 and 2014. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to between approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2016). This is a minimum estimate, however, because the sublethal effects of the DWH oil spill event on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years, which may have contributed substantially to additional nesting deficits observed following the DWH oil spill event. These sublethal effects could have slowed growth and maturation rates, increased remigration intervals, and decreased clutch frequency (number of nests per female per nesting season). The nature of the DWH oil spill event effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. It is clear that the DWH oil spill event resulted in large losses to the Kemp's ridley population across various age classes, and likely had an important population-level effect on the species. Still, we do not have a clear understanding of those impacts on the population trajectory for the species into the future.

3.3.4 Status of Loggerhead Sea Turtle – Northwest Atlantic DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a Final Rule which designated 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) NWA (threatened), (2) Northeast Atlantic Ocean (endangered), (3) South Atlantic Ocean (threatened), (4) Mediterranean Sea (endangered), (5) North Pacific Ocean (endangered), (6) South Pacific Ocean (endangered), (7) North Indian Ocean (endangered), (8) Southeast Indo-Pacific Ocean (endangered), and (9) Southwest Indian Ocean (threatened). The NWA DPS is the only one that occurs within the action area, and therefore it is the only one considered in this Opinion.

Species Description and Distribution

Loggerheads are large sea turtles. Adults in the southeast United States average about 3 ft (92 cm) long, measured as SCL, and weigh approximately 255 lb (116 kg) (Ehrhart and Yoder 1978). Adult and subadult loggerhead sea turtles typically have a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, 5 pairs of costals, 5 vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes (Dodd Jr. 1988).

The loggerhead sea turtle inhabits continental shelf and estuarine environments throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd Jr. 1988). Habitat uses within these areas vary by life stage. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd Jr. 1988). Subadult and adult loggerheads are primarily found in coastal waters and eat benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990). For the NWA

DPS, most nesting occurs along the coast of the United States, from southern Virginia to Alabama. Additional nesting beaches for this DPS are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison and Morford 1996, Addison 1997), off the southwestern coast of Cuba (Moncada Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

Non-nesting, adult female loggerheads are reported throughout the U.S. Atlantic, Gulf of Mexico, and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches. Aerial surveys suggest that loggerheads as a whole are distributed in U.S. waters as follows: 54% off the southeast U.S. coast, 29% off the northeast U.S. coast, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf Coast of Florida. Previous Section 7 analyses have recognized at least 5 western Atlantic subpopulations, divided geographically as follows: (1) a Northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29ºN; (2) a South Florida nesting subpopulation, occurring from 29°N on the east coast of the state to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez M. 1990, TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001).

The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula. It also concluded that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the recovery plan uses a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are as follows: (1) the Northern Recovery Unit (NRU; Florida/Georgia border north through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU; Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU; islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU; Franklin County, Florida, through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU; Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the NWA DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the NWA DPS.

Life History Information

The Northwest Atlantic Loggerhead Recovery Team defined the following 8 life stages for the loggerhead life cycle, which include the ecosystems those stages generally use: (1) egg (terrestrial zone), (2) hatchling stage (terrestrial zone), (3) hatchling swim frenzy and transitional stage (neritic zone[4]), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations (Frazer and Ehrhart 1985, NMFS 2001). The annual mating season occurs from late March to early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008). Loggerhead hatchlings are 1.5-2-in-long and weigh about 0.7 oz (20 g).

As post-hatchlings, loggerheads hatched on U.S. beaches enter the "oceanic juvenile" life stage, migrating offshore and becoming associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986, Witherington 2002, Conant, Dutton et al. 2009). Oceanic juveniles grow at rates of 1-2 inches (2.9-5.4 cm) per year (Snover 2002, Bjorndal, Bolten et al. 2003) over a period as long as 7-12 years (Bolten, Bjorndal et al. 1998) before moving to more coastal habitats. Studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Laurent, Casale et al. 1998, Bolten and Witherington 2003). These studies suggest some turtles may either remain in the oceanic habitat in the North Atlantic longer than hypothesized, or they move back and forth between oceanic and coastal habitats interchangeably (Witzell 2002). Stranding records indicate that when immature loggerheads reach 15-24 in (40-60 cm) SCL, they begin to reside in coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell 2002).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico. Estuarine waters of the United States, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, as well as numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the Atlantic and Gulf of Mexico shoreline, essentially all shelf waters are inhabited by loggerheads (Conant, Dutton et al. 2009).

Like juveniles, non-nesting adult loggerheads also use the neritic zone. However, these adult loggerheads do not use the relatively enclosed shallow-water estuarine habitats with limited ocean access as frequently as juveniles. Areas such as Pamlico Sound, North Carolina, and the Indian River Lagoon, Florida, are regularly used by juveniles but not by adult loggerheads. Adult loggerheads do tend to use estuarine areas with more open ocean access, such as the Chesapeake Bay in the U.S. mid-Atlantic. Shallow-water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads (Conant, Dutton et al. 2009).

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, The Bahamas, Cuba, and the Gulf of Mexico. Seasonal use of mid-Atlantic shelf waters,

[4] Neritic refers to the nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters.

especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been documented (Hawkes, Broderick et al. 2007)Georgia Department of Natural Resources, unpublished data; South Carolina Department of Natural Resources, unpublished data). Satellite telemetry has identified the shelf waters along the west Florida coast, The Bahamas, Cuba, and the Yucatán Peninsula as important resident areas for adult female loggerheads that nest in Florida (Foley, Schroeder et al. 2008, Girard, Tucker et al. 2009, Hart, Lamont et al. 2012). The southern edge of the Grand Bahama Bank is important habitat for loggerheads nesting on the Cay Sal Bank in The Bahamas, but nesting females are also resident in the bights of Eleuthera, Long Island, and Ragged Islands. They also reside in Florida Bay in the United States, and along the north coast of Cuba (A. Bolten and K. Bjorndal, University of Florida, unpublished data). Moncada, Abreu-Grobois et al. (2010) report the recapture of 5 adult female loggerheads in Cuban waters originally flipper-tagged in Quintana Roo, Mexico, which indicates that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

Status and Population Dynamics

A number of stock assessments and similar reviews (TEWG 1998, TEWG 2000, NMFS 2001, Heppell, Crowder et al. 2003, NMFS and USFWS 2008, Conant, Dutton et al. 2009, NMFS-SEFSC 2009, TEWG 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.

Numbers of nests and nesting females can vary widely from year to year. Nesting beach surveys, though, can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (e.g., (NMFS and USFWS 2008). NMFS and USFWS (2008) concluded that the lack of change in 2 important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population.

Peninsular Florida Recovery Unit

The PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008). The statewide estimated total for 2017 was 96,912 nests (FWRI nesting database).

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 5). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2017; http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/). Over that time period, 3 distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represented a new record for loggerheads on the core index beaches. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but non-significant increasing trend. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability between 2012-2016 resulting in widening confidence intervals (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/). Nesting at the core index beaches declined in 2017 to 48,033, and rose slightly again to 48,983 in 2018, which is still the 4th highest total since 2001. However, it is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.) it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani, et al. 2019).

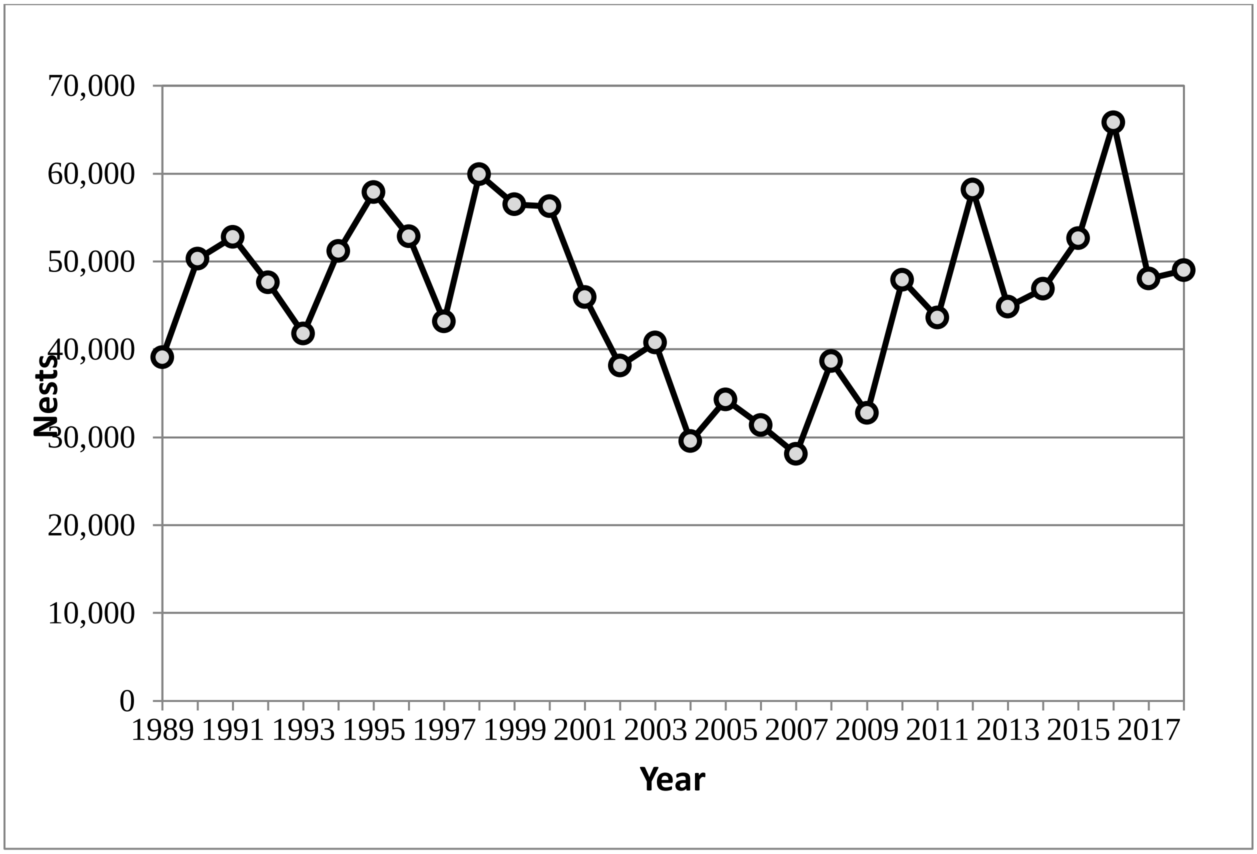

Figure 5. Loggerhead sea turtle nesting at Florida index beaches since 1989.

Northern Recovery Unit

Annual nest totals from beaches within the NRU averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (Georgia Department of Natural Resources [GADNR] unpublished data, North Carolina Wildlife Resources Commission [NCWRC] unpublished data, South Carolina Department of Natural Resources [SCDNR] unpublished data), and represent approximately 1,272 nesting females per year, assuming 4.1 nests per female

(Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3% annually from 1989-2008. Nest totals from aerial surveys conducted by SCDNR showed a 1.9% annual decline in nesting in South Carolina from 1980-2008. Overall, there are strong statistical data to suggest the NRU had experienced a long-term decline over that period of time.

Data since that analysis (Table 3) are showing improved nesting numbers and a departure from the declining trend. Georgia nesting has rebounded to show the first statistically significant increasing trend since comprehensive nesting surveys began in 1989 (Mark Dodd, GADNR press release, http://www.georgiawildlife.com/node/3139). South Carolina and North Carolina nesting have also begun to shift away from the past declining trend. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016. Nesting in 2017 and 2018 declined relative to 2016, back to levels seen in 2013 to 2015.

Table 3. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets compiled at Seaturtle.org).

Year	Georgia	South Carolina	North Carolina	Totals
2008	1,649	4,500	841	**6,990**
2009	998	2,182	302	**3,472**
2010	1,760	3,141	856	**5,757**
2011	1,992	4,015	950	**6,957**
2012	2,241	4,615	1,074	**7,930**
2013	2,289	5,193	1,260	**8,742**
2014	1,196	2,083	542	**3,821**
2015	2,319	5,104	1,254	**8,677**
2016	3,265	6,443	1,612	**11,320**
2017	2,155	5,232	1,195	**8,582**
2018	1,735	2,762	765	**5,262**
2019	3,945	8,774	2,291	**15,010**

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record (Figure 6). South Carolina has not updated its Index Beach information, but it likely follows a similar pattern to the statewide data in Table 3 above.

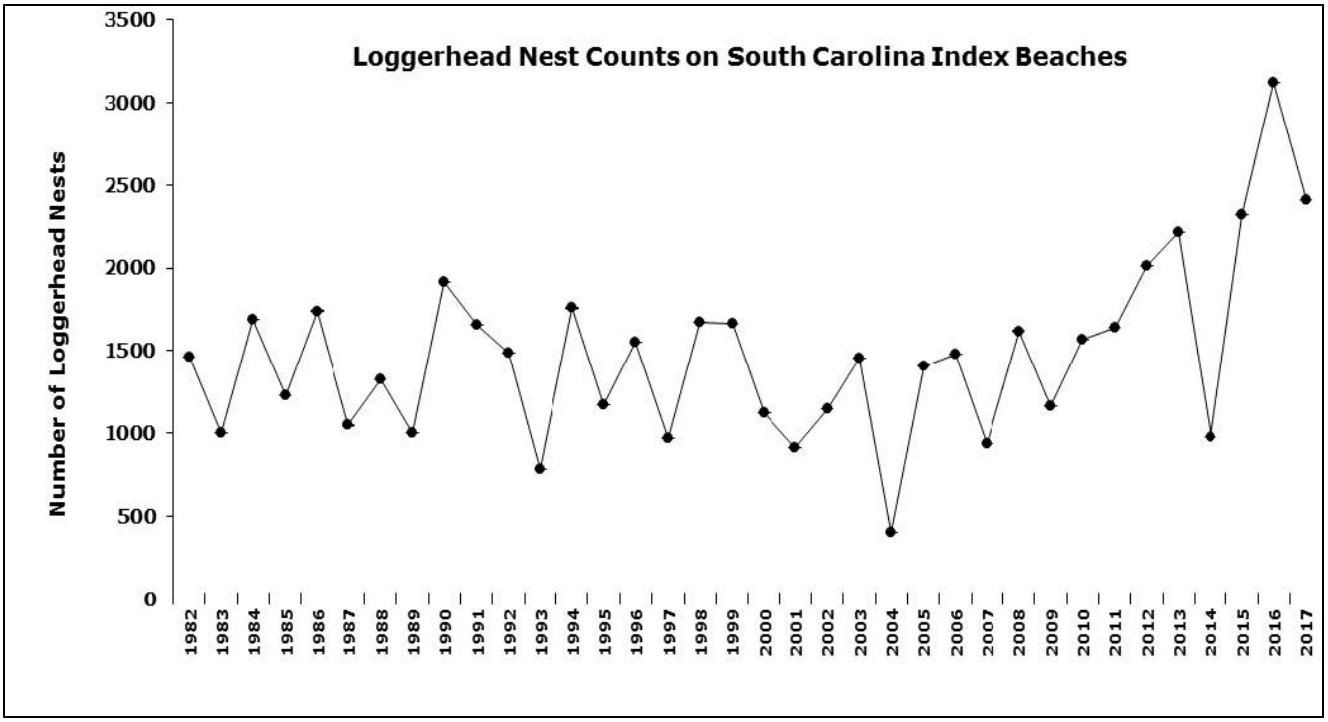

Figure 6. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: http://www.dnr.sc.gov/seaturtle/nest.htm).

