



**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

<http://sero.nmfs.noaa.gov>

F/SER31: NMB  
SER-2016-18030

Chief, Tampa Permits Section  
Jacksonville District Corps of Engineers  
Department of the Army  
10117 Princess Palms Avenue, Suite 120  
Tampa, Florida 33610-8302

MAR 01 2017

Ref.: SAJ-2013-00697 (SP-LDD), City of St. Petersburg, Replacement of the St. Petersburg Pier, St. Petersburg, Pinellas County, Florida

Dear Sir or Madam,

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 (ESA). The Opinion considers the effects of a proposal by the Jacksonville District of the U.S. Army Corps of Engineers (USACE) to authorize the replacement of a public fishing pier. 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 project effects on sea turtles (loggerhead, green, and Kemp's ridley) and smalltooth sawfish.

We look forward to further cooperation with you on other USACE projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Nicole Bonine, Consultation Biologist, by phone at 727-824-5336, or by email at [Nicole.Bonine@noaa.gov](mailto:Nicole.Bonine@noaa.gov).

Sincerely,

Fol Roy E. Crabtree, Ph.D.  
Regional Administrator

Enclosures:  
Biological Opinion

File: 1514-22 F.4



**Endangered Species Act - Section 7 Consultation  
Biological Opinion**


**Action Agency:** U.S. Army Corps of Engineers (USACE), Jacksonville District

**Activity:** Replacement and Continued Operation of the St. Petersburg Pier,  
St. Petersburg, Pinellas County, Florida

**Consulting Agency:** National Oceanic and Atmospheric Administration, National  
Marine Fisheries Service (NMFS), Southeast Regional Office,  
Protected Resources Division, St. Petersburg, Florida

Consultation Number SER-2016-18030

**Approved by:**

  
For Roy E. Crabtree, Ph.D., Regional Administrator  
NMFS, Southeast Regional Office  
St. Petersburg, Florida

**Date Issued:**

3/1/17

---

**CONTENTS**

|    |   |    |
|----|---|----|
| 1  | Consultation History .....  | 5  |
| 2  | Descriptions of the Proposed Actions and Action Areas .....         | 5  |
| 3  | Status of Listed Species AND CRITICAL HABITAT .....                 | 9  |
| 4  | Environmental Baseline .....  | 42 |
| 5  | Effects of the Action .....   | 45 |
| 6  | Cumulative Effects .....  | 58 |
| 7  | Jeopardy Analysis .....   | 58 |
| 8  | Conclusion .....  | 68 |
| 9  | Incidental Take Statement .....                                     | 68 |
| 10 | Conservation Recommendations .....                                  | 71 |
| 11 | Reinitiation of Consultation .....                                  | 72 |
| 12 | Literature Cited .....  | 72 |
| 13 | Appendix 1. Example of Protected Species/Fishing Pier Signage ..... | 94 |

## LIST OF TABLES

---

|   |    |
|---|----|
| Table 1. Effects Determinations for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action .....   | 9  |
| Table 2. Reported Sea Turtle Captures at Piers in Tampa Bay .....   | 13 |
| Table 3. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets).....   | 21 |
| Table 4. Criteria for Assessing PRM, With Mortality Rates Shown as Percentages for Hardshell Sea Turtles and Leatherbacks (in Parentheses) (NMFS and SEFSC 2012)..... | 52 |
| Table 5. Category of Injury from Hook-and-Line Captures at Fishing Piers in Mississippi (January 1, 2010- June 10, 2013).....   | 53 |
| Table 6. Disposition of Sea Turtles Captured at Mississippi Fishing Piers (January 1, 2010-June 10, 2015) .....   | 54 |
| Table 7. Estimated Overall PRM Rate for Turtles Released Immediately from the Pier Potentially with Trailing Line .....   | 56 |
| Table 8. Total Estimated Take for a 3-Year Period at St. Petersburg Pier .....  | 57 |
| Table 9. Anticipated Non-lethal Take by Species During Any 3-Year Period.....   | 57 |
| Table 10. Estimated Captures and PRM by Species.....  | 69 |

---

## LIST OF FIGURES

|   |    |
|---|----|
| Figure 1. The two construction drawings above were provided by the applicant from ASD Architects and Roger Partners Architects + Urban Designers. ....  | 8  |
| Figure 2. Image showing the existing St. Petersburg Pier and surrounding area (©2016 Google)8   |    |
| Figure 3. Sea Turtle Strandings in Zone 5 (Data provided by the STSSN) Zone 5 is located along the west coast of Florida within Latitude 27, which ranges from approximately just north of Clearwater continuing south to just north of Englewood, Florida.....   | 12 |
| Figure 4. Loggerhead sea turtle nesting at Florida index beaches since 1989.....  | 21 |
| Figure 5. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website, <a href="http://www.dnr.sc.gov/seaturtle/nest.htm">http://www.dnr.sc.gov/seaturtle/nest.htm</a> ).....  | 22 |
| Figure 6. 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. .... | 25 |
| Figure 7. Green sea turtle nesting at Florida index beaches since 1989 .....  | 29 |
| Figure 8. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2015).....   | 34 |

## Acronyms and Abbreviations

---

|         |  |
|---------|--|
| CFR     | Code of Federal Regulations                    |
| CPUE    | Catch Per Unit Effort                          |
| DPS     | Distinct Population Segment                    |
| DWH     | Deepwater Horizon                              |
| DTRU    | Dry Tortugas Recovery Unit                     |
| ESA     | Endangered Species Act                         |
| FP      | Fibropapillomatosis disease                    |
| FWRI    | Fish and Wildlife Research Institute           |
| GADNR   | Georgia Department of Natural Resources        |
| GCRU    | Greater Caribbean Recovery Unit                |
| IMMS    | Institute of Marine Mammal Studies             |
| ISED    | International Sawfish Encounter Database       |
| ITS     | Incidental Take Statement                      |
| NA DPS  | Distinct Population Segment                    |
| NMFS    | National Marine Fisheries Service              |
| NCWRC   | North Carolina Wildlife Resources Commission   |
| NGMRU   | Northern Gulf of Mexico Recovery Unit          |
| NOAA    | National Oceanic and Atmospheric Association   |
| NRU     | Northern Recovery Unit                         |
| NWA     | Northwest Atlantic                             |
| Opinion | Biological Opinion                             |
| PRM     | Post-release mortality                         |
| RPMs    | Reasonable and Prudent Measures                |
| SA DPS  | South Atlantic Distinct Population Segment     |
| SCDNR   | South Carolina Department of Natural Resources |
| SCL     | Straight carapace length                       |
| SEFSC   | Southeast Fisheries Science Center             |
| STSSN   | Sea Turtle and Stranding Network               |
| TEDs    | Turtle Exclusion Devices                       |
| TEWG    | Turtle Expert Working Group                    |
| USACE   | U.S. Army Corps of Engineers                   |
| USFWS   | U.S. Fish and Wildlife Service                 |

## Units of Measurement

|                 |                    |
|-----------------|--------------------|
| °C              | Degrees Celsius    |
| °F              | Degrees Fahrenheit |
| cm              | Centimeter(s)      |
| ft              | Feet               |
| ft <sup>2</sup> | Feet squared       |
| in              | Inch(es)           |
| kg              | Kilograms          |
| lb              | Pound(s)           |
| m               | Meter(s)           |

## **Background**

Section 7(a)(2) of the 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 NMFS or the U.S. Fish and Wildlife Service (USFWS), depending upon the protected species or critical habitat 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, and if so, the Opinion identifies alternatives to the action as proposed that will avoid ‘jeopardy’ or ‘adverse modification.’ 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 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 impacts associated with USACE Jacksonville District’s proposal to replace the St. Petersburg Public Pier in St. Petersburg, Pinellas County, Florida. This Opinion analyzes the project effects on sea turtles (loggerhead, Kemp’s ridley, and green) and smalltooth sawfish in accordance with Section 7 of the ESA. Our determination is based on project information provided by USACE and other sources of information including the published literature cited herein.

## **1 CONSULTATION HISTORY**

---

NMFS received a request for consultation from USACE on June 22, 2016. NMFS attended a meeting to discuss the project with the USACE, City of St. Petersburg, and the applicant’s consulting and engineering firms. After the meeting, information was provided to us on September 6, 8, and 12, 2016. We provided a draft of the project description for review on October 12, 2016. The applicant responded on October 12, 2016, and we initiated formal consultation on that date.

## **2 DESCRIPTIONS OF THE PROPOSED ACTIONS AND ACTION AREAS**

---

### **2.1 Proposed Actions**

The City of St. Petersburg proposes to replace the existing public pier that was demolished in 2016 (NMFS tracking number SER-2014-13371) and then continue to operate the new pier. The proposed project (figure 1) will include multiple construction actions including:

1. Replacement of the St. Petersburg pier in approximately the same location. The new pier will include a kayak area, bait shack, dedicated fishing area, restaurant, and educational center.
2. Installation of a new breakwater structure in front of the existing Spa Beach consisting of 2 oyster reefs measuring approximately 120 feet (ft) wide and 150 ft wide with an approximately 10 ft gap between them to allow for water and species movement. A total of 0.55 acres (ac) of limestone boulders, concrete rubble, and rock will be placed in approximately -10 to -12-ft-deep water in areas of unvegetated bay bottom.
3. Modification to Spa Beach including seawall removal and minor expansion (1.16 ac) of the beach area. The removal of the seawall will result in returning 0.11 ac to natural bay bottom.
4. Floating “water lounge” area at the east end of the pier anchored in place with helical anchors.
5. Upland improvements including removing a portion of 2<sup>nd</sup> Avenue, replacing the existing transit stop, and replacing restrooms.

Construction will require the installation of 435 new 24-inch (in) square concrete piles installed by a combination of vibratory hammer and impact hammer. The applicant has stated that 2 crews may work simultaneously with barge-mounted impact hammers to install piles, with no more than 6 piles total installed per day. Our noise analysis for this Opinion is based on this information. Pile installation will be completed by a combination of barge-mounted vibratory hammer, impact hammer, and crane. Other barges are likely to be used during construction along with land-based equipment.

Construction of the new pier and supporting piles is expected to directly impact 40 square feet (ft<sup>2</sup>) of non-ESA listed seagrasses and indirectly shade 0.06 ac of seagrass of the total of 1.94 ac of seagrasses identified in the project area. The applicant has worked to minimize seagrass impacts and proposes a no net loss of habitat function approach to seagrass impacts based on the potential expansion of seagrasses expected behind the proposed breakwaters. Seagrasses impacts and recovery will be monitored post construction and impacts will be mitigated at a 2:1 ratio. Mangroves and corals are not present within the proposed action area.

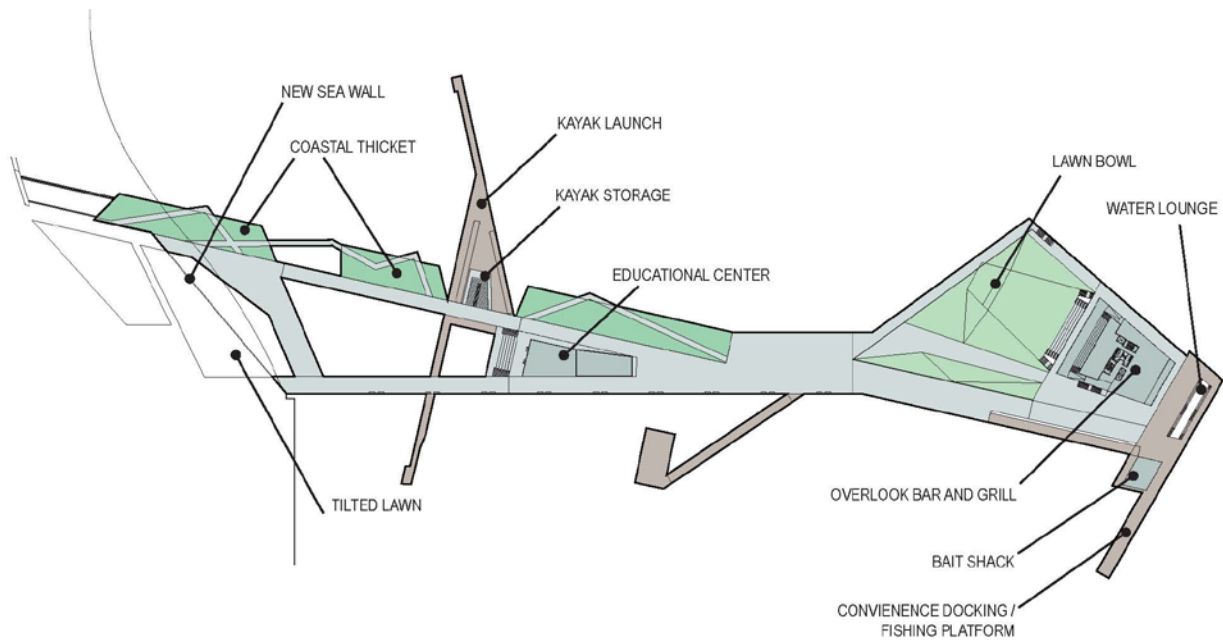
The applicant proposes to implement the following construction or operational conditions:

- All fishing will be restricted to a specific area at the end of the proposed pier.
- The 10-11 ft high pier will include a lower level deck positioned 5.5 ft above the water to be used as a dedicated fishing area. This allows easier access to release ESA-listed species that may be accidentally captured at the pier without having to lift them 10-11 ft up to unhook them.
- Educational signs will be posted at the fishing portion of the pier informing the public how to handle potential encounters with ESA-listed species. The applicant agreed to use the “Save the Sea Turtle, Sawfish, and Dolphins” sign available on our website at [http://sero.nmfs.noaa.gov/protected\\_resources/section\\_7/protected\\_species\\_educational\\_signs/index.html](http://sero.nmfs.noaa.gov/protected_resources/section_7/protected_species_educational_signs/index.html).
- The applicant will install and maintain monofilament recycling bins within the designated fishing area of the pier.



- A fish cleaning station will be installed in the fishing area of the pier away from the edge of the pier and posted with a sign to not dispose of fish carcasses, debris, or remains in the water. A trash can or other covered disposal method will be provided at the fish cleaning station.
- The bait shop will be located in the fishing area of the pier. This shop will have a pier attendant equipped with a large net able to lift sea turtles accidentally hooked out of the water and tools to unhook captured sea turtles or smalltooth sawfish while still in the water. Bait shop staff will be directed to assist in handling captured ESA-listed species by first calling the contact number on the educational sign and second following the directions on the sign if unable to reach someone.
- The applicant will coordinate with local organizations to support and encourage annual underwater cleanups at the pier.
- The applicant will provide NMFS with annual reports of sea turtles or smalltooth sawfish reported as captured at the pier. Captures shall be reported to the phone number provided on the educational sign and written reports shall be sent to [takereport.nmfs@noaa.gov](mailto:takereport.nmfs@noaa.gov) and reference this consultation (St. Petersburg Pier, NMFS tracking number SER-2016-18030)
- The applicant intends to use turbidity curtains and follow NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006, which requires work to stop if sea turtles or sawfish are observed within 50 ft of operating or moving construction equipment.
- All work will be completed during daylight hours. Construction is expected to be completed in 4 months with work occurring 5 days per week.

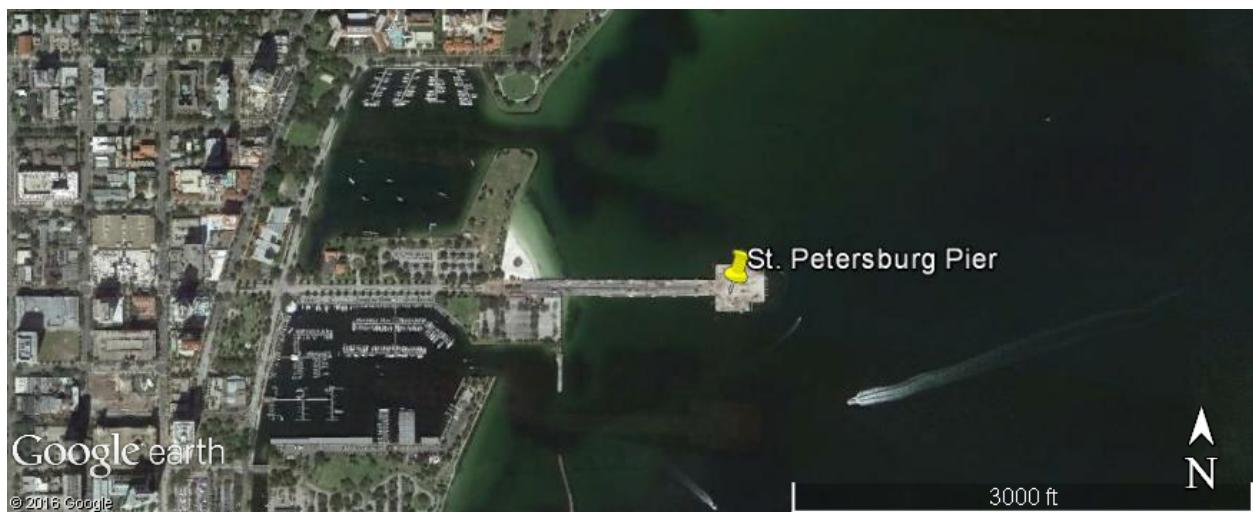




**Figure 1. The two construction drawings above were provided by the applicant from ASD Architects and Roger Partners Architects + Urban Designers.**

## 2.2 Action Area

The proposed project area is located at 27.773571°N, 82.622437°W (World Geodetic System 1984), at the western end of 2<sup>nd</sup> Avenue South, St. Petersburg, Pinellas County, Florida. The project area is in the city of St. Petersburg in Tampa Bay. The action area includes the previous pier that was demolished and surrounding waters that may be affected by the proposed project (Figure 2). Based on our analysis of the project effects below, we consider the action area to be within 705 ft (215 meters [m]) from the end of the pier, as this is the anticipated extent of behavioral noise impacts (discussed in Section 3.1).



**Figure 2. Image showing the previous St. Petersburg Pier and surrounding area (©2016 Google)**



### 3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 1 below provides a list of the ESA-listed species that may be affected by the proposed action. The project is not located in designated critical habitat, and there are no potential routes of effect to any designated critical habitat.

**Table 1. Effects Determinations for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action**

| Species   | ESA Listing Status | Action Agency Effect Determination | NMFS Effect Determination |
|---|--------------------|------------------------------------|---------------------------|
| <b>Sea Turtles</b>  |                    |                                    |                           |
| Green (North and South Atlantic distinct population segment [DPS])  | T                  | NLAA                               | LAA                       |
| Kemp's ridley   | E                  | NLAA                               | LAA                       |
| Loggerhead (Northwest Atlantic Ocean DPSs)  | T                  | NLAA                               | LAA                       |
| <b>Fish</b>   |                    |                                    |                           |
| Smalltooth sawfish (U.S. DPS)   | E                  | NLAA                               | LAA                       |
| E = endangered; T = threatened; NE = no effect; NLAA = may affect, not likely to adversely affect; LAA = likely to adversely affect |                    |                                    |                           |

#### 3.1 Potential Effects to Species

Sea turtles and smalltooth sawfish may be affected by construction activities (i.e., pile driving, barge equipment movement, and oyster reef breakwater material placement). Sea turtles and smalltooth sawfish may be injured if struck by equipment or materials. However, we believe this potential effect is discountable because these species are expected to exhibit avoidance behavior by moving away from physical disturbances. The applicant's implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers to watch for smalltooth sawfish or sea turtles. Operation of any mechanical construction equipment will cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition.

Pile driving may generate turbidity in the area, which can decrease the water quality for sea turtles and smalltooth sawfish. This effect will be discountable given the deployment of turbidity curtains around in-water construction to contain suspended sediments.

Temporary displacement of these species may occur due to their leaving the construction area to avoid activity during the 4 months of anticipated weekday construction. We believe this effect will be insignificant given the availability of foraging and refuge resources for sea turtles and smalltooth sawfish that they can continue to use in the surrounding areas in Tampa Bay during construction.

We believe that the changes in habitat resulting from the footprint of the new structure will result in discountable effects to the availability of foraging and refuge resources for sea turtles and smalltooth sawfish. Construction of the replacement pier will require a modification of the alignment of the pier. This realignment will result in impacts to approximately 0.0009 ac (40 ft<sup>2</sup>) of seagrasses; however, the applicant has proposed a mitigation plan that will result in no net loss of seagrass functionality upon completion of the project. No additional resources such as corals or mangroves occur in the project area and none will be impacted from the new pier construction.

Effects to listed species as a result of noise created by construction activities can physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in 2 ways. First, effects can result from a single noise event's exceeding the threshold for direct physical injury to animals, and these constitute an immediate adverse effect on these animals. 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.<sup>1</sup> The noise analysis in this consultation evaluates effects to ESA-listed fish (i.e., smalltooth sawfish) and sea turtles identified by NMFS as potentially affected in Table 1 above.

Based on our noise calculations, installation of piles by vibratory hammer will not result in any form of injurious noise effects. In the analysis in SAJ-82 (SAJ-82, Appendix B, Table 11 footnote), the noise source level used for this analysis was based on the vibratory installation of a 13-in steel pipe pile as a surrogate for the vibratory installation of a concrete pile. This is a very conservative approach since the installation of a 13-in steel pipe pile would be considerably louder than a similarly-sized wood or concrete pile or vinyl sheet pile. This installation method could result in behavioral effects at radii of up to 16 ft (5 m) for sea turtles and up to 72 ft (22 m) for ESA-listed fishes. Given the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe this effect will be 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, installation of piles by vibratory hammer will not result in any injurious noise effect, and we anticipate any behavioral effects will be insignificant.