Other NWA DPS Recovery Units

The remaining 3 recovery units—DTRU, NGMRU, and GCRU—are much smaller nesting assemblages, but they are still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort was relatively stable during the period from 1995-2004, although the 2002 year was missed. Nest counts ranged from 168-270, with a mean of 246, but there was no detectable trend during this period (NMFS and USFWS 2008). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. Analysis of the 12-year dataset (1997-2008) of index nesting beaches in the area shows a statistically significant declining trend of 4.7% annually. Nesting on the Florida Panhandle index beaches, which represents the majority of NGMRU nesting, had shown a large increase in 2008, but then declined again in 2009 and 2010 before rising back to a level similar to the 2003-2007 average in 2011. Nesting survey effort has been inconsistent among the GCRU nesting beaches, and no trend can be determined for this subpopulation (NMFS and USFWS 2008). Zurita et al. (2003) found a statistically significant increase in the number of nests on 7 of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. Nonetheless, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008).

In-water Trends

Nesting data are the best current indicator of sea turtle population trends, but in-water data also provide some insight. In-water research suggests the abundance of neritic juvenile loggerheads is steady or increasing. Although Ehrhart et al. (2007) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (CPUE) (Ehrhart, Redfoot et al. 2007, Epperly, Braun-McNeill et al. 2007, Arendt, Byrd et al. 2009). Researchers believe that this increase in CPUE is likely linked to an increase in juvenile abundance, although it is unclear whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence. Bjorndal, Bolten et al. (2005), cited in NMFS and USFWS (2008), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). In-water studies throughout the eastern United States, however, indicate a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerheads, a pattern corroborated by stranding data (TEWG 2009).

Population Estimate

The NMFS Southeast Fisheries Science Center developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS-SEFSC 2009). The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Resulting trajectories of model runs for each individual recovery unit, and the western North Atlantic population as a whole, were found to be very similar. The model run estimates from the adult female population size for the western North Atlantic (from the 2004-2008 time frame), suggest the adult female population size is approximately 20,000-40,000 individuals, with a low likelihood of females' numbering up to 70,000 (NMFS-SEFSC 2009). A less robust estimate for total benthic females in the western North Atlantic was also obtained, yielding approximately 30,000-300,000 individuals, up to less than 1 million (NMFS-SEFSC 2009). A preliminary regional abundance survey of loggerheads within the northwestern Atlantic continental shelf for positively identified loggerhead in all strata estimated about 588,000 loggerheads (interquartile range of 382,000-817,000). When correcting for unidentified turtles in proportion to the ratio of identified turtles, the estimate increased to about 801,000 loggerheads (interquartile range of 521,000-1,111,000) (NMFS-NEFSC 2011).

Threats

The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 3.3.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant, Dutton et al. 2009).

Regarding the impacts of pollution, loggerheads may be particularly affected by organochlorine contaminants; they have the highest organochlorine concentrations (Storelli, Barone et al. 2008) and metal loads (D'Ilio, Mattei et al. 2011) in sampled tissues among the sea turtle species. It is thought that dietary preferences were likely to be the main differentiating factor among sea turtle species. Storelli et al. (2008) analyzed tissues from stranded loggerhead sea turtles and found that mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals, and porpoises (Law, Fileman et al. 1991).

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of DWH on loggerhead sea turtles are considered here. Impacts to loggerhead sea turtles occurred to offshore small juveniles as well as large juveniles and adults. A total of 30,800 small juvenile loggerheads (7.3% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. Of those exposed, 10,700 small juveniles are estimated to have died as a result of the exposure. In contrast to small juveniles, loggerheads represented a large proportion of the adults and large juveniles exposed to and killed by the oil. There were 30,000 exposures (almost 52% of all exposures for those age/size classes) and 3,600 estimated mortalities. A total of 265 nests (27,618 eggs) were also translocated during response efforts, with 14,216 hatchlings released, the fate of which is unknown (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

Unlike Kemp's ridleys, the majority of nesting for the loggerhead NWA DPS occurs on the Atlantic coast, and thus loggerheads were impacted to a relatively lesser degree. However, it is likely that impacts to the NGMRU of the loggerhead NWA DPS would be proportionally much greater than the impacts occurring to other recovery units. Impacts to nesting and oiling effects on a large proportion of the NGMRU recovery unit, especially mating and nesting adults likely had an impact on the NGMRU. Based on the response injury evaluations for Florida Panhandle and Alabama nesting beaches (which fall under the NGMRU), the Trustees estimated that approximately 20,000 loggerhead hatchlings were lost due to DWH oil spill response activities on nesting beaches. Although the long-term effects remain unknown, the DWH oil spill event impacts to the NGMRU may result in some nesting declines in the future due to a large reduction of oceanic age classes during the DWH oil spill event. Although adverse impacts occurred to loggerheads, the proportion of the population that is expected to have been exposed to and directly impacted by the DWH oil spill event is relatively low. Thus we do not believe a population-level impact occurred due to the widespread distribution and nesting location outside of the Gulf of Mexico for this species.

Specific information regarding potential climate change impacts on loggerheads is also available. Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes, Broderick et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Weishampel, Bagley et al. 2004, Hawkes, Broderick et al. 2007), short inter-nesting intervals (Hays, Broderick et al. 2002), and shorter nesting seasons (Pike, Antworth et al. 2006).

4. ENVIRONMENTAL BASELINE

By regulation (50 CFR 402.02), environmental baselines for Opinions refer to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat 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 impact of State or private actions which are contemporaneous with the consultation in process. The consequences to the listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Focusing on the impacts of the activities in the action area specifically allows us to assess the prior experience and state (or condition) of the endangered and threatened individuals. This consideration is important because in some states or life history stages, or areas of their ranges, listed individuals will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other states, stages, or areas within their distributions. These localized stress responses or stressed baseline conditions may increase the severity of the adverse effects expected from the proposed action.

4.1 Status of Sea Turtles within the Action Area

Based on STSSN recreational hook-and-line capture and entanglement data, we believe green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be affected by recreational fishing that will occur at the pier upon completion of the proposed action (Table 2). All of these sea turtle species are migratory, traveling to forage grounds or for reproduction purposes. San Antonio Bay waters within the action area are likely used by these species of sea turtle for nearshore reproductive, developmental, and foraging habitat. NMFS believes that no individual sea turtle is likely to be a permanent resident of the action area, although some individuals may be present at any given time and may be adversely affected by recreational fishing occurring at the pier. These same individuals will migrate into offshore waters of the Gulf of Mexico, Caribbean Sea, and other areas of the North Atlantic Ocean at certain times of the year, and thus may be affected by activities occurring there; therefore, the status of the sea turtle species in the action area are considered to be the same as those discussed in Sections 3.3.1-3.3.4. There have been no reported recreational hook-and-line captures of sea turtles at the Bayfront Seadrift Fishing Pier according to STSSN data for the years 2007-2016.

4.2 Factors Affecting Sea Turtles within the Action Area

4.2.1 Federal Actions

ESA Section 7 Consultations

Other than the proposed action, no other federally permitted projects are known to have occurred within the action area, as per a review of the NMFS Protected Resources Division's completed consultation database by the consulting biologist on May 6, 2020.

ESA Section 10 Permits

Sea turtles are the focus of research activities authorized by Section 10 permits under the ESA. The ESA allows the issuance of permits to take listed species for the purposes of scientific research and enhancement (Section 10(a)(1)(A)). In addition, the ESA allows for NMFS to enter into cooperative agreements with states, developed under Section 6 of the ESA, to assist in recovery actions for listed species. However, we believe activities under these permits are not likely to occur within the action area that is the subject of this Biological Opinion.

4.2.2 State or Private Actions

Recreational Fishing

Recreational fishing as regulated by the State of Texas can affect sea turtles or their habitats within the action area. Pressure from recreational fishing in and adjacent to the action area is likely to continue. Observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and frequently ingest the hooks. Overall, hooked sea turtles have been reported to the STSSN by the public fishing from boats, piers, beaches, banks and jetties, and from commercial anglers fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001). Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to sea turtles in the area. A detailed summary of the known impacts of hook-and-line incidental captures to Kemp's ridley and loggerhead sea turtles can be found in the Turtle Expert Working Group (TEWG) reports (1998; 2000).

The Bayfront Seadrift Fishing Pier, originally built in 2014, currently operates 24-hours a day, year-round. The pier currently receives heavy recreational use, mostly for fishing. The proposed action extends the useful life of the pier and allows its use to continue. Historic use indicates that the on average, there are 9.87 people fishing from the pier at any given time during the weekdays, and 12.88 people at any given time on the weekends. The 10-year STSSN dataset (2007-2016) contains no reported recreational hook-and-line captures of sea turtles at the Bayfront Seadrift Fishing Pier.

4.2.3 Marine Debris and Acoustic Impacts

A number of activities that may affect ESA-listed sea turtle species in the action area include anthropogenic marine debris and acoustic effects. The effects from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study the effects to sea turtles from these sources.

4.2.4 Marine Pollution and Environmental Contamination

Sources of pollutants along the coastal areas include atmospheric loading of PCBs, stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean, and groundwater and other discharges (Vargo, Lutz et al. 1986). In addition, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, and boat traffic can degrade marine habitats used by sea turtles. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo, Lutz et al. 1986), the impacts of many other anthropogenic toxins have not been investigated. The development of marinas and docks in inshore waters can negatively affect nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters, the species analyzed in this Opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles within the action area.

4.2.5 Stochastic Events

Stochastic (i.e., random) events, such as hurricanes, occur in Texas and can affect the action area. These events are unpredictable and their effect on the recovery of ESA-listed sea turtles is unknown; yet, they have the potential to directly impede recovery if animals die as a result or indirectly if important habitats are damaged. Other stochastic events, such as a cold snap, can injure or kill these species.

5. EFFECTS OF THE ACTION

Effects of the action are 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 402.02).

5.1 Effects of Hook-and-Line Captures to Listed Species

As discussed above in Section 3, we believe hook-and-line gear commonly used by recreational anglers fishing from fishing piers can adversely affect sea turtles. Here we provide more detail on the potential effects of entanglement, hooking, and trailing line to sea turtles from interactions with hook-and-line gear.

5.1.1 Entanglement

Sea turtles are particularly prone to entanglement as a result of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that hook-and-line gear can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding or migration. Entanglement can interfere with a sea turtle's ability to swim or impair its feeding, breeding, or migration and may even prevent surfacing and cause drowning. If the sea turtle is entangled when young, the fishing line becomes tighter and more constricting as the sea turtle grows, cutting off blood flow and causing deep gashes, some severe enough to remove an appendage. Sea turtles have been found entangled in many different types of hook-and-line gear.

5.1.2 Hooking

Sea turtles are also injured and killed by being hooked. Hooking can occur as a result of a variety of scenarios, some depending on the foraging strategies and diving and swimming behavior of the various species of sea turtles. Sea turtles are either hooked externally in the flippers, head, shoulders, armpits, or beak, or internally inside the mouth or when the animal has swallowed the bait (Balazs, Pooley et al. 1995). Swallowed hooks are of the greatest threat. A sea turtle's esophagus (throat) is lined with strong conical papillae directed towards the stomach (White 1994). The presence of these papillae in combination with an S-shaped bend in the esophagus make it difficult to see hooks when looking through a sea turtle's mouth, especially if the hooks have been deeply ingested. Because of a sea turtle's digestive structure, deeply ingested hooks are also very difficult to remove without seriously injuring the turtle. A sea turtle's esophagus is also firmly attached to underlying tissue; thus, if a sea turtle swallows a hook and tries to free itself or is hauled on board a vessel, the hook can pierce the sea turtle's esophagus or stomach and can pull organs from its connective tissue. These injuries can cause the sea turtle to bleed internally or can result in infections, both of which can kill the sea turtle. If an ingested hook does not lodge into, or pierce, a sea turtle's digestive organs, it can pass through the digestive system entirely (Aguilar, Mas et al. 1995, Balazs, Pooley et al. 1995) with little damage (Work 2000). For example, a study of loggerheads deeply hooked by the Spanish Mediterranean pelagic longline fleet found ingested hooks could be expelled after 53 to 285 days (average 118 days) (Aguilar, Mas et al. 1995). If a hook passes through a sea turtle's digestive tract without getting lodged, the hook probably has not harmed the turtle.

5.1.3 Trailing Line

Trailing line (i.e., line left on a sea turtle after it has been captured and released) poses a serious risk to sea turtles. Line trailing from a swallowed hook is also likely to be swallowed, which may irritate the lining of the digestive system. The line may cause the intestine to twist upon itself until it twists closed, creating a blockage ("torsion"), or may cause a part of the intestine to slide into another part of intestine like a telescopic rod ("intussusception") which also leads to blockage. In both cases, death is a likely outcome (Watson, Epperly et al. 2005). The line may also prevent or hamper foraging, eventually leading to death. Trailing line may also become snagged on a floating or fixed object, further entangling a turtle and potentially slicing its appendages and affecting its ability to swim, feed, avoid predators, or reproduce. Sea turtles have been found trailing gear that has been snagged on the sea floor, or has the potential to snag, thus anchoring them in place (Balazs 1985). Long lengths of trailing gear are more likely to entangle the sea turtle, eventually leading to impaired movement, constriction wounds, and potentially death.

5.2 Captures Total Captures of Sea Turtles

5.2.1 Estimating Reported Captures of Sea Turtles

In the STSSN dataset for the years 2007-2016, no sea turtle captures were reported at the Bayfront Seadrift Fishing Pier; however, there are 4 reported captures of sea turtles at 3 similar public, inshore fishing structures in Zone 19. Because these structures are in a similar habitat and location as each other (i.e., inshore in Zone 19), we assume sea turtle behavior, density, and species composition are relatively the same for each. Because the 3 structures are of a similar size (i.e., relatively large, public fishing locations), they likely have similar angler effort, and we assume anglers fishing the 3 structures use similar baits, equipment, and fishing techniques. Therefore, the potential for interactions with sea turtles is likely the same for each.