Based on our noise calculations, installation of concrete piles by impact hammer will not cause single-strike or peak-pressure injurious noise effects. However, the cumulative sound exposure level of multiple pile strikes over the course of a day may cause injury to ESA-listed fishes and sea turtles up to 72 ft (22 m) away from the pile. Due to the mobility of sea turtles and ESA-listed fish species, and because the project occurs in open water, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an

---

<sup>1</sup> NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

animal suffering physical injury from noise is extremely unlikely to occur and is therefore discountable. An animal's movement away from the injurious sound radius is a behavioral response, with the same effects discussed below.

The installation of piles using an impact hammer could result in behavioral effects at radii of 705 ft (215 m) for ESA-listed fishes and 151 ft (46 m) for sea turtles. Animals using this particular type of habitat would likely be opportunistically foraging or resting. Due to the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances in this open-water environment. Because there is similar habitat nearby, we believe behavioral effects will be 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 any behavioral effects will be insignificant.

The proposed project has stated that they may use 2 barges with impact hammers to work simultaneously on the project. Between both crews, they will install no more than 6 piles per day. We calculated the potential noise effects by increasing the number of pile strikes to 20,000 strikes per day to account for increased pile driving occurring from 2 barges. This increase still does not result in single-strike or peak-pressure injurious noise effects. However, it did increase the area over which cumulative sound exposure levels over the course of a day may cause injury to ESA-listed fishes and sea turtles to 152 ft (46 m) away from the pile. It did not increase the behavioral response zone, but could result in 2 separate behavioral response zones or one larger zone if the 2 barges are working in different areas. We believe that in these open areas around the pier that the effects to species from in-water construction noise using 2 barges for pile driving would be the same as those already analyzed above. The cumulative sound exposure zone and behavioral zones do not impede species from maneuvering around construction in this open bay environment.

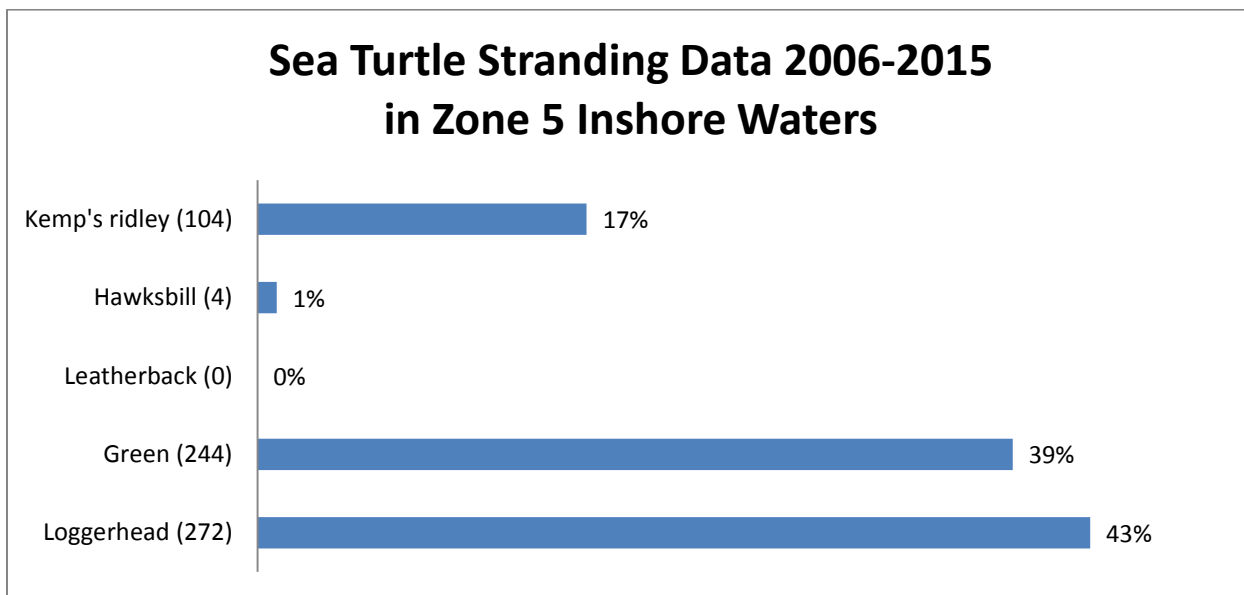
Additional effects which are likely to adversely affect smalltooth sawfish and sea turtles are discussed in Section 5 (Effects of the Action).

### **3.2 Species and Critical Habitat Likely to be Adversely Affected**

A public pier can facilitate recreational fishing activities that could injure or kill sea turtles and smalltooth sawfish via incidental hooking and entanglement either by actively fished lines, discarded, remnant, or broken-off fishing lines, and/or other debris.

To determine which sea turtles species would most likely occur near the St. Petersburg fishing pier, we evaluated several data sources. First, we reviewed data from the National Oceanic and Atmospheric Association (NOAA) Southeast Fisheries Science Center (SEFSC) Sea Turtle and Stranding Network (STSSN) shown in Figure 3 below. This data indicates that loggerhead, green, and Kemp's ridley sea turtles are significantly more common in the action area. No leatherback sea turtles were found in inland waters and only 4 hawksbill sea turtles were reported making up only 1 percent of the stranded sea turtles in a 10 year period. It is important to note that the data from Zone 5 (located along the west coast of Florida within Latitude 27, which

ranges from approximately just north of Clearwater continuing south to just north of Englewood, Florida) is a much more expansive area than our action area and includes the inland waters of the Gulf of Mexico. Thus, the lack of reported leatherback sea turtles and the low number of hawksbill sea turtles reported further confirms that we do not expect these species to be present at the St. Petersburg fishing pier.



**Figure 3. Sea Turtle Strandings in Zone 5** (Data provided by the STSSN)

The Florida Fish and Wildlife Research Institute (FWRI) tracks the number of turtles that nest on Florida Beaches. Nesting data in the last 5 years (2011-2015) are available on their web site ([www.myfwc.com](http://www.myfwc.com)). During this 5-year period, a total of 1,643 loggerhead, and 1 green sea turtles nested on beaches in Pinellas County. That equates to nearly 100 percent of the nesting turtles in Pinellas County being loggerhead sea turtles, with just 1 green sea turtle (0.07%).

Our records show 8 public fishing piers in Tampa Bay including the (1) Fort Desoto Pier (St. Petersburg), (2) North Sunshine Skyway Fishing Piers (St Petersburg), (3) South Sunshine Skyway Fishing Piers (Ellenton), and (4) Anna Maria City Pier and Rod and Reel Pier (located a half mile apart in Anna Maria) all located at the mouth of Tampa Bay. Within the bay area, piers include (1) St. Petersburg Pier, (2) Safety Harbor Pier (Safety Harbor), and (3) Weedon Island Fishing Pier, R.E. Olds Park Pier (Oldsmar) and (4) Ballast Point (Tampa). These piers vary in size, proximity to the Gulf, fishing pressure, and reporting. Table 2 below shows the reported sea turtle and smalltooth sawfish captures that we have records for from 2000-2015.

**Table 2. Reported Sea Turtle Captures at Piers in Tampa Bay**

| <b>Location</b>   | <b>Sea Turtle Captures</b>         | <b>Smalltooth Sawfish Captures</b> |
|---|------------------------------------|------------------------------------|
| <b>Piers within Tampa Bay</b>                           |                                    |                                    |
| St. Petersburg Pier                                     | 2011, 2014<br>(both Kemp's ridley) |                                    |
| Weedon Island Fishing Pier                              |                                    | 2001                               |
| Safety Harbor Pier                                      |                                    |                                    |
| R.E. Olds Park Pier                                     |                                    |                                    |
| Ballast Point   |                                    |                                    |
| <b>Piers within Tampa Bay near the mouth of the bay</b> |                                    |                                    |
| North Skyway Bridge Fishing Pier                        |                                    | 2003                               |
| South Skyway Bridge Fishing Pier                        |                                    |                                    |
| Anna Maria City Pier                                    | 2010, 2010<br>(both loggerhead)    | 2008, 2008, 2014                   |
| Fort Desoto   | 2004, 2008<br>(both loggerhead)    |                                    |
| <b>Total Captures Reported</b>                          | <b>6</b>                           | <b>5</b>                           |

Since we only have 2 reports of a sea turtle capture at the St. Petersburg Pier, we considered the reported captures for all piers throughout Tampa Bay. As shown in Table 2 above, sea turtle and smalltooth sawfish captures at piers in Tampa Bay are rare, with most reports occurring at locations at the mouth of the bay. Therefore, the 2 captures at the St. Petersburg Pier in the last 15 years seems consistent with the other similar piers in Tampa Bay considering this pier is in the most urban location of all the piers in the interior portion of Tampa Bay and likely has the greatest fishing pressure.

Based on the above discussion, we believe that green, loggerhead, and Kemp's ridley sea turtles and smalltooth sawfish may occur in the area and may be affected by hook-and-line capture or entanglement at the proposed pier. These effects will be discussed further in Section 5. Section 3.2.1 will address the general threats that confront all sea turtle species followed by specific species information on the distribution, life history, population structure, abundance, population trends, and unique threats to each species of sea turtle.

### **3.2.1 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 sections 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 2008b; NMFS et al. 2011a). Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to U.S. Atlantic pelagic longline fisheries. Sea turtles in the benthic environment in waters off the coastal United States 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 section of this opinion 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 United States, 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 et al. 1994; Bolten 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 United States, 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 (Bouchard et al. 1998; Lutcavage et al. 1997a). 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 et al. 2003; Witherington 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 (Garrett 2004; Grant and Ross 2002; Hartwell 2004; Iwata et al. 1993). 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 the 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 2007b). 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°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007b).

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 1990b). 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 2007c). 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 (Baker et al. 2006; Daniels et al. 1993; Fish et al. 2005). 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 et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish) 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 2008b).

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.

### **3.2.2 Loggerhead Sea Turtle – Northwest Atlantic (NWA) 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 designating 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) Northwest Atlantic Ocean (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 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 centimeters [cm]) long, measured as a straight carapace length (SCL), and weigh approximately 255 pound (lb) (116 kilogram [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 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 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 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 1990a). 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 1997; Addison and Morford 1996), off the southwestern coast of Cuba (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 1998b).

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 29°N; (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 2000b); and (5) a Dry

Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS-SEFSC 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 (Florida/Georgia border north through southern Virginia), (2) the Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas), and (5) the Greater Caribbean Recovery Unit (Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008a). 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<sup>2</sup>), (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 1985b; 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 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008a). Loggerhead hatchlings are 1.5-2 in long and weigh about 0.7 ounces (20 grams).