Whether those interactions are reported varies depending on a number of factors, including whether there are signs encouraging reporting at the pier and jetties and angler behavior; sometimes anglers do not report encounters with ESA-listed species due to concerns over their personal liability or public perception at the time of the capture. Given this variability, it is difficult to estimate reporting behavior, but we assume that similar fishing structures within the same zone could have similar reporting rates. Therefore, even though the historic reported captures may be different between the 3 structures, the potential for reported captures is relatively the same for all similar, inshore fishing structures in Zone 19.[5]

Thus, we believe the best available data to estimate the number of expected reported captures at the Bayfront Seadrift Fishing Pier in the future can be determined by taking the average of the historic reported sea turtles captures across the 3 similar inshore, public fishing structures in Zone 19. Averaging the historic reported capture data across the 3 structures helps smooth variability among the locations and over time, providing for a more accurate overall estimate of future reported captures at the Bayfront Seadrift Fishing Pier.

To calculate the average number of reported hook-and-line captures across similar structures in Zone 19 over all the years of available data, we use the following equation:

$$Average\ Reported\ Captures\ per\ Structure\ in\ 10\ years$$
$$= Sum\ of\ Reported\ Captures\ at\ 3\ Structures\ in\ 10\ years \div 3\ Locations$$
$$= 4 \div 3$$
$$= 1.3333\ per\ structure$$

[5] Historic reported captures of sea turtle species is the best available data to estimate the potential for future reported captures of those species in light of the 20-year trend in increased nesting. There is no other data available to estimate taking of those species at fishing piers.

To calculate the estimated expected annual number of reported recreational hook-and-line captures of sea turtles at the Bayfront Seadrift Fishing Pier, we refer to the information on the similar structures in Zone 19 above and use the following equation:

$$\begin{aligned}&\textit{Expected Annual Reported Captures}\\&= \textit{Average Reported Captures per Structure in } 10 \textit{ years} \div 10 \textit{ years}\\&= 1.3333 \div 10\\&= 0.1333 \textit{ per year } (\textit{Table } 4, \textit{Line } 1)\end{aligned}$$

5.2.2 Estimating Unreported Captures of Sea Turtles

While we believe the best available information for estimating future captures at the Bayfront Seadrift Fishing Pier is the reported captures at public fishing structures in the surrounding area, we also recognize the need to account for unreported captures. In the following section, we use the best available data to estimate the number of unreported recreational hook-and-line-captures.

To the best of our knowledge, only 2 fishing pier surveys aimed at collecting data regarding unreported recreational hook-and-line captures of ESA-listed species have been conducted in the Southeast. One is from Charlotte Harbor, Florida (located on the Florida side of the Gulf of Mexico), and the other is from Mississippi.

The fishing pier survey in Charlotte Harbor, Florida, was conducted at 26 fishing piers in smalltooth sawfish critical habitat (Hill 2013). During the survey, 93 anglers were asked a series of open-ended questions regarding captures of sea turtles, smalltooth sawfish, and dolphins, including whether or not they knew these encounters were required to be reported and if they did report encounters. The interviewer also noted conditions about the pier including if educational signs regarding reporting of hook-and-line captures were present at the pier. Hill (2013) found that only 8% of anglers would have reported a sea turtle hook-and-line capture (i.e., 92% of anglers would not have reported a sea turtle capture).

NMFS conducted the fishing pier survey in Mississippi that interviewed 382 anglers (Cook, Coleman et al. 2014). This survey indicated that approximately 60% of anglers who incidentally captured a sea turtle on hook-and-line reported it (i.e., 40% of anglers would not have reported a sea turtle capture) (Cook, Coleman et al. 2014). It is important to note that in 2012 educational signs were installed at all fishing piers in Mississippi, alerting anglers to report accidental hook-and-line captures of sea turtles. After the signs were installed, there was a dramatic increase in the number of reported sea turtle hook-and-line captures. Though this increase in reported captures may not solely be related to outreach efforts, it does highlight the importance of educational signs on fishing piers. The STSSN in Mississippi (M. Cook, STSSN, pers. comm. to N. Bonine, NMFS SERO [Southeast Regional Office] PRD, April 17, 2015) indicated that inconsistency in reporting of captures may also be due to anglers' concerns over their personal liability, public perception at the time of the capture, or other consequences from turtle captures. Since it is illegal to harm an endangered species, anglers are often afraid to admit the incidental capture.

No studies have been conducted in or near the action area to determine the rate of underreporting. While all fishing piers in Texas have educational signs instructing the public on how to handle encounters with ESA-listed species, anecdotal reports to the STSSN from recreational anglers along the Upper Texas Coast indicate sea turtles are caught much more frequently than are reported especially in more rural areas (D. Shaver, Texas Coordinator, STSSN, pers. comm. to D. Bethea, NMFS SERO PRD, on February 10, 2019); often anglers will only report a sea turtle when it has an injury or a flipper tag (L. Howell, NOAA NMFS Galveston, pers. comm. to D. Bethea, NMFS SERO PRD, on January 27, 2017). In addition, Mississippi has a small coastline and a very active STSSN that is a common presence at fishing piers along the Mississippi coast. The same is not true for the Texas coast. Due to this anecdotal evidence, we believe it is reasonable (and conservative to the species) to use the higher unreported rate in the (Hill 2013) fishing pier study to estimate the future unreported captures at the Bayfront Pier.

We will address unreported captures by assuming that the expected annual reported captures of 0.1333 sea turtles per year at the Bayfront Seadrift Fishing Pier represents 8% of the actual captures and 92% of sea turtle captures will be unreported. To calculate the annual number of unreported recreational hook-and-line captures of sea turtles at Bayfront Seadrift Fishing Pier, we use the equation:

$$
\begin{aligned}
&\textit{Expected Annual Unreported Captures} \\
&= (\textit{Expected Annual Reported Captures} \div 8\%) \times 92\% \\
&= (0.1333 \div 0.08) \times 0.92 \\
&= 1.5333\ \textit{per year}\ (\textit{Table}\ 4, \textit{Line}\ 2)
\end{aligned}
$$

5.2.3 Calculating Total Captures of Sea Turtles

The number of captures in any given year can be influenced by sea temperatures, species abundances, fluctuating salinity levels in estuarine habitats where piers may be located, and other factors that cannot be predicted. For these reasons, we believe basing our future capture estimate on a 1-year estimated capture is largely impractical. Using our experience monitoring other fisheries, a 3-year time period is appropriate for meaningful evaluation of future impacts and monitoring. The triennial takes are set as consecutive 3-year running sums (i.e., 2020-2022, 2021-2023, 2022-2024 and so on) and not for static 3-year periods (i.e., 2020-2022, 2023-2025, 2025-2027, and so on). This approach reduces the likelihood of reinitiation of ESA consultation process because of inherent variability in captures, while still allowing for an accurate assessment of how the proposed action is performing versus our expectations. Table 4 calculates the total sea turtle captures at Bayfront Seadrift Fishing Pier for any 3-year period based on the expected annual reported and unreported captures.

Table 4. Summary of Expected Reported and Unreported Captures

Captures	Total
1. Expected Annual Reported	0.1333
2. Expected Annual Unreported	1.5333
Annual Total	1.6667
Triennial (3-year) Total	5.0000

5.3 Estimating Post Release Mortality (PRM) of Sea Turtles

5.3.1 Estimating Post Release Mortality for Reported Captures of Sea Turtles

Almost all sea turtles that are captured, landed, and reported to the STSSN are evaluated by a trained veterinarian to determine if they can be immediately released alive or require a rehabilitation facility; exceptions may happen if the sea turtle breaks free before help can arrive. Sea turtles that are captured and reported to the STSSN may die onsite, may be evaluated, released alive, and subsequently suffer PRM later, or may be evaluated and taken to a rehabilitation facility. Those taken to a rehabilitation facility may be released alive at a later date or kept in rehabilitation indefinitely (either due to serious injury or death). We consider those that are never returned to the wild population to have suffered PRM. The risk of PRM to sea turtles from reported hook-and-line captures will depend on numerous factors, including how deeply the hook is embedded, whether or not the hook was swallowed, whether the sea turtle was released with trailing line, how soon and how effectively the hooked sea turtle was de-hooked or otherwise cut loose and released, and other factors which are discussed in more detail below.

We believe the complete (i.e., inshore and offshore combined) 10-year STSSN dataset for hook and line captures and entanglements in Zone 19 is a more accurate representation of post-release mortality for sea turtles than a smaller subset of data from a specific pier (e.g., Bayfront Seadrift Fishing Pier) or a larger set of data from another area (e.g., Mississippi) because this dataset pertains specifically to Texas where the take is anticipated to occur. Table 5 provides a breakdown of known final disposition of the 53 sea turtles caught or entangled in recreational hook-and-line gear in the STSSN dataset for Zone 19.

Table 5. Final Disposition of Sea Turtles from Reported Recreational Hook-and-Line Captures and Gear Entanglements in Zone 19, 2007-2016 (n=53)

	Dead or Died Onsite	Released Alive, Immediately (Evaluated)	Taken to Rehab, Released Alive Later	Taken to Rehab, Kept or Died in Rehab
Number of Records	28	11	4	10
Percentage	52.8	20.8	7.6	18.9

Of the 53 sea turtles reported captured on recreational hook-and-line or entangled in gear in Zone 19, 71.7% were removed from the wild population either through death or being unable to be released from the rehabilitation facility (i.e., lethal captures, 52.8 + 18.9) and 28.3% were released alive back into the wild population (i.e., non-lethal captures, 20.8 + 7.6).

To calculate the annual estimated lethal captures of reported sea turtles at the Bayfront Seadrift Fishing Pier, we use the following equation:

$$\begin{aligned}
&\mathit{Annual\ Lethal\ Reported\ Captures} \\
&= \mathit{Expected\ Annual\ Reported\ Captures}\ [\mathit{Table}\ 4, \mathit{Line}\ 1] \\
&\qquad\qquad \times \mathit{Lethal\ Captures}\ [\mathit{calculated\ from\ Table}\ 5] \\
&= 0.1333 \times 0.7170 \\
&= 0.0956\ \mathit{per\ year}\ (\mathit{Table}\ 9, \mathit{Line}\ 1A)
\end{aligned}$$

To calculate the estimated annual non-lethal captures of reported sea turtles at Bayfront Seadrift Fishing Pier, we use the following equation:

$$\begin{aligned}&Annual\ Non-lethal\ Reported\ Captures\\&= Expected\ Annual\ Reported\ Captures\ [Table\ 4, Line\ 1] \times Non\\&\qquad - lethal\ Captures\ [calculated\ from\ Table\ 5]\\&= 0.1333 \times 0.2830\\&= 0.0377\ per\ year\ (Table\ 9, Line\ 1B)\end{aligned}$$

5.3.2 Estimating Post-Release Mortality for Unreported Captures of Sea Turtles

Sea turtles that are captured and not reported to the STSSN may be released alive and subsequently suffer PRM. The risk of PRM to sea turtles from hook-and-line captures will depend on numerous factors, including how deeply the hook is embedded, whether or not the hook was swallowed, whether the sea turtle was released with trailing line, how soon and how effectively the hooked sea turtle was de-hooked or otherwise cut loose and released, and other factors which are discussed in more detail below. While the preferred method to release a hooked sea turtle safely is to bring it ashore and de-hook/disentangle it there and release it immediately, that cannot always be accomplished. The next preferred technique is to cut the line as close as possible to the sea turtle's mouth or hooking site rather than attempt to pull the sea turtle up to the pier. Some incidentally captured sea turtles are likely to break free on their own and escape with embedded/ingested hooks and/or trailing line. Because of considerations such as the tide, weather, and the weight and size of a hooked captured sea turtle, some will not be able to be de-hooked, and will be cut free by anglers and intentionally released. These sea turtles will escape with embedded or swallowed hooks, or trailing varying amounts of fishing line, which may cause post-release injury or death.

In January 2004, NMFS convened a workshop of experts to develop criteria for estimating PRM of sea turtles caught in the pelagic longline fishery based on the severity of injury. In 2006, those criteria were revised and finalized (Ryder, Conant et al. 2006). In February 2012, the Southeast Fisheries Science Center updated the criteria again by adding 3 additional hooking scenarios, bringing the total to 6 categories of injury (NMFS2012a). Table 6 describes injury categories for hardshell sea turtles captured on hook-and-line gear and the associated PRM estimates for sea turtles released with hook and trailing line greater than or equal to half the length of the carapace (i.e., Release Condition B as defined in (NMFS 2012).

Table 6. Estimated Post Release Mortality Based on Injury Category for Hardshell Sea Turtles Captured via Hook-and-Line and Released in Release Condition B (NMFS 2012).

Injury Category	Description	Post-release Mortality
I	Hooked externally with or without entanglement	20%
II	Hooked in upper or lower jaw with or without entanglement—includes ramphotheca (i.e., beak), but not any other jaw/mouth tissue parts	30%
III	Hooked in cervical esophagus, glottis, jaw joint, soft palate, tongue, and/or other jaw/mouth tissue parts not categorized elsewhere, with or without entanglement—includes all events where the insertion point of the hook is visible when viewed through the mouth.	45%
IV	Hooked in esophagus at or below level of the heart with or without entanglement—includes all events where the insertion point of the hook is not visible when viewed through the mouth	60%
V	Entangled only, no hook involved	50%*
VI	Comatose/Resuscitated	60%**

*There is no PRM estimate of Release Condition B for Injury Category V. For Injury Category V, we believe it is prudent to use the PRM for Release Condition A (Released Entangled) because we know the sea turtle was released entangled without a hook, but we do not know how much line was remaining.
**For Injury Category 6, we believe it is prudent to use the PRM Release Condition D (Released with All Gear Removed) because we believe that if a fisher took the time to resuscitate the sea turtle, then it is likely the fisher also took the time to disentangle the animal completely before releasing it back into the wild.

PRM varies based on the initial injury the animal sustained and the amount of gear left on the animal at the time of release. Again, we will rely on the STSSN dataset we used in Section 5.3.1 because this data includes the location of where on the animal the sea turtle was hooked for 50 of the 53 interactions (Table 7).

Table 7. Known Category of Injury of Sea Turtles from Reported Recreational Hook-and-Line Captures and Gear Entanglements in Zone 19, 2007-2016 (n=50)

Injury Category*	I	II	III	IV	V	VI
Number	9	0	1	1	39	0
Percentage	18.0	0	2.0	2.0	78.0	0.0

*SERO PRD assigned an Injury Category of 0 to all records with unknown hooking and entanglement locations. We exclude Injury Category 0 these from the calculation because we are unsure of the location and therefore cannot assign a corresponding PRM. In this case, there are 3 interactions with an unknown hooking/entanglement location in the dataset.

Like above, we assume that 8% of the sea turtles captured at the pier will be reported, and that reported turtles will be sent to rehabilitation if needed. To estimate the fate of the 92% of sea turtles expected to go unreported, and therefore un-evaluated or rehabilitated, we use the estimated PRM for the injury categories in Table 6 along with the percentage of captures in each injury category in Table 7 to calculate the weighted PRM for each injury category. We then sum the weighted PRMs across all injury categories to determine the overall PRM for the sea turtles at the Bayfront Seadrift Fishing Pier. This overall rate helps us account for the varying severity of future injuries and varying PRM associated with these injuries. Based on the assumptions we have made about the percentage of sea turtles that will be released alive without rehabilitation, the hooking location, and the amount of fishing gear likely to remain on an animal released immediately at the pier, we estimate a total weighted PRM of 44.7% for the 92% of sea turtles captured, unreported, and released immediately at the Bayfront Seadrift Fishing Pier (Table 8).

Table 8. Estimated Weighted and Overall Post Release Mortality for Sea Turtles Released Immediately

Injury Category	PRM (%) [from Table 6]	Percentage [from Table 7]	% Weighted PRM*
I	20	18.0	3.6
II	30	0	0
III	45	2.0	0.9
IV	60	2.0	1.2
V	50	78.0	39.0
		Total % Weighted PRM	44.7

*% Weighted PRM = % PRM × Percentage for each Injury Category

To calculate the estimated annual lethal captures of unreported sea turtles, we use the following equation:

$$
\begin{aligned}
&\mathit{Annual\ Unreported\ Lethal\ Captures}\\
&= \mathit{Annual\ Unreported\ Captures}\ [\mathit{Table}\ 4, \mathit{Line}\ 2] \times \mathit{Total\ Weighted\ PRM}\ [\mathit{Table}\ 8]\\
&= 1.5333\ \times 44.7\%\\
&= 0.6854\ \mathit{per\ pier}\ (\mathit{Table}\ 9, \mathit{Line}\ 2A)
\end{aligned}
$$

If the equation for calculating annual lethal captures of unreported sea turtles multiplies the annual unreported captures by the total weighted PRM of 44.7%, then the equation for calculating annual non-lethal captures of unreported sea turtles would multiply the annual unreported captures by 55.3% (100% – 44.7%). Therefore, to calculate the estimated annual non-lethal captures of unreported sea turtles, we use the following equation:

$$
\begin{aligned}
&\mathit{Annual\ Unreported\ Non-lethal\ Captures}\\
&= \mathit{Annual\ Unreported\ Captures}\ [\mathit{Table}\ 4, \mathit{Line}\ 2] \times 55.3\%\\
&= 1.5333 \times 55.3\%\\
&= 0.8479\ \mathit{per\ pier}\ (\mathit{Table}\ 9, \mathit{Line}\ 2B)
\end{aligned}
$$

5.3.3 Calculating Total Post Release Mortality

As we discussed above, we use a 3-year running total to evaluate future impacts to sea turtles due to PRM. Table 9 shows the total sea turtle captures at the Bayfront Seadrift Fishing Pier for any 3-year consecutive period based on the expected annual lethal and non-lethal reported and unreported captures.

Table 9. Summary of Post Release Mortality

Captures	A. Lethal	B. Non-lethal
1. Annual Reported Captures	0.0956	0.0377
2. Annual Unreported Captures	0.6854	0.8479
Annual Total	0.7810	0.8857
Triennial (3-year) Total	2.3430	2.6570

5.4 Estimating Captures of Sea Turtles by Species

Of the sea turtles in the STSSN inshore stranding data for Zone 19 identifiable to species and which may be adversely affected by the proposed action (Table 2; n=27), 81% were green (n=22), 11% were Kemp's ridley (n=3), and 7% were loggerhead sea turtles (n=2). We will assume the same species composition for future captures at the Bayfront Seadrift Fishing Pier.

Table 10 estimates the number of lethal and non-lethal captures by sea turtle species for any consecutive 3-year period at the Bayfront Seadrift Fishing Pier. To be conservative to the species, numbers of captures are rounded up to the nearest whole number. While this results in an increase in the total number of sea turtles, compared to what is presented in the non-species-specific total estimates in Section 5.3.1 and 5.3.2, this approach is most conservative to the species, ensures that we are adequately analyzing the effects of the proposed action on whole animals, and that impacts from the proposed action can be more easily tracked. The impacts of future captures to the green sea turtle DPSs are discussed in the Jeopardy Analysis (Section 7) and presented in the Incidental Take Statement (Section 9; Table 11).

Table 10. Estimated Captures of Sea Turtle Species for Any Consecutive 3-Year Period

Species	Lethal Captures	Non-lethal Captures	Total Captures
Green sea turtle (NA or SA DPS)	2 ($2.3430 \times 0.8148 = 1.9091$)	3 ($2.6570 \times 0.8148 = 2.1650$)	5
Kemp's ridley sea turtle	1 ($2.3430 \times 0.1111 = 0.2603$)	1 ($2.6570 \times 0.1111 = 0.2952$)	2
Loggerhead sea turtle (NWA DPS)	1 ($2.3430 \times 0.0741 = 0.1736$)	1 ($2.6570 \times 0.0741 = 0.1968$)	2

6. CUMULATIVE EFFECTS

ESA Section 7 regulations require NMFS to consider cumulative effects in formulating its Opinions (50 CFR 402.14). Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). At this time, we are not aware of any other non-federal actions being planned or under development in the action area. Within the action area, major future changes are not anticipated in the ongoing human activities described in the environmental baseline. The present, major human uses of the action area are expected to continue at the present levels of intensity in the near future.

7. JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action is likely to jeopardize the continued existence of green, Kemp's ridley, and/or loggerhead sea turtles. In the Effects of the Action, we outlined how the proposed action would affect these species at the individual level and the extent of those effects in terms of the number of associated interactions, captures, and mortalities of each species to the extent possible based on the best available data. Now we assess each of these species' responses to this impact, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the Status of the Species, the Environmental Baseline, and the Cumulative Effects, are likely to jeopardize their continued existence in the wild.

To "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 the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Thus, in making this determination for each species, we must look at whether the proposed action directly or indirectly reduces the reproduction, numbers, or distribution of a listed species. Then, if there is a reduction in 1 or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

The NMFS and USFWS's ESA Section 7 Handbook (USFWS and NMFS 1998) defines survival and recovery, as they apply to the ESA's jeopardy standard. Survival means "the species' persistence . . . beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment." 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 sufficiently large 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 means "improvement in the status of a 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." Recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities.

The status of each listed species likely to be adversely affected by the proposed action is reviewed in the Status of the Species. For any species listed globally, our jeopardy determination must find that the proposed action will appreciably reduce the likelihood of survival and recovery at the global species range (i.e., in the wild). For any species listed as DPSs, a jeopardy determination must find that the proposed action will appreciably reduce the likelihood of survival and recovery of that DPS.

7.1 Green Sea Turtles (NA and SA DPSs)

Within U.S. waters, individuals from both the NA and SA DPS of green sea turtle can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, an analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley, Singel et al. 2007). This information suggests that the vast majority of the anticipated captures in the Gulf of Mexico are likely to come from the NA DPS. However, it is possible that animals from the SA DPS could be captured by recreational hook-and-line upon completion of the proposed project. For these reasons, we will act conservatively and conduct 2 jeopardy analyses (1 for each DPS). The NA DPS analysis will assume based on Foley et al. (2007) that 96% of animals adversely affected during the proposed actions are from that DPS. The SA DPS analysis will assume that 4% of the green sea turtles adversely affected by the proposed actions are from that DPS.

Applying the above percentages to our estimated take of 5 green sea turtles (2 lethal, 3 non-lethal) during any consecutive 3-year period, we estimate the following:

- Up to 5 green sea turtles will come from the NA DPS (5 × 0.96 = 4.80, rounded up to 5), of which 2 will be lethal and 3 will be non-lethal.
- 1 green sea turtle will come from the SA DPS (3 × 0.04 = 0.20, rounded up to 1), which could be lethal or non-lethal.

We note rounding when splitting the take into the two DPSs results in a slightly higher combined total (i.e., 6 instead of 5) than the 3-year estimate. While we use the higher numbers for purposes of analyzing the likelihood of jeopardy to the DPSs (Section 7.1.1 and 7.1.2), we do not expect more than 5 green sea turtle takes during any consecutive 3-year period.

7.1.1 NA DPS of Green Sea Turtle

Survival

The proposed action may result in the capture of up to 5 green sea turtles (2 lethal, 3 non-lethal) from the NA DPS over any consecutive 3-year period. The potential non-lethal capture of 3 green sea turtles from the NA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individual sea turtle suffering non-lethal injuries or stresses is expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The non-lethal capture will occur in the action area, which encompass a small portion of the overall range/distribution of green sea turtles within the NA DPS. Any incidentally caught animals would be released within the general area where caught and no change in the distribution of NA DPS green sea turtles would be anticipated. The potential lethal capture would reduce the number of NA DPS green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. A lethal interaction would also result in a potential reduction in future reproduction, assuming the individual was female and would have survived otherwise to reproduce. For example, as discussed in this Opinion, an adult green sea turtle can lay up to 7 clutches (usually 3-4) of eggs every 2-4 years, with a mean clutch size of 110-115 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The potential lethal capture of 2 green sea turtles from the NA DPS is expected to occur in a discrete action area and green sea turtles in the NA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce the species likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species, we presented the status of the NA DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we outlined the past and present impacts of all state, federal, or private actions and other human activities in or having effects in the action area that have affected and continue to affect the NA DPS. In the Cumulative Effects, we discussed the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In Section 3.2.2, we summarized the available information on number of green sea turtle nesters and nesting trends at NA DPS beaches; all major nesting populations demonstrate long-term increases in abundance (Seminoff, Allen et al. 2015). Therefore, nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors that have contributed to the Status of the Species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Since the nesting abundance trend information for the NA DPS of green sea turtle is clearly increasing, we believe the potential lethal capture of 2 green sea turtles from the NA DPS during any consecutive 3-year period attributed to the consultation pier will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the consultation pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle NA DPS in the wild.

Recovery

The NA DPS of green sea turtles does not have a separate recovery plan at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991) does exist. Since the animals within the NA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the NA DPS, is developed. The Atlantic Recovery Plan lists the following relevant recovery objectives 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 6 years.*
- *A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.*

According to data collected from Florida's index nesting beach survey from 1989-2018, green sea turtle nest counts across Florida index beaches have increased substantially from a low of approximately 267 in the early 1990s to a high of approximately 38,954 in 2017 (See Figure 3), and indicate that the first listed recovery objective is being met. The average number of nests at Florida index beaches for the six years prior to and including 2018 has been well above 5,000 (average of approximately 17,000 nests from 2013-2018; see Figure 3). At all Florida beaches, not just index beaches, the high was 53,103 in 2017 (https://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/ accessed by the consulting biologist on March 10, 2020). There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting, however, it is likely that numbers on foraging grounds have increased, which is consistent with the criteria of the second listed recovery objective.

The potential lethal take of 2 green sea turtles from the NA DPS during any consecutive 3-year period will result in a reduction in numbers when a capture occurs; however, it is unlikely to have any detectable influence on the recovery objectives and trends noted above, even when considered in the context of the of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. The non-lethal capture of 3 green sea turtles from the NA DPS would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of NA DPS green sea turtles' recovery in the wild.

Conclusion

The potential combined lethal and non-lethal capture of green sea turtles from the NA DPS associated with the consultation pier is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NA DPS of the green sea turtle in the wild.

7.1.2 SA DPS of Green Sea Turtle

Survival

The proposed action may result in the capture of 1 green sea turtle, which could be lethal or non-lethal, from the SA DPS over any consecutive 3-year period. The potential non-lethal capture of a green sea turtle from the SA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures will occur in the action area, which encompass a small portion of the overall range/distribution of green sea turtles within the SA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of SA DPS green sea turtles would be anticipated.

The potential lethal take of up to 1 green sea turtle from the SA DPS during any consecutive 3-year period would reduce the number of green sea turtles, compared to their numbers in the absence of the consultation pier, assuming all other variables remained the same. A lethal interaction would also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived otherwise to reproduce. Like above, the anticipated lethal capture is expected to occur in a small, discrete action area and green sea turtles in the SA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

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. In the Status of Species, we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we considered the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area that have affected and continue to affect this DPS. In the Cumulative Effects, we considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In Section 3.3.2, we summarized available information on number of green sea turtle nesters and nesting trends at SA DPS beaches; some of the largest nesting beaches such as Ascension Island, Aves Island (Venezuela), and Galibi (Suriname) appear to be increasing. Therefore, is likely that nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors that have contributed to the status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the nesting abundance trend information for green sea turtles appears to be increasing, we believe the potential lethal capture of up to 1 green sea turtle from the SA DPS during any consecutive 3-year period attributed to recreational fishing at the consultation pier will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the SA DPS of the green sea turtle in the wild.

Recovery

Like the NA DPS, the SA DPS of green sea turtles does not have a separate recovery plan in place at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991) does exist. Since the animals within the SA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the SA DPS, is developed. In our analysis for the NA DPS, we stated that the Atlantic Recovery Plan lists the following relevant recovery objectives 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 6 years.*
- *A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.*

Because the first objective listed above is specific to nesting in Florida, it is specific to the NA DPS, but demonstrates the importance of increases in nesting to recovery. As previously stated, nesting at the primary SA DPS nesting beaches appears to have been increasing over the course of the decades. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the likely increases in nesting, and likely correlation between increased nesting and increased overall population, it is likely that numbers on foraging grounds also have increased.

The potential lethal capture of up to 1 green sea turtle from the SA DPS during any consecutive 3-year period will result in a reduction in numbers when capture occurs; however, it is unlikely to have any detectable influence on the trends noted above, even when considered in context with the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Non-lethal take of a green sea turtle from the SA DPS would not affect the adult female nesting population or number of nests per nesting season. Thus, the recreational fishing from the consultation pier will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the SA DPS of green sea turtles' recovery in the wild.

Conclusion

The combined potential lethal and non-lethal capture of green sea turtles associated with consultation pier is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the SA DPS of the green sea turtle in the wild.

7.2 Kemp's Ridley Sea Turtle

Survival

The proposed action may result in the capture of up to 2 Kemp's ridley sea turtles (1 lethal, 1 non-lethal) during any consecutive 3-year period. The potential non-lethal capture of 1 Kemps's ridley sea turtle is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individual suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of Kemp's ridley sea turtles are anticipated. The captures will occur in the action area, which encompasses a small portion of this species overall range/distribution. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of Kemp's ridley sea turtles would be anticipated. The potential lethal capture of 1 Kemp's ridley sea turtle during any consecutive 3-year period would reduce the species' population compared to the number that would have been present in the absence of the proposed actions, assuming all other variables remained the same. The Turtle Expert Working Group (TEWG 1998) estimates age at maturity from 7-15 years for this species. Females return to their nesting beach about every 2 years (TEWG 1998). The mean clutch size for Kemp's ridley sea turtle is 100 eggs/nest, with an average of 2.5 nests per female per season. Lethal takes could also result in a potential reduction in future reproduction, assuming at least one of these individuals would be female and would have survived to reproduce in the future. The loss of a Kemp's ridley sea turtle as a result of the proposed action could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage would be expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. However, the anticipated lethal capture is expected to occur in small, discrete action area and Kemp's ridley sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

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. In the Status of Species, we presented the status of the Kemp's ridley sea turtle, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we considered the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area that have affected and continue to affect this DPS. In the Cumulative Effects, we considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. 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 trend. In Section 3.3.3, we summarized available information on number of Kemp's ridley sea turtle nesters and nesting trends. At this time, it is unclear whether the increases and declines in Kemp's ridley nesting seen over the past decade at nesting beaches in Mexico, or the similar trend with the emerging Texas population, represents a population oscillating around an equilibrium point or if nesting will decline or increase in the future. With the recent increase in nesting data (2015-17) and recent declining numbers of nests (2013-14 and 2018-2019), it is too early to tell whether the long-term trend line is affected; however, there may be cause for concern. Nonetheless, data from 1990 to present continue to support that Kemp's ridley sea turtle is increasing in population size. We believe this long-term increasing trend in nesting is evidence of an increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the nesting trend information is increasing, we believe the potential lethal capture of 1 Kemp's ridley sea turtle during any consecutive 3-year period attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the consultation pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of Kemp's ridley sea turtles in the wild.