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; Conant et al. 2009a; Witherington 2002). Oceanic juveniles grow at rates of 1-2 in (2.9-5.4 cm) per year (Bjorndal et al. 2003; Snover 2002) over a period as long as 7-12 years (Bolten 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 (Bolten and Witherington 2003; Laurent et al. 1998). 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

---

<sup>2</sup> Neritic refers to the nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 m.

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, and 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 et al. 2009a).

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 et al. 2009a).

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, 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 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 et al. 2008; Girard et al. 2009; Hart 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 et al. (2010) report the recapture in Cuban waters of 5 adult female loggerheads originally flipper-tagged in Quintana Roo, Mexico, indicating 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 (Conant et al. 2009a; Heppell et al. 2003; NMFS-SEFSC 2001; NMFS-SEFSC 2009; NMFS and USFWS 2008a; TEWG 1998b; TEWG 2000b; 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

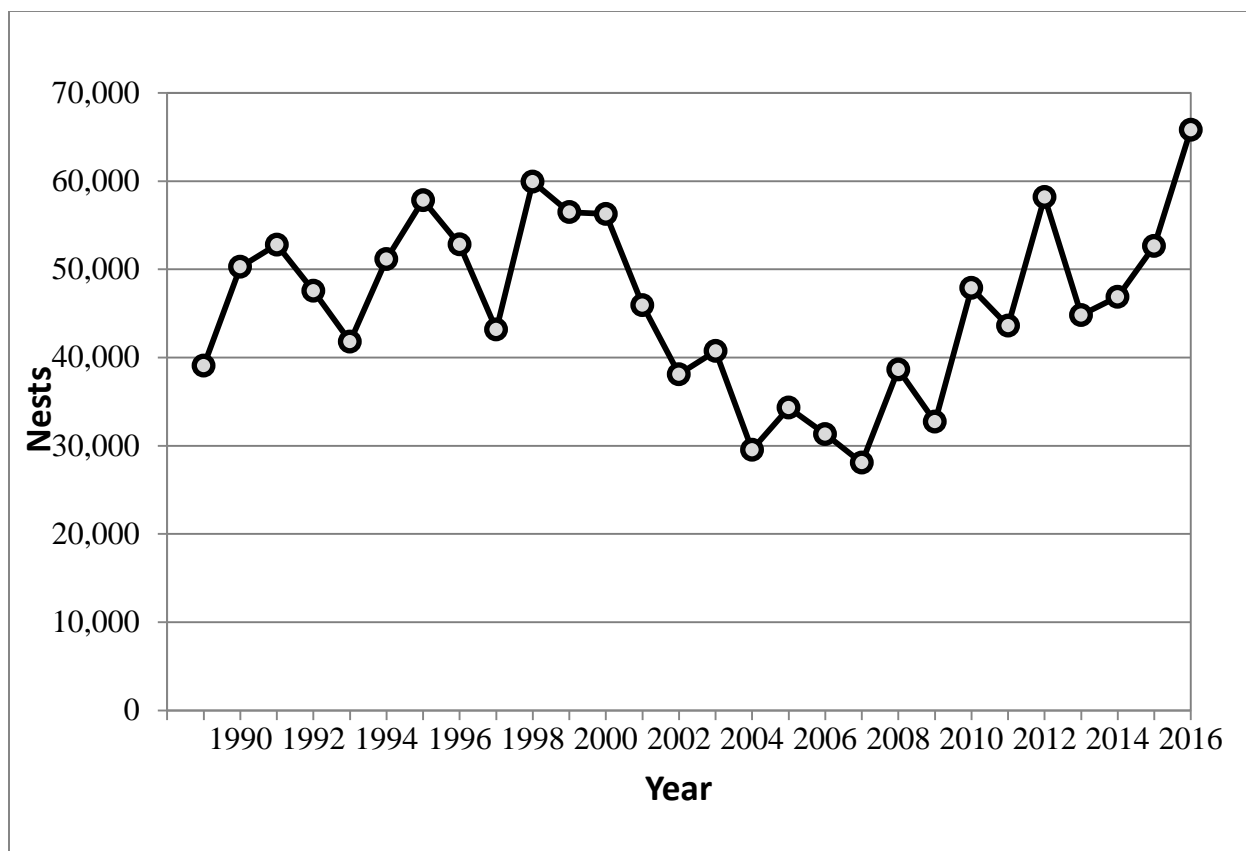
strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (e.g., (NMFS and USFWS 2008a). NMFS and USFWS (2008a) concluded that the lack of change in 2 important demographic parameters of loggerheads, remigration 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 Peninsular Florida Recovery Unit is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989-2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008a). The statewide estimated total for 2013 was 77,975 nests (FWRI nesting database).

In addition to the total nest count estimates, the 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 4). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2015) (<http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/>). Over that time period, 3 distinct trends were identified. From 1989-1998 there was a 24% increase that was then followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 74% increase in nesting between 2008 and 2015. FWRI examined the trend from the 1998 nesting high through 2015 and found that the decade-long post-1998 decline was replaced with a slight but nonsignificant increasing trend. Looking at the data from 1989 through 2015 (an increase of over 38%), FWRI concluded that there was an overall positive change in the nest counts (<http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/>).





**Figure 4. Loggerhead sea turtle nesting at Florida index beaches since 1989**

#### Northern Recovery Unit

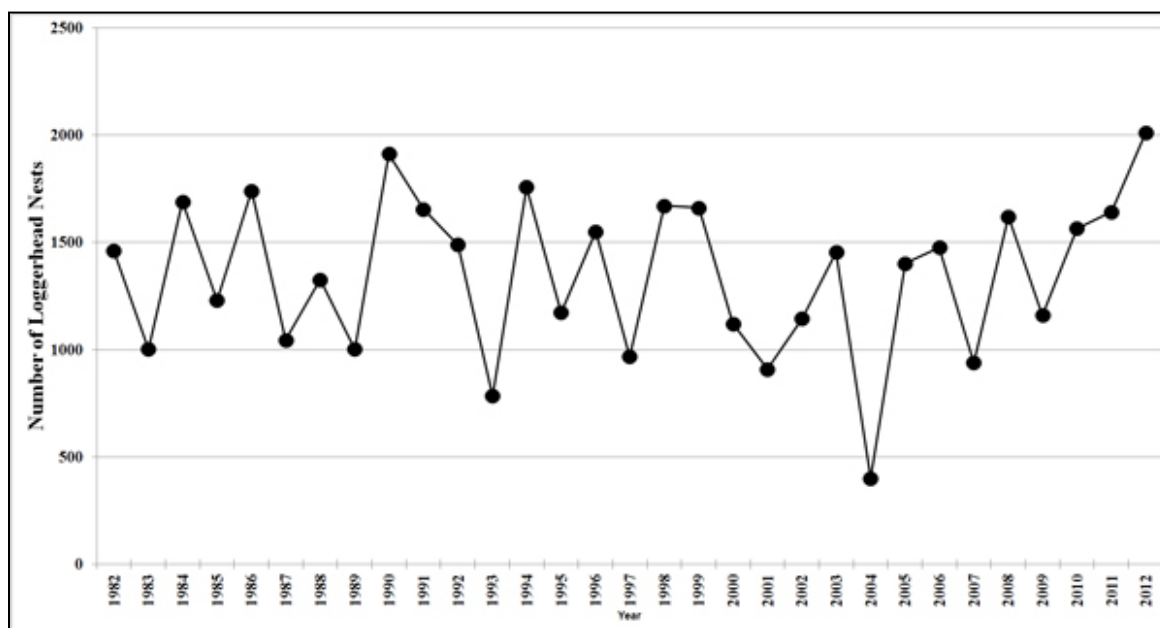
Annual nest totals from beaches within the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (Georgia Department of Natural Resources [GADNR] unpublished data, North Carolina Wildlife Resources Commission [NCWRC] unpublished data, 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 show a shift away from the declining trend of the past.

**Table 3. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets)**

| <b>Nests Recorded</b> | <b>2008</b>  | <b>2009</b>  | <b>2010</b>  | <b>2011</b>  | <b>2012</b>  | <b>2013</b>  | <b>2014</b>  |
|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Georgia               | 1,649        | 998          | 1,760        | 1,992        | 2,241        | 2,289        | 1,196        |
| South Carolina        | 4,500        | 2,182        | 3,141        | 4,015        | 4,615        | 5,193        | 2,083        |
| North Carolina        | 841          | 302          | 856          | 950          | 1,074        | 1,260        | 542          |
| <b>Total</b>          | <b>6,990</b> | <b>3,472</b> | <b>5,757</b> | <b>6,957</b> | <b>7,930</b> | <b>8,742</b> | <b>3,821</b> |

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 2009-2012, with 2012 showing the highest index nesting total since the start of the program (Figure 5).



**Figure 5. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website, <http://www.dnr.sc.gov/seaturtle/nest.htm>)**

#### Other Northwest Atlantic DPS Recovery Units

The remaining 3 recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (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 9-year 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 2008a). 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 2008a). Zurita et al. (2003b) 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 2008a).

### 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. (2007a) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (CPUE) (Arendt et al. 2009; Ehrhart et al. 2007a; Epperly et al. 2007). 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. Bjørndal et al. (2005), cited in NMFS and USFWS (2008a), 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 to 40,000 individuals, with a low likelihood of being 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 (Specific to Loggerhead Sea Turtles)*

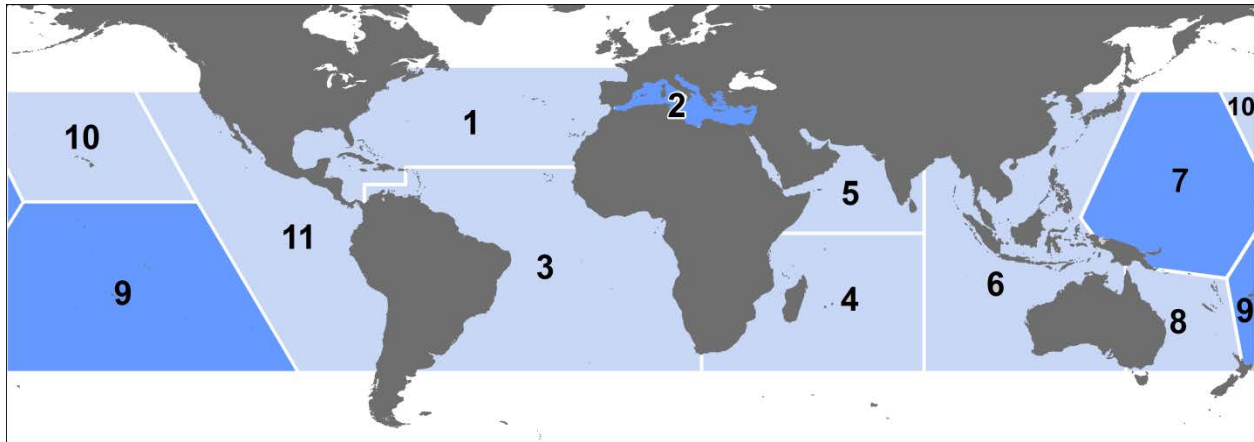
The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 3.2.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009a).