Recovery

As to whether the proposed action will appreciably reduce the species' likelihood of recovery, the recovery plan for the Kemp's ridley sea turtle (NMFS, USFWS et al. 2011) lists the following relevant recovery objective:

- *A population of at least 10,000 nesting females in a season (as measured by clutch frequency/female/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.*

The recovery plan states the average number of nests per female is 2.5; it sets a recovery goal of 10,000 nesting females associated with 25,000 nests. The 2012 nesting season recorded approximately 22,000 nests in Mexico. Yet, in 2013 through 2014, there was a significant decline, with only 16,385 and 11,279 nests recorded, respectively, which would equate to 6,554 nesting females in 2013 (16,385 / 2.5) and 4,512 in 2014 (11,279 / 2.5). Nest counts increased 2015-2017, they did not reach 25,000 by 2017, and they decreased 2018-2019; however, it is clear that the population has increased over the last 2 decades. The increase in Kemp's ridley sea turtle nesting is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the U.S., and possibly other changes in vital rates (TEWG 1998, TEWG 2000).

The potential lethal take of 1 Kemp's ridley sea turtle during any consecutive 3-year period by recreational fishing at the pier will result in a reduction in numbers and reproduction; however, it is unlikely to have any detectable influence on the nesting trends noted above. Given annual nesting numbers are in the thousands, the projected loss is not expected to have any discernable impact to the species. The potential non-lethal take would not affect the adult female nesting population. Thus, recreational fishing at the pier will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the Kemp's ridley sea turtles' recovery in the wild.

Conclusion

The combined potential lethal and non-lethal take of Kemp's ridley sea turtles associated with the pier is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of Kemp's ridley sea turtles in the wild.

7.3 NWA DPS of Loggerhead Sea Turtle

Survival

The proposed action may result in the capture of up to 2 loggerhead sea turtles (1 lethal, 1 non-lethal) from the NWA DPS during any consecutive 3-year period. The potential non-lethal capture of a loggerhead sea turtle from the NWA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of loggerhead sea turtles are anticipated. The capture will occur in the action area, which encompasses a small portion of the overall range/distribution of loggerhead sea turtles within the NWA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of NWA DPS of loggerhead sea turtle would be anticipated. The potential lethal take of a loggerhead sea turtle from the NWA DPS during any consecutive 3-year period represents a reduction in numbers. A lethal capture could also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived to reproduce in the future. For example, an adult female loggerhead sea turtle can lay approximately 4 clutches of eggs every 3-4 years, with 100-126 eggs per clutch. Thus, the loss of adult females could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. However, a reduction in the distribution of loggerhead sea turtles is not expected from lethal capture attributed to the proposed action. The potential lethal capture is expected to occur in a small, discrete action area and loggerhead sea turtles in the NWA DPS generally have large ranges; thus, no reduction in the distribution is expected from the lethal capture of these individuals.

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. In the Status of Species, we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we considered the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area that have affected and continue to affect this DPS. In the Cumulative Effects, we considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Abundance estimates in the western North Atlantic indicate the population is large (i.e., several hundred thousand individuals). In Section 3.3.4, we summarized available information on number of loggerhead sea turtle nesters and nesting trends. Nesting trends across all of the recovery units have been steady or increasing over several years against the background of the past and ongoing human and natural factors that have contributed to the current status of the species. Additionally, in-water research suggests the abundance of neritic juvenile loggerheads is steady or increasing.

While the lethal capture of a loggerhead sea turtle from the NWA DPS during any consecutive 3-year period will affect the population, in the context of the overall population's size and current trend, we do not expect this loss to result in a detectable change to the population numbers or increasing trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the loggerhead sea turtle DPS in the wild.

Recovery

The recovery plan for the for the Northwest Atlantic population of loggerhead sea turtles (NMFS and USFWS 2009) was written prior to the loggerhead sea turtle DPS listings. However, this plan deals with the populations that comprise the current NWA DPS and is therefore, the best information on recovery criteria and goals for the DPS. It lists the following recovery objectives that are relevant to the effects of the proposed actions:

- *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*
- *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.*

Recovery is the process of removing threats so self-sustaining populations persist in the wild. The proposed actions would not impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. The recovery plan estimates that the population will reach recovery in 50-150 years following implementation of recovery actions. The minimum end of the range assumes a rapid reversal of the current declining trends; the higher end assumes that additional time will be needed for recovery actions to bring about population growth.

Nesting trends have been significantly increasing over several years. The potential lethal capture of 1 loggerhead sea turtle from the NWA DPS during any consecutive 3-year period is so small in relation to the overall population, that it would be hardly detectable, even when considered in the context of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. We believe this is true for both nesting and juvenile in-water populations. The potential non-lethal capture of 1 loggerhead sea turtle would not affect the adult female nesting population, number of nests per nesting season, or juvenile in-water populations. Thus, recreational fishing at the consultation pier will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the loggerhead sea turtles' recovery in the wild.

Conclusion

The combined potential lethal and non-lethal take of loggerhead sea turtles associated with the pier is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NWA DPS of the loggerhead sea turtle in the wild.

8. CONCLUSION

After reviewing the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects using the best available data, it is NMFS's Opinion that the proposed action is not likely to jeopardize the continued existence of the NA or SA DPS of green sea turtle, Kemp's ridley sea turtle, or the NWA DPS of loggerhead sea turtle.

9. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and protective regulations issued pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption.

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of

Section 7(b)(4) and Section 7(o)(2), taking that would otherwise be considered prohibited under Section 9 or Section 4(d), but which is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the reasonable and prudent measures and the terms and conditions of the Incidental Take Statement (ITS) of the Opinion.

9.1 Anticipated Amount or Extent of Incidental Take

The take estimates (lethal and non-lethal captures) shown above in Table 11 are our best estimates of the total amount of sea turtle take expected over any consecutive 3-year period. However, as described in Section 5 above, some sea turtle captures are expected to go unreported. The take limits prescribed in this Opinion that will trigger the requirement to reinitiate consultation must be based on the amount of take that we expect to be *reported* as it will be impossible to count the incidents that go unreported. We believe the best available information for estimating the future level of reporting of captured sea turtles at each of the proposed piers is again the data collected from the Hill (2013) fishing pier study.

In Section 5.2.1, we developed an estimate of the total number of sea turtle captures expected to be reported annually (0.1333; Table 4, Line 1). We take that number and multiply by 3 to get the 3-year total estimate of reported sea turtle captures at the proposed pier (0.1333 × 3 = 0.4000). We then apply the species breakdown reported in the STSSN data for recreational hook-and-line captures and gear entanglement in Zone 19 (those identifiable to species and which may be adversely affected by the proposed action; 81% were green, 11% were Kemp's ridley, and 7% were loggerhead sea turtle), to the 3-year reported total to estimate the number of each species of sea turtle we expect to be reported captured over any 3-year period (Table 11). For those estimates that come out to be less than 1, we round up to reach a whole number that can be used as a take limit.

It is important to note that the mortality rates estimated above for captured turtles are not likely to be detected in the initial reporting of captures, as most turtles are expected to live for some period following capture. Some of these individuals may be sent to rehab facilities and later die in those facilities, or may be released and die in the wild from undetected injuries, as discussed in our PRM analysis in Section 5.3.1 above. While it is also possible that some turtles may die immediately from severe injuries related to hook-and-line capture or entanglement (which will be included in the annual reports discussed below [Terms & Conditions (T&Cs), Section 9.4]), we do not expect that result (see Section 5.1). At the time of the interaction, we expect the sea turtle take in the ITS below to be non-lethal. As discussed in Section 5.3.1, up to 71.7% of this take could be lethal as a result of post-release mortality, and reports of such post-release mortality are consistent with the analysis in this Opinion and this ITS.

Table 11. Incidental Take Limits by Species for Any Consecutive 3-Year Period Based on Reported Captures in Section 5.2.1

Species	Total Estimated Reported Captures	Incidental Take Limit
Green sea turtle (NA or SA DPS)	0.4000 × 0.8148 = 0.3259	No more than 1 reported capture*

Species	Total Estimated Reported Captures	Incidental Take Limit
Kemp's ridley sea turtle	0.4000 × 0.1111 = 0.0444	No more than 1 reported capture
Loggerhead sea turtle (NWA DPS)	0.4000 × 0.0741 = 0.0296	No more than 1 reported capture

*We do not expect, and do not authorize, more than 1 green sea turtle take during any consecutive 3-year time period, which may come from either the NA or the SA DPS.

9.2 Effect of Take

NMFS has determined the anticipated incidental take is not likely to jeopardize the continued existence of the green sea turtle (NA and SA DPS), Kemp's ridley sea turtle, or loggerhead sea turtle (NWA DPS).

9.3 Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires NMFS to issue a statement specifying the impact of any incidental take on ESA-listed species, which results from an agency action otherwise found to comply with Section 7(a)(2) of the ESA. It also states that the Reasonable and Prudent Measures (RPMs) necessary to minimize the impacts of take and the T&Cs to implement those measures must be provided and must be followed to minimize those impacts. Only incidental taking by the federal action agency or applicant that complies with the specified T&Cs is authorized.

The RPMs and T&Cs are specified as required by 50 CFR 402.14(i)(1)(ii) and (iv) to document the incidental take by the proposed action and to minimize the impact of that take ESA-listed species. These RPMs and T&Cs are nondiscretionary, and must be implemented by the federal action agency in order for the protection of Section 7(o)(2) to apply. If the applicant fails to adhere to the T&Cs of this ITS through enforceable terms, and/or fails to retain oversight to ensure compliance with these T&Cs, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of the incidental take, the applicant must report the progress of the action and its impact on the species to NMFS as specified in this ITS [50 CFR 402.14(i)(3)].

NMFS has determined that the following RPMs and associated T&Cs are necessary and appropriate to minimize impacts of the incidental take of ESA-listed sea turtles related to the proposed action:

1. The federal action agency must ensure that the applicant provides take reports regarding all interactions with ESA-listed species at the fishing pier.
2. The federal action agency must ensure that the applicant minimizes the likelihood of injury or mortality to ESA-listed species resulting from hook-and-line capture or entanglement by activities at the fishing pier.
3. The federal action agency must ensure that the applicant reduces the impacts to incidentally captured ESA-listed species.
4. The federal action agency must ensure that the applicant coordinates periodic fishing line removal (i.e., cleanup) events with non-governmental or other local organizations.

9.4 Terms and Conditions

The following T&Cs implement the above RPMs:

1. To implement RPM 1, the federal action agency must ensure that the applicant reports all known angler-reported hook-and-line captures of ESA-listed species and any other takes of ESA-listed species to the NMFS's Southeast Regional Office.
    a. Within 24 hours of any reported capture, entanglement, stranding, or other take, the applicant must notify NMFS's Southeast Regional Office by email: takereport.nmfsser@noaa.gov.
        i. Emails must reference this Opinion by the NMFS tracking number (SERO-2019-00943 Bayfront Seadrift Fishing Pier Repair TX) and date of issuance.
        ii. The email must state the species, date and time of the incident, general location and activity resulting in capture (e.g., fishing from the pier by hook-and-line), condition of the species (i.e., alive, dead, sent to rehabilitation), size of the individual, behavior, identifying features (i.e., presence of tags, scars, or distinguishing marks), and any photos that may have been taken.
    b. Every year, the applicant must submit a summary report of capture, entanglement, stranding, or other take of ESA-listed species to NMFS's Southeast Regional Office by email: takereport.nmfsser@noaa.gov.
        i. Emails and reports must reference this Opinion by the NMFS tracking number (SERO-2019-00943 Seadrift Bayfront Seadrift Fishing Pier Repair TX) and date of issuance.
        ii. The report will contain the following information: the total number of ESA-listed species captures, entanglements, strandings, or other take that was reported at or adjacent to the pier included in this Opinion.
        iii. The report will contain all information for any sea turtles taken to a rehabilitation facility holding an appropriate USFWS Native Endangered and Threatened Species Recovery permit.
        iv. The first report will be submitted by January 31, 2021, and will cover the time period from pier opening until December 31, 2020. The second report will be submitted by January 31, 2022 and will cover calendar year 2021 and the information in the first report. The third report will be submitted by January 31, 2023 and will cover the prior two calendar years (calendar years 2022 and 2021) and the information from the first report. The next report will be submitted by January 31, 2024 and will cover the prior three calendar years (calendar years 2023, 2022, and 2021). Thereafter, reports will be prepared every year, covering the prior rolling three year time period, and emailed no later than January 31 of any year.
        v. Reports will include current photographs of signs and bins required in T&C 2, below, and records of the clean-ups required in T&C 3 below.

2. To implement RPMs 2 and 3, the federal action agency must ensure that the applicant must:

a. Install and maintain the following NMFS Protected Species Educational Sign: '*Save Dolphins, Sea Turtles, and Manta Ray*'
    i. Signs will be posted at least at the entrance to and terminal end of the pier.
    ii. Signs will be installed prior to opening the pier for public use.
    iii. Photographs of the installed signs will be emailed to NMFS's Southeast Regional Office (takereport.nmfsser@noaa.gov) with the NMFS tracking number (SERO-2019-00943 Bayfront Seadrift Fishing Pier Repair TX) and date of issuance.
    iv. Sign designs and installation methods are provided at the following website: http://sero.nmfs.noaa.gov/protected_resources/section_7/protected_species_educational_signs/index.html.
    v. Current photographs of the signs will be included in each report required by T&C 1, above.
b. Install and maintain fishing line recycling bins and trash receptacles at the piers to reduce the probability of trash and debris entering the water.
    i. Fishing line recycling bins and trash receptacles will be installed prior to opening the pier for public use.
    ii. Photographs of the installed bins will be emailed to NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov) with the NMFS tracking number for this Opinion (SERO-2019-00943 Bayfront Seadrift Fishing Pier Repair TX) and date of issuance.
    iii. The applicant must regularly empty the bins and trash receptacles and make sure they are functional and upright.
    iv. Additionally, current photographs of the bins will be included in each report required by T&C 1, above.

3. To implement RPMs 2, 3, and 4, the federal action agency must ensure that the applicant must:
    a. Perform at least one annual underwater cleanup to remove derelict fishing line and associated gear from around the pier structure.
    b. Submit a record of each cleaning event in the report required by T&C 1 above.

10. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation Recommendations (CRs) are designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS believes the following CRs further the conservation of the listed species that will be affected by the proposed action. NMFS strongly recommends that these measures be considered and implemented by the federal action agency:

Sea Turtles:

- Encourage the Texas sea turtle rehabilitation center(s) to work with other Southeast U.S. sea turtle rehabilitation facilities on the best handling techniques, data collection and reporting, and public outreach.
- Encourage research to develop deterrents to discourage sea turtles from using fishing piers as a habitualized food source.
- Conduct or fund outreach designed to increase the public's knowledge and awareness of ESA-listed sea turtle species.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NMFS requests notification of the implementation of any of these or additional conservation recommendations.

11. REINITIATION OF CONSULTATION

As provided in 50 CFR Section 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 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 identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

12. LITERATURE CITED

81 FR 20057 (2016). "Endangered and Threatened Wildlife and Plants; Final Rule To List Eleven Distinct Population Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act. Final Rule." Federal Register **81**(66): 20057 -20090.

Ackerman, R. A. (1997). The nest environment and the embryonic development of sea turtles. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. Boca Raton, Florida, CRC Press**:** 83-106.

Addison, D. (1997). "Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996." Bahamas Journal of Science **5**(1): 34-35.

Addison, D. and B. Morford (1996). "Sea turtle nesting activity on the Cay Sal Bank, Bahamas." Bahamas Journal of Science **3**(3): 31-36.

Aguilar, R., et al. (1994). Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. J. I. Richardson and T. H. Richardson. Jekyll Island, Georgia, U.S. Department of Commerce. **NOAA Technical Memorandum NMFS-SEFSC-361:** 91-96.

Aguilar, R., et al. (1995). Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, Caretta caretta, population in the western Mediterranean. 12th Annual Workshop on Sea Turtle Biology and Conservation, Jekyll Island, Georgia.

Aguirre, A., et al. (2002). "Pathology of oropharyngeal fibropapillomatosis in green turtles *Chelonia mydas*." Journal of Aquatic Animal Health **14**: 298-304.

Antonelis, G. A., et al. (2006). "Hawaiian monk seal (*Monachus schauinslandi*): Status and conservation issues." Atoll Research Bulletin **543**: 75-101.

Arendt, M., et al. (2009). Examination of local movement and migratory behavior of sea turtles during spring and summer along the Atlantic coast off the southeastern United States, South Carolina Department of Natural Resources, Marine Resources Division.

Baker, J., et al. (2006). Potential effecfs of sea-level rise on terrestrial habitat and biota of the northwestern Hawaiian Islands. Twentieth Annual Meeting Society for Conservation Biology Conference. San Jose, California**:** 3.

Balazs, G. H. (1982). Growth rates of immature green turtles in the Hawaiian Archipelago. Biology and Conservation of Sea Turtles. K. A. Bjorndal. Washington D.C., Smithsonian Institution Press**:** 117-125.

Balazs, G. H. (1983). Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, Northwestern Hawaiian Islands, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service.

Balazs, G. H. (1985). Impact of ocean debris on marine turtles: entanglement and ingestion. Proceedings of the workshop on the fate and impact of marine debris, Honolulu, HI, NOAA-NMFS.

Balazs, G. H., et al. (1995). Guidelines for handling marine turtles hooked or entangled in the Hawaii longline fishery: Results of an expert workshop held in Honolulu, Hawaii March 15-17,1995. Honolulu, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center.

Bass, A. L. and W. N. Witzell (2000). "Demographic composition of immature green turtles (*Chelonia mydas*) from the east central Florida coast: Evidence from mtDNA markers." Herpetologica **56**(3): 357-367.

Bjorndal, K. A. (1982). The consequences of herbivory for life history pattern of the Caribbean green turtle, *Chelonia mydas*. Biology and Conservation of Sea Turtles. Washington, D. C., Smithsonian Institution**:** 111-116.

Bjorndal, K. A., et al. (2005). "Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the greater Caribbean." Ecological Applications **15**(1): 304-314.

Bjorndal, K. A., et al. (2003). "Compensatory growth in oceanic loggerhead sea turtles: Response to a stochastic environment." Ecology **84**(5): 1237-1249.

Bjorndal, K. A., et al. (1999). "Twenty-six years of green turtle nesting at Tortuguero, Costa-Rica: An encouraging trend." Conservation Biology **13**(1): 126-134.

Bolten, A. and B. Witherington (2003). Loggerhead Sea Turtles. Washington, D. C., Smithsonian Books.

Bolten, A. B., et al. (1994). Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. Research Plan to Assess Marine Turtle Hooking Mortality. G. J. Balazs and S. G. Pooley, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center. **Technical Memorandum NMFS-SEFSC-201:** 48-55.

Bolten, A. B., et al. (1998). "Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis." Ecological Applications **8**(1): 1-7.

Bouchard, S., et al. (1998). "Effects of exposed pilings on sea turtle nesting activity at Melbourne Beach, Florida." Journal of Coastal Research **14**(4): 1343-1347.

Bowen, B. W., et al. (1992). "Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny." Evolution **46**(4): 865-881.

> To address aspects of the evolution and natural history of green turtles, we assayed mitochondrial (mt) DNA genotypes from 226 specimens representing 15 major rookeries around the world. Phylogenetic analyses of these data revealed (1) a comparatively low level of mtDNA variability and a slow mtDNA evolutionary rate (relative to estimates for many other vertebrates); (2) a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific Oceans; (3) no evidence for matrilineal distinctiveness of a commonly recognized taxonomic form in the East Pacific (the black turtle C. m. agassizi or C. agassizi); (4) in opposition of published hypotheses, a recent origin for the Ascension Island rookery, and its close genetic relationship to a geographically proximate rookery in Brazil; and (5) a geographic population substructure within each ocean basin (typically involving fixed or nearly fixed genotypic differences between nesting populations) that suggests a strong propensity for natal homing by females. Overall, the global matriarchal phylogeny of Chelonia mydas appears to have been shaped by both geography (ocean basin separations) and behavior (natal homing on regional or rookery-specific scales). The shallow evolutionary population structure within ocean basins likely results from demographic turnover (extinction and colonization) of rookeries over time frames that are short by evolutionary standards but long by ecological standards.

Bresette, M., et al. (2006). Recruitment of post-pelagic green turtles (*Chelonia mydas*) to nearshore reefs on Florida's southeast coast. Twenty-Sixth Annual Symposium on Sea Turtle

Biology and Conservation. M. Frick, A. Panagopoulou, A. F. Rees and K. Williams. Athens, Greece, International Sea Turtle Society**:** 288.

Caldwell, D. K. and A. Carr (1957). Status of the sea turtle fishery in Florida. Twenty-Second North American Wildlife Conference. J. B. Trefethen. Statler Hotel, Washington, D. C., Wildlife Management Institute**:** 457-463.

Campell, C. L. and C. J. Lagueux (2005). "Survival probability estimates for large juvenile and adult green turtles (*Chelonia mydas*) exposed to an artisanal marine turtle fishery in the western Caribbean." Herpetologica **61**(2): 91-103.

Carballo, J. L., et al. (2002). "Analysis of four macroalgal assemblages along the Pacific Mexican coast during and after the 1997-98 El Niño." Ecosystems **5**(8): 749-760.

Carr, A. F. (1986). New perspectives on the pelagic stage of sea turtle development, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center**:** 36.

Carr, T. and N. Carr (1991). "Surveys of the sea turtles of Angola." Biological Conservation **58**(1): 19-29.

Chaloupka, M. and C. Limpus (2005). "Estimates of sex- and age-class-specific survival probabilities for a southern Great Barrier Reef green sea turtle population." Marine Biology **146**(6): 1251-1261.

Chaloupka, M., et al. (2008). "Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982-2003)." Marine Biology **154**(5): 887-898.

Chaloupka, M. Y. and J. A. Musick (1997). Age growth and population dynamics. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. Boca Raton, Florida, CRC Press**:** 233-276.

Conant, T. A., et al. (2009). Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act, National Oceanic and Atmospheric Administration, National Marine Fisheries Service**:** 222.

Cook, M. C., et al. (2014). Hooked on Kemp's - Preliminary Results of Mississippi's Angler Survey. International Sea Turtle Symposium-2014. New Orleans, LA.

D'Ilio, S., et al. (2011). "The occurrence of chemical elements and POPs in loggerhead turtles (*Caretta caretta*): An overview." Marine Pollution Bulletin **62**(8): 1606-1615.

Daniels, R. C., et al. (1993). "Sea-level rise - destruction of threatened and endangered species habitat in South Carolina." Environmental Management **17**(3): 373-385.

Dodd Jr., C. K. (1988). Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). Biological Report, U.S. Fish and Wildlife Service**:** 110.

Doughty, R. W. (1984). "Sea turtles in Texas: A forgotten commerce." Southwestern Historical Quarterly **88**: 43-70.

Dow, W., et al. (2007). An atlas of sea turtle nesting habitat for the wider Caribbean region. Beaufort, North Carolina, The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy**:** 267.

DWH Trustees (2015). Deepwater Horizon Oil Spill: Draft Programmatic Damage Assessment and Restoration Plan and Draft Programmatic Environmental Impact Statement. Retrieved from http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

DWH Trustees (2015). DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). 2015. Deepwater Horizon Oil Spill: Draft Programmatic Damage Assessment and Restoration Plan and Draft Programmatic Environmental Impact Statement. Retrieved from http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

Ehrhart, L. M. (1983). "Marine turtles of the Indian River Lagoon System." Florida Scientist **46**(3/4): 337-346.

Ehrhart, L. M., et al. (2007). "Marine turtles of the central region of the Indian River Lagoon System, Florida." Florida Scientist **70**(4): 415-434.

Ehrhart, L. M. and R. G. Yoder (1978). "Marine turtles of Merritt Island National Wildlife Refuge, Kennedy Space Centre, Florida." Florida Marine Research Publications **33**: 25-30.

Epperly, S. P., et al. (2007). "Trends in catch rates of sea turtles in North Carolina, USA." Endangered Species Research **3**(3): 283-293.

Fish, M. R., et al. (2005). "Predicting the Impact of Sea-Level Rise on Caribbean Sea Turtle Nesting Habitat." Conservation Biology **19**(2): 482-491.

FitzSimmons, N. N., et al. (2006). Green turtle populations in the Indo-Pacific: A (genetic) view from microsatellites. Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation. N. Pilcher. **Technical Memorandum NMFS-SEFSC-536:** 111.

Foley, A. M., et al. (2008). Post-nesting migrations and resident areas of Florida loggerheads (Caretta caretta). Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation. H. J. Kalb, A. S. Rhode, K. Gayheart and K. Shanker. Savannah, Georgia, U.S. Department of Commerce. **NOAA Technical Memorandum NMFS-SEFSC-582:** 75-76.

Foley, A. M., et al. (2005). "Fibropapillomatosis in stranded green turtles (*Chelonia mydas*) from the eastern United States (1980-98): Trends and associations with environmental factors." Journal of Wildlife Diseases **41**(1): 29-41.

We examined data collected by the US Sea Turtle Stranding and Salvage Network on 4,328 green turtles (*Chelonia mydas*) found dead or debilitated (i.e., stranded) in the

eastern half of the USA from Massachusetts to Texas during the period extending from 1980 to 1998. Fibropapillomatosis (FP) was reported only on green turtles in the southern half of Florida (south of 298N latitude). Within this region, 22.6% (682/3,016) of the turtles had tumors. Fibropapillomatosis was more prevalent in turtles found along the western (Gulf) coast of Florida (51.9%) than in turtles found along the eastern (Atlantic) coast of Florida (11.9%) and was more prevalent in turtles found in inshore areas (38.9%) than in turtles found in offshore areas (14.6%). A high prevalence of FP corresponded to coastal waters characterized by habitat degradation and pollution, a large extent of shallow-water area, and low wave energy, supporting speculation that one or more of these factors could serve as an environmental cofactor in the expression of FP. A high prevalence of FP did not correspond to high-density green turtle assemblages. Turtles with tumors were found most commonly during the fall and winter months, and the occurrence of tumors was most common in turtles of intermediate size (40–70-cm curved carapace length). Stranded green turtles with tumors were more likely to be emaciated or entangled in fishing line and less likely to have propeller wounds than were stranded green turtles without tumors. Turtles with and without tumors were equally likely to show evidence of a shark attack. The percent occurrence of tumors in stranded green turtles increased from approximately 10% in the early 1980s to over 30% in the late 1990s. Fibropapillomatosis was first documented in southernmost Florida in the late 1930s and spread throughout the southern half of Florida and the Caribbean during the mid-1980s. Because green turtles living in south Florida are known to move throughout much of the Caribbean, but are not known to move to other parts of the USA or to Bermuda, the spread and current distribution of FP in the western Atlantic, Gulf of Mexico, and Caribbean can be explained by assuming FP is caused by an infectious agent that first appeared in southern Florida. Aberrant movements of captive-reared turtles or of turtles that are released into areas where they were not originally found could spread FP beyond its current distribution.

Foley, A. M., et al. (2007). "Characteristics of a green turtle (*Chelonia mydas*) assemblage in northwestern Florida determined during a hypothermic stunning event." Gulf of Mexico Science **25**(2): 131-143.

A hypothermic stunning event (i.e., cold-stunning event) during late Dec. 2000 and early Jan. 2001 involving an unprecedented number of sea turtles provided an opportunity to characterize the green turtle (Chelonia mydas) assemblage in St. Joseph Bay (Gulf County, Florida). In addition to 388 green turtles, the 401 cold-stunned turtles comprised 10 Kemp's ridleys (Lepidochelys kempii) and three loggerheads (Caretta caretta). Most (337/401) of the turtles survived and were eventually released. To place this event in perspective, we categorize sea turtle cold-stunning events in the eastern United States as either acute or chronic. Acute cold-stunning events, like the one in St. Joseph Bay, occur only during unusually cold winters in shallow-water areas (< 2 m), where sea turtles are year-round residents. These are short-lived (< 2 wk) events with low mortality rates (< 30%) that affect principally green turtles. Chronic cold-stunning events occur every winter in areas where sea turtles are seasonal residents. These are long-lived (1-3 mo) events with high mortality rates (> 60%) that affect primarily Kemp's ridleys. All of the green turtles from St. Joseph Bay were neritic-phase juveniles, and the mean straight-line carapace length of this group was 36.6 cut (range = 25.0-75.3 cm, SD = 8.9). This

assemblage of juvenile green turtles is the first documented along the northern Gulf of Mexico. Sequencing of mtDNA (mitochondrial DNA) from tissue samples taken from 255 of the green turtles revealed that about 81% were from the nesting populations in the United States (Florida) and Mexico (Yucatan). This assemblage is unusual in the United States because it does not have a substantial representation from the nesting population in Costa Rica (Tortuguero), the Atlantic's largest green turtle nesting population. Based on necropsies of 51 of the green turtles, the sex ratio of this assemblage was female-biased (3.25 females: 1 male), which may be a result of warm incubation temperatures on the nesting beaches in Florida. The majority of the material found in the gastrointestinal tracts of the green turtles that died was turtle grass (Thalassia testudinum). This was the first time turtle grass has been identified as the primary diet of Juvenile green turtles anywhere in the continental United States. Green turtles in St. Joseph Bay appear to have few direct threats, but the seagrass upon which these turtles primarily forage has suffered extensive damage from boat propellers.