Regarding the impacts of pollution, loggerheads may be particularly affected by organochlorine contaminants; they have the highest organochlorine concentrations (Storelli et al. 2008) and metal loads (D'Ilio 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 et al. 1991a).

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 et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Hawkes et al. 2007; Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

### **3.2.3 Green Sea Turtle**

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). 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 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 6. 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 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 et al. 1992; FitzSimmons 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 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 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.

#### NA DPS Distribution

The NA DPS boundary is illustrated in Figure 6. 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 (Dow et al. 2007; NMFS and USFWS 1991). The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994; Meylan 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 (Doughty 1984; Hildebrand 1982; 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.

#### SA DPS Distribution

The SA DPS boundary is shown in Figure 6, 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 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 (Lima et al. 2010; López-Barrera et al. 2012; Marcovaldi et al. 2009). 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 et al. 2007; Naro-Maciel et al. 2012). While no nesting occurs as far south as Uruguay and Argentina, both have important foraging grounds for South Atlantic green turtles (Gonzalez Carman et al. 2011; Lezama 2009; López-Mendilaharsu et al. 2006; Prosdocimi 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 1985a) 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 1989b). 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 1989b). Eggs incubate for approximately 2 months before hatching. Hatchling green sea turtles are approximately 2 in (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 2007a). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 in (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 in (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 (Bresette et al. 2006; Zug and Glor 1998). 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 et al. 2002). Green sea turtles mature slowly, requiring 20-50 years to reach sexual maturity (Chaloupka and Musick 1997a; 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 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 2007a).

#### *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 et al. 2015), with information for each of the DPSs.

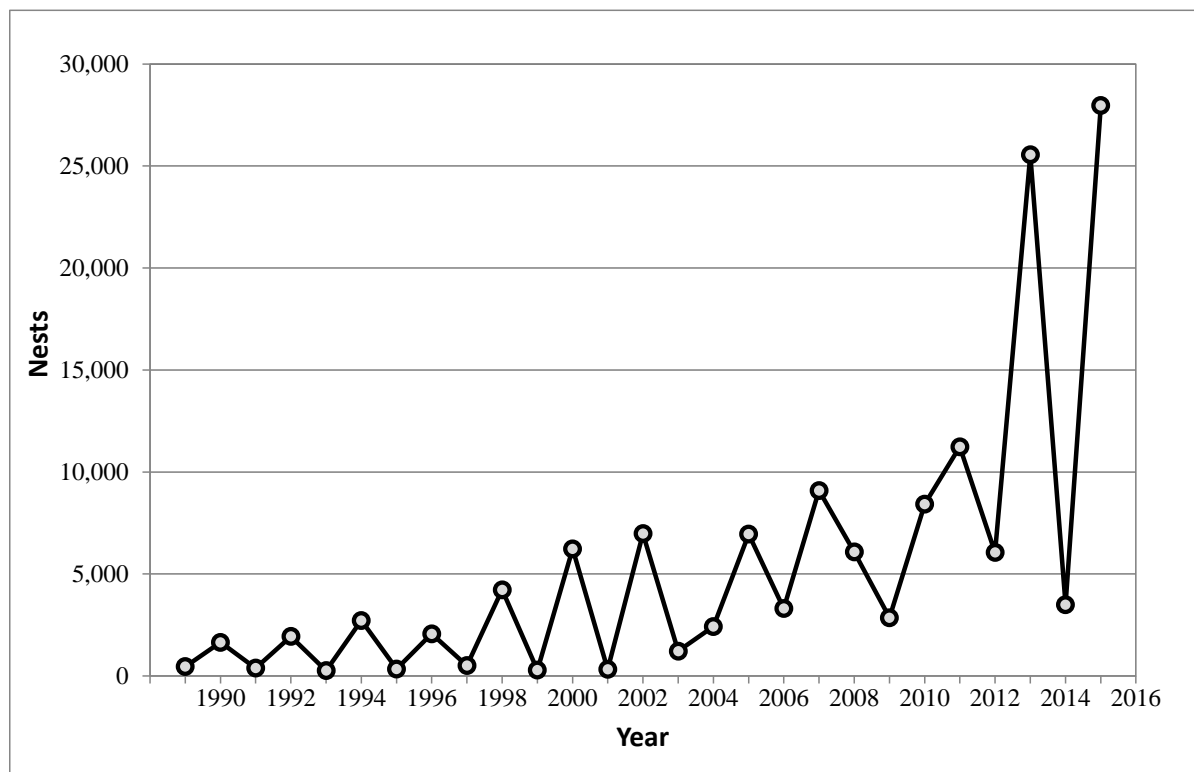
#### NA DPS

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 et al. 2015).

Tortuguero, Costa Rica is by far the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff 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 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 2007a). Modeling by Chaloupka 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 where an estimated 200-1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan 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 (nesting databases maintained on [www.seaturtle.org](http://www.seaturtle.org)).

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 7). According to data collected from Florida's index nesting beach survey from 1989-2015, green sea turtle nest counts across Florida have increased approximately ten-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015. 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 7). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%.



**Figure 7. 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 et al. 2007b), 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 et al. 2006).

#### SA 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 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, Aves Island (Venezuela), and Galibi (Suriname) appear to be increasing. Others such as Trindade (Brazil), Atol das Rocas (Brazil), and Poilão 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 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 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 3.2.1.

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 (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). These tumors range in size from 0.04 in (0.1 cm) to greater than 11.81 in (30 cm) in diameter and may affect swimming, vision, feeding, and organ function (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). 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 et al. 1995), and environmental conditions (e.g., habitat degradation, pollution, low wave energy, and shallow water (Foley et al. 2005). FP is cosmopolitan, but it has been found to affect large numbers of animals in specific areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991).

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 1989a). 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 3.2.1, 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 juveniles 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 DWH oil spill of 2010, 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).

#### **3.2.4 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 (Groombridge 1982; TEWG 2000a; Zwinenberg 1977).

### *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) 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 1989a), 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 move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

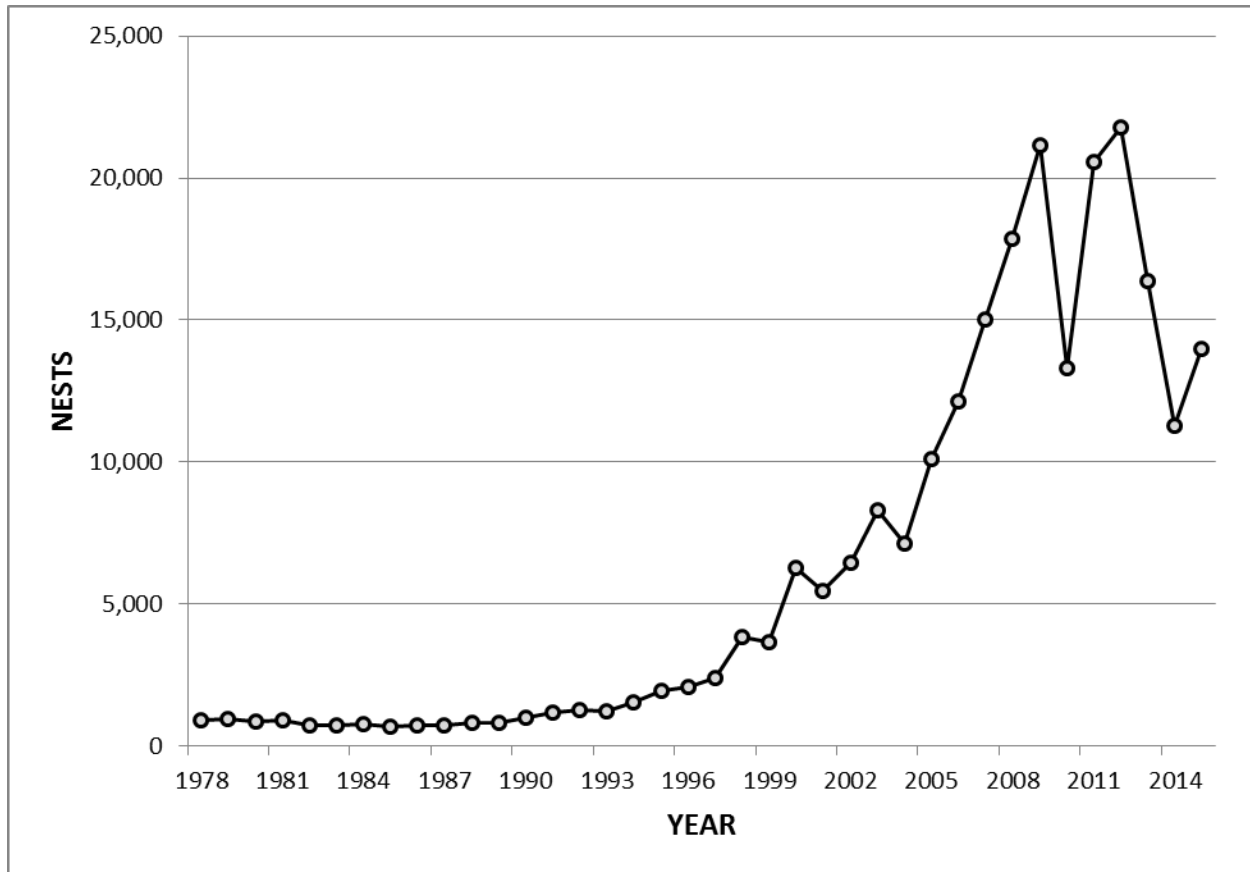
The average rates of growth may vary by location, but generally fall within  $2.2-2.9 \pm 2.4$  in per year ( $5.5-7.5 \pm 6.2$  cm/year) (Schmid and Barichivich 2006; Schmid and Woodhead 2000). Age to sexual maturity ranges greatly from 5-16 years, though NMFS et al. (2011a) determined the best estimate 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 and 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 8), 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 reached a record high of 21,797 in 2012 (Gladys Porter Zoo 2013). In 2013 through 2014, there was a second significant decline, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 recorded nests (J. Pena, Gladys Porter Zoo, pers. comm. to M. Barnette, NMFS, October 19, 2015). At this time, it is unclear if nesting will now steadily increase uninterrupted, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past 5 years. 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 209 nests in 2012 (National Park Service data, <http://www.nps.gov/pais/naturescience/strp.htm>, <http://www.nps.gov/pais/naturescience/current-season.htm>). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, with a significant decline in 2010 followed by a second decline in 2013-2014. Nesting rebounded in 2015, with 159 nests documented along the Texas coast (D. Shaver, National Park Service, pers. comm. to M. Barnette, NMFS, October 28, 2015).



**Figure 8. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2015)**

Heppell et al. (2005b) predicted in a population model that the population is expected to increase at least 12-16% per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011a) produced an updated model that predicted the population to increase 19% per year and 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 turtle exclusion devices (TEDs), reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998a; TEWG 2000a). 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 of 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 3.2.1; 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<sup>3</sup> 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.

Over the past 6 years, NMFS has documented (via the Sea Turtle Stranding and Salvage Network data, <http://www.sefsc.noaa.gov/species/turtles/strandings.htm>) elevated sea turtle strandings in the Northern Gulf of Mexico, particularly throughout the Mississippi Sound area. 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) occurring 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, March 2012). Yet, available

---

<sup>3</sup> Arribadas is the Spanish word for "arrival" and is the term used for massive synchronized nesting within the genus *Lepidochelys*.

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 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 fishery during the summer of 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fishery, all but one of which 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, and all sea turtles were released alive. 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 fishery. Due to this issue, a proposed 2012 rule to require TEDs in the skimmer trawl fishery (77 FR 27411) was not implemented. Based on anecdotal information, these interactions were a relatively new issue for the inshore skimmer trawl fishery. 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 3.2.1, specific impacts of the DWH spill on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact from the DWH spill 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 able to be 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. However, 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 et al. 2011a), 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 2015).

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), with an estimated 3,110 mortalities (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 approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2015). However, this is a minimum estimate because of the overall potential DWH effect because the sublethal effects of DWH oil on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years may have contributed substantially to additional nesting deficits observed following DWH. 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 effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. Additionally, 483 eggs from 5 nests were translocated, with 125 ultimately released as hatchlings (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. It is clear that the DWH 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. However, we do not have a clear understanding of those impacts on the population trajectory for the species into the future.

### **3.2.5 Smalltooth Sawfish**

The U.S. DPS of smalltooth sawfish was listed as endangered under the ESA effective May 1, 2003 (68 FR 15674; April 1, 2003).

#### *Species Description and Distribution*

The smalltooth sawfish is a tropical marine and estuarine elasmobranch. It has an extended snout with a long, narrow, flattened, rostral blade (rostrum) with a series of transverse teeth along either edge. In general, smalltooth sawfish inhabit shallow coastal waters of warm seas throughout the world and feed on a variety of small fish (e.g., mullet, jacks, and ladyfish) (Simpfendorfer 2001), and crustaceans (e.g., shrimp and crabs) (Bigelow and Schroeder 1953; Norman and Fraser 1937).

Although this species is reported to have a circumtropical distribution, NMFS identified smalltooth sawfish from the Southeast United States as a DPS, due to the physical isolation of this population from others, the differences in international management of the species, and the significance of the U.S. population in relation to the global range of the species (see 68 FR15674). Within the United States, smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, although peninsular Florida has historically been the region of the United States with the largest number of recorded captures (NMFS 2000). Recent records indicate there is a resident reproducing population of smalltooth sawfish in south and southwest Florida from Charlotte Harbor through the Dry Tortugas, which is also the last U.S. stronghold for the species (Poulakis and Seitz 2004; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2005). Water temperatures (no lower than 16-18°C) and the

availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the northern movements of smalltooth sawfish in the western North Atlantic. Most specimens captured along the Atlantic coast north of Florida are large adults (over 10 ft) that likely represent seasonal migrants, wanderers, or colonizers from a historic Florida core population(s) to the south, rather than being members of a continuous, even-density population (Bigelow and Schroeder 1953).

#### *Life History Information*

Smalltooth sawfish fertilization is internal and females give birth to live young. The brood size, gestation period, and frequency of reproduction are unknown for smalltooth sawfish. Therefore, data from the closely related (in terms of size and body morphology) largetooth sawfish represent our best estimates of these parameters. The largetooth sawfish likely reproduces every other year, has a gestation period of approximately 5 months, and produces a mean of 7.3 offspring per brood, with a range of 1-13 offspring (Thorson 1976). Smalltooth sawfish are approximately 31 in (80 cm) at birth and may grow to a length of 18 ft (548 cm) or greater during their lifetime (Bigelow and Schroeder 1953; Simpfendorfer 2002). Simpfendorfer et al. (2008) report rapid juvenile growth for smalltooth sawfish for the first 2 years after birth, with stretched total length increasing by an average of 25-33 in (65-85 cm) in the first year and an average of 19-27 in (48-68 cm) in the second year. By contrast, very little information exists on size classes other than juveniles, which make up the majority of sawfish encounters; therefore, much uncertainty remains in estimating life history parameters for smalltooth sawfish, especially as it relates to age at maturity and post-juvenile growth rates. Based on age and growth studies of the largetooth sawfish (Thorson 1982) and research by Simpfendorfer (2000), the smalltooth sawfish is likely a slow-growing (with the exception of early juveniles), late-maturing (10-20 years) species with a long lifespan (30-60 years). Juvenile growth rates presented by Simpfendorfer et al. (2008) suggest smalltooth sawfish are growing faster than previously thought and therefore may reach sexual maturity at an earlier age.

There are distinct differences in habitat use based on life history stage. Juvenile smalltooth sawfish, those up to 3 years of age or approximately 8 ft in length (Simpfendorfer et al. 2008), inhabit the shallow waters of estuaries and can be found in sheltered bays, dredged canals, along banks and sandbars, and in rivers (NMFS 2000). Juvenile smalltooth sawfish occur in euryhaline waters (i.e., waters with a wide range of salinities) and are often closely associated with muddy or sandy substrates, and shorelines containing red mangroves, *Rhizophora mangle* (Simpfendorfer 2001; Simpfendorfer 2003). Tracking data from the Caloosahatchee River in Florida indicate very shallow depths and salinity are important abiotic factors influencing juvenile smalltooth sawfish movement patterns, habitat use, and distribution (Simpfendorfer et al. 2011). Another recent acoustic tagging study in a developed region of Charlotte Harbor, Florida, identified the importance of mangroves in close proximity to shallow water habitat for juvenile smalltooth sawfish, stating that juveniles generally occur in shallow water within 328 ft (100 m) of mangrove shorelines, generally red mangroves (Simpfendorfer et al. 2010). Juvenile smalltooth sawfish spend the majority of their time in waters less than 13 ft (4 m) in depth (Simpfendorfer et al. 2010) and are seldom found in depths greater than 32 ft (10 m) (Poulakis and Seitz 2004). Simpfendorfer et al. (2010) also indicated developmental differences in habitat use: the smallest juveniles (young-of-the-year juveniles measuring < 100 cm in length) generally used water depths less than 0.5 m (1.64 ft), had small home ranges (4,264-4,557 m<sup>2</sup>), and

exhibited high levels of site fidelity. Although small juveniles exhibit high levels of site fidelity for specific nursery habitats for periods of time lasting up to 3 months (Wiley and Simpfendorfer 2007), they do undergo small movements coinciding with changing tidal stages. These movements often involve moving from shallow sandbars at low tide to within red mangrove prop roots at higher tides (Simpfendorfer et al. 2010), behavior likely to reduce the risk of predation (Simpfendorfer 2006). As juveniles increase in size, they begin to expand their home ranges (Simpfendorfer et al. 2010; Simpfendorfer et al. 2011), eventually moving to more offshore habitats where they likely feed on larger prey and eventually reach sexual maturity.

Researchers have identified several areas within the Charlotte Harbor Estuary that are disproportionately more important to juvenile smalltooth sawfish, based on intra- or inter-annual (within or between year) capture rates during random sampling events within the estuary (Poulakis 2012; Poulakis et al. 2011). These areas were termed “hotspots” and also correspond with areas where public encounters are most frequently reported. Use of these “hotspots” can vary within and among years based on the amount and timing of freshwater inflow. Smalltooth sawfish use hotspots further upriver during high salinity conditions (drought) and areas closer to the mouth of the Caloosahatchee River during times of high freshwater inflow (Poulakis et al. 2011). At this time, researchers are unsure what specific biotic or abiotic factors influence this habitat use, but they believe a variety of conditions in addition to salinity, such as temperature, dissolved oxygen, water depth, shoreline vegetation, and food availability, may influence habitat selection (Poulakis et al. 2011).

While adult smalltooth sawfish may also use the estuarine habitats used by juveniles, they are commonly observed in deeper waters along the coasts. Poulakis and Seitz (2004) noted that nearly half of the encounters with adult-sized smalltooth sawfish in Florida Bay and the Florida Keys occurred in depths from 200-400 ft (70-122 m) of water. Similarly, Simpfendorfer and Wiley (2005) reported encounters in deeper waters off the Florida Keys, and observations from both commercial longline fishing vessels and fishery-independent sampling in the Florida Straits report large smalltooth sawfish in depths up to 130 ft (~40 m) (ISED 2014). Even so, NMFS believes adult smalltooth sawfish use shallow estuarine habitats during parturition (when adult females return to shallow estuaries to pup) because very young juveniles still containing rostral sheaths are captured in these areas. Since very young juveniles have high site fidelities, we hypothesize that they are birthed nearby or in their nursery habitats.

#### *Status and Population Dynamics*

Few long-term abundance data exist for the smalltooth sawfish, making it very difficult to estimate the current population size. Simpfendorfer (2001) estimated that the U.S. population may number less than 5% of historic levels, based on anecdotal data and the fact that the species' range has contracted by nearly 90%, with south and southwest Florida the only areas known to support a reproducing population. Since actual abundance data are limited, researchers have begun to compile capture and sightings data (collectively referred to as encounter data) in the International Sawfish Encounter Database (ISED) that was developed in 2000. Although this data cannot be used to assess the population because of the opportunistic nature in which they are collected (i.e., encounter data are a series of random occurrences rather than an evenly distributed search over a defined period of time), researchers can use this database to assess the spatial and temporal distribution of smalltooth sawfish. We expect that as the population grows,

the geographic range of encounters will also increase. Since the conception of the ISED, over 3,000 smalltooth sawfish encounters have been reported and compiled in the encounter database (ISED 2014).

Despite the lack of scientific data on abundance, recent encounters with young-of-the-year, older juveniles, and sexually mature smalltooth sawfish indicate that the U.S. population is currently reproducing (Seitz and Poulakis 2002; Simpfendorfer 2003). The abundance of juveniles encountered, including very small individuals, suggests that the population remains viable (Simpfendorfer and Wiley 2004), and data analyzed from Everglades National Park as part of an established fisheries-dependent monitoring program (angler interviews) indicate a slightly increasing trend in abundance within the park over the past decade (Carlson and Osborne 2012; Carlson et al. 2007). Using a demographic approach and life history data for smalltooth sawfish and similar species from the literature, Simpfendorfer (2000) estimated intrinsic rates of natural population increase for the species at 0.08-0.13 per year and population doubling times from 5.4-8.5 years. These low intrinsic rates<sup>4</sup> of population increase, suggest that the species is particularly vulnerable to excessive mortality and rapid population declines, after which recovery may take decades.