Formia, A. (1999). "Les tortues marines de la Baie de Corisco." Canopee **14**: i-ii.

Frazer, N. B. and L. M. Ehrhart (1985). "Preliminary growth models for green, (*Chelonia mydas*) and loggerhead, (*Caretta caretta*), turtles in the wild." Copeia **1985**(1): 73-79.

Fretey, J. (2001). Biogeography and conservation of marine turtles of the Atlantic Coast of Africa. UNebraskaP/CMississippi Secretariat**:** Bonn, Germany.

Garrett, C. (2004). Priority Substances of Interest in the Georgia Basin - Profiles and background information on current toxics issues, Canadian Toxics Work Group Puget Sound, Georgia Basin International Task Force**:** 402.

Geraci, J. R. (1990). Physiologic and toxic effects on cetaceans. Sea Mammals and Oil: Confronting the Risks. J. R. Geraci and D. J. S. Aubin. San Diego, Academic Press**:** 167-197.

Girard, C., et al. (2009). "Post-nesting migrations of loggerhead sea turtles in the Gulf of Mexico: Dispersal in highly dynamic conditions." Marine Biology **156**(9): 1827-1839.

Gladys Porter Zoo (2013). Gladys Porter Zoo's Preliminary Annual Report on the Mexico/United States of America Population Restoration Project for the Kemp’s Ridley Sea Turtle, *Lepidochelys kempii,* on the Coasts of Tamaulipas, Mexico 2013.

Gonzalez Carman, V., et al. (2011). "Argentinian coastal waters: A temperate habitat for three species of threatened sea turtles." Marine Biology Research **7**: 500-508.

Grant, S. C. H. and P. S. Ross (2002). Southern Resident killer whales at risk: Toxic chemicals in the British Columbia and Washington environment. Canadian Technical Report of Fisheries and Aquatic Sciences. Sidney, B.C., Department of Fisheries and Oceans Canada. **2412:** 124.

Green, D. (1993). "Growth rates of wild immature green turtles in the Galápagos Islands, Ecuador." Journal of Herpetology **27**(3): 338-341.

Groombridge, B. (1982). "Kemp's ridley or Atlantic ridley, *Lepidochelys kempii* (Garman 1980)." The IUCN Amphibia, Reptilia Red Data Book: 201-208.

Guseman, J. L. and L. M. Ehrhart (1992). Ecological geography of western Atlantic loggerheads and green turtles: Evidence from remote tag recoveries. Eleventh Annual Workshop on Sea Turtle Biology and Conservation. M. Salmon and J. Wyneken. Jekyll Island, Georgia, U.S. Department of Commerce. **Technical Memorandum NMFS-SEFSC-302:** 50.

Hart, K. M., et al. (2012). "Common coastal foraging areas for loggerheads in the Gulf of Mexico: Opportunities for marine conservation." Biological Conservation **145**: 185-194.

Hartwell, S. I. (2004). "Distribution of DDT in sediments off the central California coast." Marine Pollution Bulletin **49**(4): 299-305.

Hawkes, L. A., et al. (2007). "Investigating the potential impacts of climate change on a marine turtle population." Global Change Biology **13**: 1-10.

Hays, G. C., et al. (2001). "The diving behavior of green turtles undertaking oceanic migration to and from Ascension Island: Dive durations, dive profiles, and depth distribution." Journal of Experimental Biology **204**: 4093-4098.

> Satellite telemetry was used to record the submergence duration of green turtles (*Chelonia mydas*) as they migrated from Ascension Island to Brazil (*N*=12 individuals) while time/depth recorders (TDRs) were used to examine the depth distribution and dive profiles of individuals returning to Ascension Island to nest after experimental displacement (*N*=5 individuals). Satellite telemetry revealed that most submergences were short (<5 min) but that some submergences were longer (>20 min), particularly at night. TDRs revealed that much of the time was spent conducting short (2–4 min), shallow (approximately 0.9–1.5 m) dives, consistent with predictions for optimisation of near-surface travelling, while long (typically 20–30 min), deep (typically 10–20 m) dives had a distinctive profile found in other marine reptiles. These results suggest that green turtles crossing the Atlantic do not behave invariantly, but instead alternate between periods of travelling just beneath the surface and diving deeper. These deep dives may have evolved to reduce silhouetting against the surface, which would make turtles more susceptible to visual predators such as large sharks.

Hays, G. C., et al. (2002). "Water temperature and internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles." Journal of Thermal Biology **27**(5): 429-432.

Heppell, S. S., et al. (2005). "A population model to estimate recovery time, population size, and management impacts on Kemp’s ridley sea turtles." Chelonian Conservation and Biology **4**(4): 767-773.

Heppell, S. S., et al. (2003). Population models for Atlantic loggerheads: Past, present, and future. Loggerhead Sea Turtles. A. Bolten and B. Witherington. Washington, D. C., Smithsonian Books**:** 255-273.

Herbst, L. H. (1994). "Fibropapillomatosis of marine turtles." Annual Review of Fish Diseases **4**: 389-425.

Herbst, L. H., et al. (1995). "An infectious etiology for green turtle fibropapillomatosis." Proceedings of the American Association for Cancer Research Annual Meeting **36**: 117.

Hildebrand, H. H. (1963). "Hallazgo del area de anidacion de la tortuga marina "lora", *Lepidochelys kempi* (Garman), en la costa occidental del Golfo de Mexico (Rept., Chel.)." Ciencia, Mexico **22**: 105-112.

Hildebrand, H. H. (1982). A historical review of the status of sea turtle populations in the western Gulf of Mexico. Biology and Conservation of Sea Turtles. K. A. Bjorndal. Washington, D. C., Smithsonian Institution Press**:** 447-453.

Hill, A. (2013). Rough Draft of Fishing Piers and Protected Species: An Asesment of the Presence and Effectiveness of Conservation Measures in Charlotte and Lee County, Florida, University of Miami, Rosenstiel School of Marine and Atmospheric Science**:** 50.

Hirth, H. F. (1971). Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus) 1758, Food and Agriculture Organization.

Hirth, H. F. (1997). "Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758)." Biological Report **91**(1): 120.

Iwata, H., et al. (1993). "Distribution of persistent organochlorines in the oceanic air and surface seawater and the role of ocean on their global transport and fate." Environmental Science and Technology **27**(6): 1080-1098.

Jacobson, E. R. (1990). "An update on green turtle fibropapilloma." Marine Turtle Newsletter **49**: 7-8.

Jacobson, E. R., et al. (1989). "Cutaneous fibropapillomas of green turtles (*Chelonia mydas*)." Journal Comparative Pathology **101**: 39-52.

Jacobson, E. R., et al. (1991). Fibropapillomas in green turtles. Research Plan for Marine Turtle Fibropapilloma. G. H. Balazs and S. G. Pooley. **NOAA-TM-NMFS-SWFSC-156:** 99-100.

Johnson, S. A. and L. M. Ehrhart (1994). Nest-site fidelity of the Florida green turtle. Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. B. A. Schroeder and B. E. Witherington. **Technical Memorandum NMFS-SEFSC-341:** 83.

Johnson, S. A. and L. M. Ehrhart (1996). "Reproductive ecology of the Florida green turtle: Clutch frequency." Journal of Herpetology **30**(3): 407-410.

Lagueux, C. J. (2001). Status and distribution of the green turtle, *Chelonia mydas*, in the wider Caribbean region. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management. K. L. Eckert and F. A. Abreu Grobois. Santo Domingo, Dominican Republic**:** 32-35.

Laurent, L., et al. (1998). "Molecular resolution of marine turtle stock composition in fishery by-catch: A case study in the Mediterranean." Molecular Ecology **7**: 1529-1542.

Law, R. J., et al. (1991). "Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles." Marine Pollution Bulletin **22**(4): 183-191.

Lezama, C. (2009). impacto de la pesqueria artesanal sobre la tortoga verde (*Chelonia mydas*) en las costas del Rio de la Plata exterior, Universidad de la República.

Lima, E. H. S. M., et al. (2010). "Incidental capture of sea turtles by the lobster fishery off the Ceará Coast, Brazil." Marine Turtle Newsletter **128**: 16-19.

López-Barrera, E. A., et al. (2012). "Incidental capture of green turtle (*Chelonia mydas*) in gillnets of small-scale fisheries in the Paranaguá Bay, Southern Brazil." Ocean and Coastal Management **60**: 11-18.

> Fishing activities are an important economic resource in the Paranaguá Bay, southern Brazil. In this area, there are reports of sea turtles interacting with small-scale fisheries. It was found that the juvenile greenturtle (Chelonia mydas) uses areas disturbed by fishing activity, which puts them at a higher risk of capture. The objective of this study was to evaluate the interactions of juvenile green-turtles with the gillnets used in small-scale fisheries, enabling a long-term understanding of those gillnet characteristics which increase the risk of turtle captures. The highest sea turtle capture rates occur in the early dry season, which is correlated with the larger displacement of individuals searching for available food sources. High levels of fishing effort also occur in this early dry period without a specific target resource. The highest levels of sea turtle mortality were observed during the coldest periods of the year (late rainy and early dry seasons) and can be related to the physiological needs of the sea turtles. The characteristics of gillnets that had the strongest relationships to turtle captures were soak time and mesh size. These results suggest that it is necessary to design new regulations governing aspects of fishing techniques such as soak time, net length or seasonal use of nets. Conservation initiatives aiming to reduce the risk of turtle capture must consider the economic importance of small-scale fishing practices and address the conflict that may exist between social concerns and environmental issues.

López-Mendilaharsu, M., et al. (2006). Biología, ecología yetología de las tortugas marinas en la zona costera uru-guaya. Bases para la Conservación y el Manejode la Costa Uruguaya. R. Menafra, L. Rodríguez-Gallego, F. Scarabino and D. Conde. Montevideo, Uruguay: Vida Silvestre, Uruguay**:** p 247-257.

Lutcavage, M., et al. (1997). Human impacts on sea turtle survival. The Biology of Sea Turtles. P. Lutz and J. A. Musick. Boca Raton, Florida, CRC Press. **1:** 387–409.

Marcovaldi, N., et al. (2009). Sea Turtle Interactions in Coastal Net Fisheries in Brazil. Proceedings of the Technical Workshop on Mitigating Sea Turtle Bycatch in Coastal Net Fisheries. Western Pacific Regional Fishery Management Council, IUCN, Southeast Asian Fisheries Development Center, Indian Ocean - South-East Asian Marine Turtle MoU. E. Gilman. Gland, Switze, Honolulu, Hawaii, USA, U.S. National Marine Fisheries Service, Southeast Fisheries Science Center: Honolulu**:** p. 28.

Márquez M., R. (1990). Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date. FAO Species Catalog, FAO Fisheries Synopsis. Rome. **11:** 81.

Márquez M., R. (1994). Synopsis of biological data on the Kemp's ridley sea turtle, *Lepidochelys kempii* (Garman, 1880), National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Center.

Matkin, C. O. and E. Saulitis (1997). Restoration notebook: Killer whale (*Orcinus orca*). Anchorage, Alaska, *Exxon Valdez* Oil Spill Trustee Council.

McMichael, E., et al. (2003). Evidence of homing behavior in juvenile green turtles in the northeastern Gulf of Mexico. Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. J. A. Seminoff. **Technical Memorandum NMFS-SEFSC-503:** 223-224.

Meylan, A., et al. (1994). Marine turtle nesting activity in the State of Florida, 1979-1992. Fourteenth Annual Symposium on Sea Turtle Biology and Conservation. K. A. Bjorndal, A. B. Bolten, D. A. Johnson and P. J. Eliazar. **Technical Memorandum NMFS-SEFSC-351:** 83.

Meylan, A. B., et al. (1995). "Sea turtle nesting activity in the State of Florida 1979-1992." Florida Department of Environmental Protection(52): 63.

Milton, S. L. and P. L. Lutz (2003). Physiological and genetic responses to environmental stress. The Biology of Sea Turtles. P. L. Lutz, J. A. Musick and J. Wyneken. Boca Raton, Florida, CRC Press. **II:** 163-197.

Mo, C. L. (1988). Effect of bacterial and fungal infection on hatching success of Olive Ridley sea turtle eggs, World Wildlife Fund-U.S.**:** 7.

Moncada, F., et al. (2010). "Movement patterns of loggerhead turtles *Caretta caretta* in Cuban waters inferred from flipper tag recaptures." Endangered Species Research **11**(1): 61-68.

Moncada Gavilan, F. (2001). Status and distribution of the loggerhead turtle, *Caretta caretta*, in the wider Caribbean region. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management. K. L. Eckert and F. A. Abreu Grobois. Santo Domingo, Dominican Republic**:** 36-40.

Monzón-Argüello, C., et al. (2010). "Evidence from genetic and Lagrangian drifter data for transatlantic transport of small juvenile green turtles." Journal of Biogeography **37**(9): 1752-1766.

Aim: A key life-history component for many animals is the need for movement between different geographical locations at particular times. Green turtle (Chelonia mydas) hatchlings disperse from their natal location to spend an early pelagic stage in the ocean, followed by a neritic stage where small juveniles settle in coastal areas. In this study, we combined genetic and Lagrangian drifter data to investigate the connectivity between natal and foraging locations. In particular we focus on the evidence for transatlantic transport. Location Atlantic Ocean.

Methods: We used mitochondrial DNA (mtDNA) sequences (n = 1567) from foraging groups (n = 8) and nesting populations (n = 12) on both sides of the Atlantic. Genetic data were obtained for Cape Verde juvenile turtles, a foraging group not previously sampled for genetic study. Various statistical methods were used to explore spatial genetics and population genetic structure (e.g. exact tests of differentiation, Geneland and analysis of molecular variance). Many-to-many mixed stock analysis estimated the connectivity between nesting and foraging groups.

Results: Our key new finding is robust evidence for connectivity between a nesting population on the South American coast (25% of the Surinam nesting population are estimated to go to Cape Verde) and a foraging group off the coast of West Africa (38% of Cape Verde juveniles are estimated to originate from Surinam), thus extending the results of previous investigations by confirming that there is substantial transatlantic dispersal in both directions. Lagrangian drifter data demonstrated that transport by drift across the Atlantic within a few years is possible.