### *Threats*

Past literature indicates smalltooth sawfish were once abundant along both coasts of Florida and quite common along the shores of Texas and the northern Gulf coast (NMFS 2010) and citations therein). Based on recent comparisons with these historical reports, the U.S. DPS of smalltooth sawfish has declined over the past century (Simpfendorfer 2001; Simpfendorfer 2002). The decline in smalltooth sawfish abundance has been attributed to several factors including bycatch mortality in fisheries, habitat loss, and life history limitations of the species (NMFS 2010).

### Bycatch Mortality

Bycatch mortality is cited as the primary cause for the decline in smalltooth sawfish in the United States (NMFS 2010). While there has never been a large-scale directed fishery, smalltooth sawfish easily become entangled in fishing gears (gill nets, otter trawls, trammel nets, and seines) directed at other commercial species, often resulting in serious injury or death (NMFS 2009). This has historically been reported in Florida (Snelson and Williams 1981), Louisiana (Simpfendorfer 2002), and Texas (Baughman 1943). For instance, one fisherman interviewed by Evermann and Bean (1897) reported taking an estimated 300 smalltooth sawfish in just one netting season in the Indian River Lagoon, Florida. In another example, smalltooth sawfish landings data gathered by Louisiana shrimp trawlers from 1945-1978, which contained both landings data and crude information on effort (number of vessels, vessel tonnage, number of gear units), indicated declines in smalltooth sawfish landings from a high of 34,900 lb in 1949 to less than 1,500 lb in most years after 1967. The Florida net ban passed in 1995 has led to a reduction in the number of smalltooth sawfish incidentally captured, "...by prohibiting the use of gill and other entangling nets in all Florida waters, and prohibiting the use of other nets larger than 500 square feet in mesh area in nearshore and inshore Florida waters"<sup>5</sup> (FLA. CONST. art. X,

---

<sup>4</sup> The rate at which a population increases in size if there are no density-dependent forces regulating the population

<sup>5</sup> "nearshore and inshore Florida waters" means all Florida waters inside a line 3 mile seaward of the coastline along the Gulf of Mexico and inside a line 1 mile seaward of the coastline along the Atlantic Ocean.



§ 16). However, the threat of bycatch currently remains in commercial fisheries (e.g., South Atlantic shrimp fishery, Gulf of Mexico shrimp fishery, federal shark fisheries of the South Atlantic, and the Gulf of Mexico reef fish fishery), though anecdotal information collected by NMFS port agents suggest smalltooth sawfish captures are now rare.

In addition to incidental bycatch in commercial fisheries, smalltooth sawfish have historically been and continue to be captured by recreational fishers. Encounter data (ISED 2014) and past research (Caldwell 1990) document that rostrums are sometimes removed from smalltooth sawfish caught by recreational fishers, thereby reducing their chances of survival. While the current threat of mortality associated with recreational fisheries is expected to be low given that possession of the species in Florida has been prohibited since 1992, bycatch in recreational fisheries remains a potential threat to the species.

#### Habitat Loss

Modification and loss of smalltooth sawfish habitat, especially nursery habitat, is another contributing factor in the decline of the species. Activities such as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff contribute to these losses (SAFMC 1998). Large areas of coastal habitat were modified or lost between the mid-1970s and mid-1980s within the United States (Dahl and Johnson 1991). Since then, rates of loss have decreased, but habitat loss continues. From 1998-2004, approximately 64,560 ac of coastal wetlands were lost along the Atlantic and Gulf coasts of the United States, of which approximately 2,450 ac were intertidal wetlands consisting of mangroves or other estuarine shrubs (Stedman and Dahl 2008). Further, Orlando et al. (1994) analyzed 18 major southeastern estuaries and recorded over 703 mile of navigation channels and 9,844 mile of shoreline with modifications. In Florida, coastal development often involves the removal of mangroves and the armoring of shorelines through seawall construction. Changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water control devices have had other impacts: altered the temperature, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). While these modifications of habitat are not the primary reason for the decline of smalltooth sawfish abundance, it is likely a contributing factor and almost certainly hampers the recovery of the species. Juvenile sawfish and their nursery habitats are particularly likely to be affected by these kinds of habitat losses or alternations, due to their affinity for shallow, estuarine systems. Although many forms of habitat modification are currently regulated, some permitted direct and/or indirect damage to habitat from increased urbanization still occurs and is expected to continue to threaten survival and recovery of the species in the future.

#### Life History Limitations

The smalltooth sawfish is also limited by its life history characteristics as a slow-growing, relatively late-maturing, and long-lived species. Animals using this life history strategy are usually successful in maintaining small, persistent population sizes in constant environments, but are particularly vulnerable to increases in mortality or rapid environmental change (NMFS 2000). The combined characteristics of this life history strategy result in a very low intrinsic rate of population increase (Musick 1999) that make it slow to recover from any significant population decline (Simpfendorfer 2000). More recent data suggest smalltooth sawfish may

mature earlier than previously thought, meaning rates of population increase could be higher and recovery times shorter than those currently reported (Simpfendorfer et al. 2008).

#### Current Threats

The 3 major factors that led to the current status of the U.S. DPS of smalltooth sawfish – bycatch mortality, habitat loss, and life history limitations – continue to be the greatest threats today. All the same, other threats such as the illegal commercial trade of smalltooth sawfish or their body parts, predation, and marine pollution and debris may also affect the population and recovery of smalltooth sawfish on smaller scales (NMFS 2010). We anticipate that all of these threats will continue to affect the rate of recovery for the U.S. DPS of smalltooth sawfish.

In addition to the anthropogenic effects mentioned previously, changes to the global climate are likely to be a threat to smalltooth sawfish and the habitats they use. The Intergovernmental Panel on Climate Change has stated that global climate change is unequivocal (IPCC 2007) and its impacts to coastal resources may be significant. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, changes in the amount and timing of precipitation, and changes in air and water temperatures (EPA 2012; NOAA 2012). The impacts to smalltooth sawfish cannot, for the most part, currently be predicted with any degree of certainty, but we can project some effects to the coastal habitats where they reside. We know that the coastal habitats that contain red mangroves and shallow, euryhaline waters will be directly impacted by climate change through sea level rise, which is expected to exceed 1 m globally by 2100 according to Meehl et al. (2007), Pfeffer et al. (2008), and Vermeer and Rahmstorf (2009). Sea level rise will impact mangrove resources, as sediment surface elevations for mangroves will not keep pace with conservative projected rates of elevation in sea level (Gilman et al. 2008). Sea level increases will also affect the amount of shallow water available for juvenile smalltooth sawfish nursery habitat, especially in areas where there is shoreline armoring (e.g., seawalls). Further, the changes in precipitation coupled with sea level rise may also alter salinities of coastal habitats, reducing the amount of available smalltooth sawfish nursery habitat.

## **4 ENVIRONMENTAL BASELINE**

---

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the species, their habitats (including designated critical habitat), and ecosystems within the action area, without the additional effects of the proposed action. In the case of ongoing actions, this section includes the effects that may contribute to the projected future status of the species, their habitats, and ecosystems. The environmental baseline describes a species' and habitat's health based on information available at the time of this consultation.

By regulation (50 CFR 402.02), environmental baselines for Biological Opinions include the past and present impacts of all state, federal, or private actions and other human activities or natural factors in, or having effects in, the action area. We identify the anticipated impacts of all proposed federal projects in the specific action area of the consultation at issue that have already undergone formal or early Section 7 consultation (as defined in 50 CFR 402.11), as well as the impact of state or private actions, or the impacts of natural phenomena, which are concurrent with the consultation in process (50 CFR 402.02).

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. In addition, we can focus on areas of designated critical habitat that occur in an action area that may be exposed to effects from the action under consultation. This consideration is important because in some states or life history stages, or areas of their ranges, listed individuals or critical habitat features 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 and Smalltooth Sawfish within the Action Area**

##### *Sea Turtles*

Based on the information discussed above, and their habitats and eating preferences, loggerhead, green, and Kemp's ridley sea turtles may be located in the action area and may be affected by the proposed recreational fishing activities. All of these species are migratory, traveling for forage grounds or reproduction purposes. Tampa Bay may be used by these sea turtles as post-hatchling developmental habitat or foraging habitat. NMFS believes that no individual sea turtles are likely to be permanent residents of the nearshore waters of this area, although some individuals may be present at any given time. These same individuals will migrate into offshore waters, as well as other areas of the Gulf of Mexico, Caribbean Sea, and North Atlantic Ocean at certain times of the year, and thus may be impacted by activities occurring there; therefore, threats to turtle in the action area are considered to be the same as those discussed in Section 3.2.1-3.2.5. Loggerhead and green sea turtles are known to nest in Pinellas County on the beaches outside of Tampa Bay according to the nesting data provided on the Florida Fish and Wildlife Conservation Commission's website ([www.myfwc.com](http://www.myfwc.com)). No nesting occurs within the bay itself.

##### *Smalltooth Sawfish*

As discussed in Section 3.2.6, smalltooth sawfish have been documented throughout the state of Florida with the majority of them occurring in Lee, Charlotte, and Monroe Counties. Critical habitat was designated in several southwest Florida counties as a means of protecting juvenile sawfish nursery habitats. Although this project is outside of critical habitat, the ISED has documented approximately 25 smalltooth sawfish encounters throughout Tampa Bay and it is possible that juvenile or adult sawfish could use the nearshore waters around the project area.

#### **4.1.1 Factors Affecting the Species and Environment within the Action Area**

##### Federal Actions

NMFS consulted on the removal of the St. Petersburg Pier in 2014 (NMFS tracking number SER-2014-13371). No other federal projects are known to have occurred in the action area that have undergone Section 7 consultation. The nearby marinas will continue to be operated and maintained, likely including maintenance dredging and other maintenance and repair activities, much of which is federally regulated and would be subject to ESA consultation.

### *Recreational Fishing at Piers*

Other fishing piers (outside of the action area) that also require federal permits have been subject to formal consultation, resulting in Biological Opinions and measures to minimize the impact of associated take. Those consultations generally found fishing piers adversely affect sea turtles and smalltooth sawfish via incidental hooking and entanglement by actively fished lines, discarded remnant, or broken-off fishing lines, and/or other debris.

### State or Private Actions

Recreational fishing as regulated by the state of Florida can affect protected species or their habitats within the action area. Pressure from recreational fishing around the action area is likely to continue and at levels that are hard to quantify.

Commercial state fisheries are located in the nearshore habitat areas, though outside of the action area for this project. Recreational fishing from private vessels may occur in the area.

Observations of state recreational fisheries have shown that sea turtles are known to bite baited hooks and frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial anglers fishing for reef fish and for sharks with both single rigs and bottom longlines. 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 loggerhead sea turtles can be found in the SEFSC Turtle Expert Working Group (TEWG) reports (1998; 2000).