Main conclusions: Small juvenile green turtles seem capable of dispersing extensively, and can drop out of the pelagic phase on a transatlantic scale (the average distance between natal and foraging locations was 3048 km). Nevertheless, we also find support for the ‘closest-to-home’ hypothesis in that the degree of contribution from a nesting population to a foraging group is correlated with proximity. Larger-sized turtles appear to feed closer to their natal breeding grounds (the average distance was 1133 km), indicating that those that have been initially transported to far-flung foraging grounds may still be able to move nearer to home as they grow larger.

Murphy, T. M. and S. R. Hopkins (1984). Aerial and ground surveys of marine turtle nesting beaches in the southeast region, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center**:** 73.

Musick, J. A. and C. J. Limpus (1997). Habitat utilization and migration in juvenile sea turtles. The Biology of Sea Turtles. P. L. Lutz and J. A. Musick. New York, New York, CRC Press**:** 137-163.

Naro-Maciel, E., et al. (2007). "Testing dispersal hypotheses in foraging green sea turtles (*Chelonia mydas*) of Brazil." Journal of Heredity **98**(1): 29-39.

Naro-Maciel, E., et al. (2012). "The interplay of homing and dispersal in green turtles: A focus on the southwestern atlantic." Journal of Heredity **103**(6): 792-805.

NMFS-NEFSC (2011). Preliminary summer 2010 regional abundance estimate of loggerhead turtles (*Caretta caretta*) in northwestern Atlantic Ocean continental shelf waters, U.S. Department of Commerce, Northeast Fisheries Science Center**:** 33.

NMFS-SEFSC (2009). An assessment of loggerhead sea turtles to estimate impacts of mortality on population dynamics, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

NMFS (1997). Endangered Species Act Section 7 Consultation - Biological Opinion on Navy activities off the southeastern United States along the Atlantic coast. National Marine Fisheries Service, Office of Protected Resources and the Southeast Regional Office**:** 58.

NMFS (2001). Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

NMFS (2012). Protocols for Categorizing Sea Turtles for Post-release Mortality Estimates. August 2001, revised February 2012. PRD Contribution: #PRD-2011-07. Miami, Florida, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center**:** 8.

NMFS and USFWS (1991). Recovery plan for U.S. population of the Atlantic green turtle (*Chelonia mydas*). Washington, D. C., National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources**:** 58.

NMFS and USFWS (1992). Recovery plan for leatherback turtles *Dermochelys coriacea* in the U. S. Carribean, Atlantic and Gulf of Mexico. Silver Spring, Maryland, National Marine Fisheries Service and U.S. Fish and Wildlife Service**:** 65.

NMFS and USFWS (1993). Recovery plan for the hawksbill turtle *Eretmochelys imbricata* in the U.S. Caribbean, Atlantic and Gulf of Mexico. St. Petersburg, Florida, National Oceanic and Atmospheric Administration, National Marine Fisheries Service**:** 52.

NMFS and USFWS (2007). Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. Silver Spring, Maryland, National Marine Fisheries Service**:** 102.

NMFS and USFWS (2007). Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: Summary and evaluation. Silver Spring, Maryland, National Marine Fisheries Service and U.S. Fish and Wildlife Service**:** 50.

NMFS and USFWS (2007). Loggerhead sea turtle (*Caretta caretta*) 5-year review: Summary and evaluation. Silver Spring, Maryland, National Marine Fisheries Service and U.S. Fish and Wildlife Service**:** 67.

NMFS and USFWS (2008). Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. Silver Spring, Maryland, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

NMFS, et al. (2011). Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. Silver Spring, Maryland, National Marine Fisheries Service**:** 156.

NMFS, et al. (2011). Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. Silver Spring, Maryland, National Marine Fisheries Service**:** 156 + appendices.

NMFS and USFWS (1991). Recovery plan for U.S. Population of Atlantic Green Turtle (*Chelonia mydas*). Silver Spring, Maryland, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources**:** 58.

NMFS and USFWS (2007). Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. Silver Spring, Maryland, National Marine Fisheries Service**:** 102.

NMFS and USFWS (2009). Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta)*. Silver Spring, Maryland, National Marine Fisheries Service and U.S. Fish and Wildlife Service**:** 325.

NRC (1990). Decline of the sea turtles: Causes and prevention. Washington, D. C., National Research Council.

Ogren, L. H. (1989). Distribution of juvenile and subadult Kemp's ridley sea turtles: Preliminary results from 1984-1987 surveys. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. C. W. Caillouet Jr. and A. M. Landry Jr. Galveston, Texas, Texas A&M University, Sea Grant College. **Publication TAMU-SG-89-105:** 116-123.

Pike, D. A., et al. (2006). "Earlier nesting contributes to shorter nesting seasons for the loggerhead seaturtle, *Caretta caretta*." Journal of Herpetology **40**(1): 91-94.

Pritchard, P. C. H. (1969). "The survival status of ridley sea-turtles in America." Biological Conservation **2**(1): 13-17.

Prosdocimi, L., et al. (2012). "Genetic composition of green turtle feeding grounds in coastal waters of Argentina based on mitochondrial DNA." Journal of Experimental Marine Biology and Ecology **412**: 37-45.

The green turtle, Chelonia mydas, like other species of marine turtles, shows great migratory displacement between its nesting and feeding grounds. In an attempt to characterize the southernmost feeding grounds of this species, mtDNA sequence variation of green turtle aggregations in Argentinean waters was studied to elucidate genetic variation and infer possible origins. The goal of the present study is contemplated within the main purpose of the PRICTMA (Regional Program for Sea Turtle Research in Conservation of Argentina) and the Network ASO-Tortugas (Red Atlántico Sur Occidental-Tortugas) which are dedicated to promoting conservation studies in marine turtles in the region. A 486-bp fragment of the mitochondrial DNA control region was sequenced from 93 samples of incidentally caught juveniles from 2004 to 2007, revealing 9 haplotypes. Nucleotide and haplotype diversity were similar to those detected in other Brazilian feeding grounds (Ubatuba and Atol das Rocas/Fernando de Noronha). Analysis of molecular variance (AMOVA) indicated significant genetic differentiation among 9 western Atlantic feeding grounds for which data is currently available, suggesting variable contributions from different nesting colonies (FST=0.29, Pb10−4; ΦST=0.55, Pb10−4). Mitochondrial DNA haplotype distributions revealed significant heterogeneity among feeding grounds (X2: 804.84, Pb10−4). A pairwise analysis revealed that most western Atlantic feeding grounds are genetically differentiated. The weighted and unweighted mixed stock analyses suggests that green turtles at Argentinean feeding grounds originate mainly in the Ascension Island rookery, with less contribution from rookeries in Suriname, Aves Island and Trindade Island.

The present results improve our knowledge of the population structure and migration patterns of the Atlantic green turtle, and inform conservation measures on feeding grounds, which may be thousands of kilometers away from the nesting colonies. This information is required to further government efforts for this endangered species.

Rebel, T. P. (1974). Sea Turtles and the Turtle Industry of the West Indies, Florida and the Gulf of Mexico. Coral Gables, Florida, University of Miami Press.

Rivas-Zinno, F. (2012). Captura incidental de tortugas marinas en Bajos del Solis, Uruguay, Universidad de la Republica Uruguay, Departamento de Ecologia y Evolucion.

Ryder, C. E., et al. (2006). Report of the Workshop on Marine Turtle Longline Post-Interaction Mortality, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources**:** 36.

Schmid, J. R. and J. A. Barichivich (2006). *Lepidochelys kempii*–Kemp's ridley. Biology and conservation of Florida turtles. Chelonian Research Monographs. P. A. Meylan. **3:** 128-141.

Schmid, J. R. and A. Woodhead (2000). Von Bertalanffy growth models for wild Kemp's ridley turtles: analysis of the NMFS Miami Laboratory tagging database. Turtle Expert Working Group Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. NOAA Technical Memorandum. Miami, Florida, U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center. **444:** 94-102.

Schroeder, B. A. and A. M. Foley (1995). Population studies of marine turtles in Florida Bay. Twelfth Annual Workshop on Sea Turtle Biology and Conservation. J. I. Richardson and T. H. Richardson. **Technical Memorandum NMFS-SEFSC-361**.

Seminoff, J. A., et al. (2015). Status review of the green turtle (*Chelonia Mydas*) under the endangered species act. NOAA Technical Memorandum**:** 571 pp.

Shaver, D. J. (1994). "Relative abundance, temporal patterns, and growth of sea turtles at the Mansfield Channel, Texas." Journal of Herpetology **28**(4): 491-497.

Snover, M. L. (2002). Growth and ontogeny of sea turtles using skeletochronology: Methods, validation and application to conservation. Ecology, Duke University. **Ph.D.:** 144.

Storelli, M. M., et al. (2008). "Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (*Chelonia mydas*) from the Mediterranean Sea." Chemosphere **70**(5): 908-913.

> This study investigated the subcellular distribution of Cd, Cu and Zn in liver and kidney of green turtles (Chelonia mydas) stranded along the Italian coast of the South Adriatic Sea (Eastern Mediterranean). Cd and Zn mean concentrations did not differ significantly between liver (4.26 mu g g(-1) and 34.53 mu g g(-1), respectively) and kidney (5.06 mu g g(-1) and 26.39 mu g g(-1), respectively), whereas the levels of Cu were significantly higher in liver (32.75 mu g g(-1)) than in kidney (8.20 mu g g(-1)) ($p < 0.009$). Most of Cd, Cu and Zn was present in hepatic and renal cytosol, and their concentrations increased with total levels in both organs, indicating that cytosol has a crucial role in metal accumulation. Cd and Cu in hepatic and renal cytosol were present mostly in metallothionein fractions (MTs), whereas Zn was fractionated into MTs and high-molecular-weight-substances (HMWS). The comparison with the results of other investigations on individuals of the same species collected in different marine areas shows good agreement relatively to essential metals. For Cd our data are comparable with those encountered in specimens from the Mediterranean Sea (Cyprus) confirming the homogeneity of the area comprising the southeastern basin of the Mediterranean Sea from an ecological point of view. (c) 2007 Elsevier Ltd. All rights reserved.

TEWG (1998). An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic, Department of Commerce, Turtle Expert Working Group**:** 96

TEWG (1998). An assessment of the Kemp’s ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the western North Atlantic, U. S. Dept. Commerce**:** 115.

TEWG (2000). Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group**:** 115.

TEWG (2009). An assessment of the loggerhead turtle population in the western North Atlantic ocean, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Turtle Expert Working Group**:** 131.

Troëng, S. and E. Rankin (2005). "Long-term conservation efforts contribute to positive green turtle *Chelonia mydas* nesting trend at Tortuguero, Costa Rica." Biological Conservation **121**: 111-116.

Tucker, A. D. (2010). "Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation." Journal of Experimental Marine Biology and Ecology **383**(1): 48-55.

USFWS and NMFS (1998). Endangered Species Act consultation handbook. Procedures for Conducting Section 7 Consultations and Conferences, U.S. Fish and Wildlife, National Marine Fisheries Service.

Vargo, S., et al. (1986). Study of the effects of oil on marine turtles. Vienna, Virginia, U.S. Department of the Interior, Minerals Management Service. **Volume 1: Executive Summary**.

Watson, J. W., et al. (2005). "Fishing methods to reduce sea turtle mortality associated with pelagic longlines." Canadian Journal of Fisheries and Aquatic Sciences **62**(5): 965-981.

Weishampel, J. F., et al. (2004). "Earlier nesting by loggerhead sea turtles following sea surface warming." Global Change Biology **10**: 1424-1427.

Weishampel, J. F., et al. (2003). "Spatiotemporal patterns of annual sea turtle nesting behaviors along an East Central Florida beach." Biological Conservation **110**(2): 295-303.

Wershoven, J. L. and R. W. Wershoven (1992). Juvenile green turtles in their nearshore habitat of Broward County, Florida: A five year review. Eleventh Annual Workshop on Sea Turtle Biology and Conservation. M. Salmon and J. Wyneken. **NMFS-SEFC-302:** 121-123.

White, F. N. (1994). Swallowing dynamics of sea turtles. Research Plan to Assess Marine Turtle Hooking Mortality. G. H. Balazs and S. G. Pooley. Honolulu, Hawaii, National Oceanic and Atmospheric Administration. **NOAA-TM-NMFS-SWFSC-201:** 89-95.

Witherington, B., et al. (2006). "*Chelonia mydas* - Green turtle." Chelonian Research Monographs **3**: 90-104.

Witherington, B., et al. (2003). Effects of beach armoring structures on marine turtle nesting, U.S. Fish and Wildlife Service. **Final Project Report:** 26.

Witherington, B., et al. (2007). Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches, U.S. Fish and Wildlife Service. **Final Project Report:** 12.

Witherington, B. E. (1992). "Behavioral responses of nesting sea turtles to artificial lighting." Herpetologica **48**(1): 31-39.

Witherington, B. E. (2002). "Ecology of neonate loggerhead turtles inhabiting lines of downwelling near a Gulf Stream front." Marine Biology **140**(4): 843-853.

Witherington, B. E. and K. A. Bjorndal (1991). "Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles *Caretta caretta*." Biological Conservation **55**(2): 139-149.

Witherington, B. E. and L. M. Ehrhart (1989). "Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon System, Florida." Copeia **1989**(3): 696-703.

Witherington, B. E. and L. M. Ehrhart (1989). Status, and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Second Western Atlantic Turtle Symposium. . L. Ogren, F. Berry, K. Bjorndal et al. **Technical Memorandum NMFS-SEFSC-226:** 351-352.

Witzell, W. N. (2002). "Immature Atlantic loggerhead turtles (*Caretta caretta*): Suggested changes to the life history model." Herpetological Review **33**(4): 266-269.

Work, T. M. (2000). Synopsis of necropsy findings of sea turtles caught by the Hawaii-based pelagic longline fishery**:** 5.

Zug, G. R. and R. E. Glor (1998). "Estimates of age and growth in a population of green sea turtles (*Chelonia mydas*) from the Indian River lagoon system, Florida: A skeletochronological analysis." Canadian Journal of Zoology **76**(8): 1497-1506.

> The Indian River lagoon system harbors a dynamic population of juvenile green sea turtles (Chelonia mydas). This foraging or developmental population occupies the lagoon year-round and periodically experiences cold-stunning events that kill a portion of the population. A sample of 59 C. mydas (28-74 cm straight carapace length) from the December 1989 cold-stunning event was aged by skeletochronology, yielding age estimates of 3-14 years. Mean growth-rate estimates range from 30 to 52 mm/year for most age and size classes, with means for the 6- to 11-year age classes (44-49 mm/year) not significantly different but greater than those of the youngest and oldest classes estimates of age at sexual maturity. The age estimates suggest that the western Atlantic C. mydas change from a developmental habitat for 6 or more years.

Zurita, J. C., et al. (2003). Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. J. A. Seminoff. Miami, Florida. **Technical Memorandum NMFS-SEFSC-503:** 25-127.

Zwinenberg, A. J. (1977). "Kemp's ridley, *Lepidochelys kempii* (Garman, 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of *Lepidochelys olivacea*)." Bulletin Maryland Herpetological Society **13**(3): 170-192.