### Other Potential Sources of Impacts in the Environmental Baseline

#### *Stochastic events*

Stochastic (i.e., random) events, such as hurricanes, occur in Florida and can affect the action area. These events are by nature unpredictable, and their effect on the recovery of sea turtle species and sawfish 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 cold snaps like the one that occurred in January 2010, can kill smalltooth sawfish (Poulakis et al. 2011) and also sea turtles.

#### *Marine Pollution and Environmental Contamination*

Coastal runoff, marina and dock construction, dredging, aquaculture, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colburn et al. 1996) and smalltooth sawfish. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Sea turtles and smalltooth sawfish analyzed in this Biological Opinion travel within near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles. For example, during Hurricane Hermine in September 2016, Tampa Bay utility companies released partially-treated sewage into Tampa Bay. According to reports in the Tampa Bay Times, an estimated 150-200 million gallons of raw or partially treated sewage was released into Tampa and Boca Ciega bays and surrounding waterways. The sewage release is being investigated by the Florida Department of Environmental Protection and the Florida Fish and Wildlife Conservation Commission.

### *Conservation and Recovery Actions Shaping the Environmental Baseline*

As discussed in Section 3.2, NMFS and cooperating states have established an extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts that not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles. Similarly, the Florida Program for Shark Research at the Florida Museum of Natural History operates and maintains a sawfish encounter database that monitors the population of smalltooth sawfish in the southeastern United States.

In response to the growing awareness of recreational fishery impacts on sea turtles, in 2006 the Marine Recreational Fishery Statistics Survey added a survey question regarding sea turtle interactions within recreational fisheries. NMFS is exploring potential revisions to Marine Recreational Information Program to quantify recreational encounters with sea turtles on a permanent basis.

## **5 EFFECTS OF THE ACTION**

---

Effects of the action include direct and indirect effects of the action under consultation. Indirect effects are those that result from the proposed action, occur later in time (i.e., after the proposed action is complete), but are still reasonably certain to occur (40 CFR 402.02).

### **5.1 Effects from Recreational Fishing at the Fishing Pier**

Sea turtles and smalltooth sawfish may be adversely affected by recreational fishing activity through incidental hooking or entanglement in actively fished or discarded fishing line. Sea turtles and sawfish have historically been captured in both recreational and commercial fisheries and are known to become entangled in fishing debris. Most sea turtle captures on rod-and-reel, as reported to the STSSN, have occurred during pier fishing. Fishing piers are suspected to attract sea turtles that learn to forage there for discarded bait and fish carcasses. Sea turtles and smalltooth sawfish are particularly prone to entanglement as a result of their body morphologies and behaviors. Records of stranded or entangled sea turtles reveal that fishing gear can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding. The configuration of the smalltooth sawfish rostrum is particularly prone to entanglement, possibly affecting the ability of the fish to function. If an individual sea turtle or sawfish is entangled when young, the fishing line can become tighter and more constricting as the individual grows, cutting off blood flow and causing deep gashes, some severe enough to remove an appendage.

In this section, we will estimate the number of sea turtles and smalltooth sawfish anticipated to be captured at the proposed project based on available data regarding the number that have been recreationally captured in the surrounding area, the number of fishers estimated to report hook-and-line captures, and the estimated survival rate of each species post capture.

### **5.2 Estimated Reporting of Hook-and-Line Captures at Fishing Piers**

While we believe the best available information for estimating future interactions at fishing piers are the documented incidental captures at a specific pier and/or in the surrounding area, we also recognize the need to account for underreporting especially in areas where educational signs are

not present. In the following sections, we describe how we derived our estimates for potential future takes

In 2013, a fishing pier survey was completed at 26 fishing piers in Charlotte Harbor on the west coast of Florida in smalltooth sawfish critical habitat (Hill 2013). During the survey, 93 fishers were asked a series of 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 the encounter. Of the 26 piers visited, only 4% had sea turtle educational signs and 19% had smalltooth sawfish educational signs. The interviewer also noted conditions about the pier including if educational signs regarding reporting of hook-and-line captures were present at the pier. Interviewed fishers were asked open-ended questions about what they would do if they were to accidentally capture a sea turtle or sawfish. Of those interviewed, 46% responded they would cut the line, while 28% would either cut the line or remove the hook depending on the situation, and 22% would try to remove the hook. It was reported that 88% did not know of requirements to report incidental captures of either sea turtles or sawfish and that only 12% stated that they would report an accidentally hooked sawfish and only 8% would report an accidentally hooked sea turtle. This demonstrates the high level of underreporting likely occurring in that area, the lack of awareness regarding reporting, and the low incidence of educational signs regarding reporting at piers in smalltooth sawfish critical habitat.

In 2013, NMFS conducted a fishing pier survey in Mississippi that interviewed 382 fishers. This survey indicated that approximately 60% of anglers that had captured a sea turtle actually reported it. Many anglers indicated they were unaware of the requirements to report a captured sea turtle (Cook et al. 2014). Interestingly, Cook et al. (2014) report that, following the survey, an increase in the number of sea turtle incidental captures reported was noted. Regardless, the study clearly indicates that 40% of incidental captures are currently going unreported. It is important to note that in 2012 educational signs were installed at all fishing piers in Mississippi alerting fishers 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 captures. Although there were only 24 reported hook-and-line captures in 2011, the number of reported captures at fishing piers in Mississippi in 2012 rose to 198. This number has continued to rise with a total of 299 reported captures in 2014. 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 Mississippi STSSN (M. Cook, STSSN, per comm. to N. Bonine, NMFS Protected Resources Division, April 17, 2015) indicated that inconsistency in reporting of captures may also be due to fishers' concern over their personal liability or consequences from turtle captures. Since it is illegal to harm an endangered species, fishers are often afraid to admit the accidental capture of a sea turtle. Educational signs at piers and outreach materials are aimed at encouraging fishers to report these encounters so that injured sea turtles can be helped. However, news outlets in Mississippi have alleged that reporting sea turtle captures at fishing piers may lead NMFS to no longer authorize the construction of fishing piers in Mississippi.

Similarly, it was noted in a study of smalltooth sawfish that many people became reluctant to report sawfish encounters once the species was listed under the ESA. Some fishers were apprehensive to continue to report sawfish encounters, fearing their favorite fishing hole would

be closed or restricted due to the known presence of sawfish (Wiley and Simpfendorfer 2010). This shows that public perception at the time of capture can affect whether the capture is reported and that reporting at piers can wax and wane from year to year based on this perception.

We believe that the Charlotte Harbor (Hill 2013) study is the most applicable study to determine underreporting at the new St. Petersburg Pier, because both piers are located in south Florida. In the Charlotte Harbor study, only one of the piers had a pier attendant that collected entrance fees and issued fishing licenses. For the St. Petersburg pier, the bait store employee will have equipment to help assist a fisher if a turtle or smalltooth sawfish is captured. However, this person will only be available during the hours the bait shop is open and the pier will remain open 24 hours a day. The employee also will not be actively observing fishing activities and will have to rely on fishers at the pier reading posted educational signs and reporting captures. In the Charlotte Harbor study, 88% of fishers interviewed stated that they did not know to report sea turtle or smalltooth sawfish captures. To be conservative, we will assume 88% underreporting of sea turtles and smalltooth sawfish captures even though a bait shop employee will be available during operating daylight hours when likely most of the fishing will occur from the pier. We will supplement the data from the Charlotte Harbor study with data from Mississippi fishing piers to fill in missing information regarding the potential outcomes of hook-and-line injuries to sea turtles captured at fishing piers.

The number of documented captures in any given year may fluctuate based on reporting (as discussed above) and can also be influenced by sea temperatures, species abundances in a given year, 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 incidental take estimate on a 1-year estimated take level is largely impractical. For these reasons, and based on our experience monitoring other fishing, we believe a 3-year time period is appropriate for meaningful monitoring. The triennial takes are set as 3-year running sums (total for any consecutive 3-year period) and not for static 3-year periods (i.e., 2015-2017, 2016-2018, 2017-2019 and so on, as opposed to 2017-2019, 2020-2022). This approach accounts for the inherent variability in take levels, while still allowing for an accurate assessment of how the proposed actions are performing versus our expectations.

### **5.3 Hook-and-Line Capture of Smalltooth Sawfish**

The ISED was created during the smalltooth sawfish listing process and is now maintained by the Florida Program for Shark Research at the Florida Museum of Natural History. This database tracks sawfish encounters reported by fishers, boaters, and researchers. Collected data includes the date of the encounter, type of encounter (sighting or capture), location and habitat of encounter, estimated total length, condition of the sawfish, and a variety of other information. The database includes both recent and historical information. As discussed above, it is expected that this database represents only a portion of actual encounters and that a large number go unreported.

NMFS believes the ISED capture data reported in the Tampa Bay area is the best data available concerning the incidental capture of smalltooth sawfish at the proposed project, though this number likely represents only a portion of the number of incidental captures due to

underreporting. Based on the reported encounter data in Section 3.2, only 1 smalltooth sawfish has been reported captured by hook-and-line at a public fishing pier within Tampa Bay (more were reported near the mouth of the bay). Since smalltooth sawfish do not seem to be drawn to fishing piers the same way that sea turtles appear to be attracted, we assume that the smalltooth sawfish captured at one of the interior piers could have been captured at any of the fishing piers within Tampa Bay. Therefore we estimated the potential risk of hook-and-line capture at the St. Petersburg Pier based on this 1 capture in 15 years at 1 of the 5 public fishing piers within Tampa Bay, as shown below:

Estimated annual smalltooth sawfish capture at a public fishing pier in Tampa Bay:  
 $1 \text{ smalltooth sawfish} / 15 \text{ years} = 0.0667 \text{ sawfish captures per year}$

Estimated annual smalltooth sawfish capture likely to occur at any 1 of the 5 specific piers in Tampa Bay (e.g., St. Petersburg Pier):  
 $0.0667 \text{ sawfish captures per year} / 5 \text{ piers} = 0.0133 \text{ captures per year per pier}$

Estimated annual smalltooth sawfish capture per year per pier (e.g., St. Petersburg Pier) assuming 88% underreporting (i.e., 12% actually reported):  
 $0.0133 \text{ captures per year per pier} \times 12\% \text{ reported} = 0.1108 \text{ estimated future captures per year at the St Pete Pier}$ . Because this estimate is so low, even a 3-year estimate seems inappropriate since 0.1108 captures per year is equal to 1 capture every 9 years at this pier. Therefore, we will estimate the smalltooth sawfish capture for this Opinion based on 9-year periods.

Based on the underreporting, the variability of reporting likely occurring at different piers in Tampa Bay, and the potential for increases in reported takes with increased education and outreach at the proposed redesigned and rebuilt pier, using underreporting to determine estimated future take is prudent. Therefore, we anticipate that 1 sawfish capture may be captured every 9 years at this pier.

NMFS's preferred method of hooked smalltooth sawfish release is to cut the line as close as possible to the sawfish's mouth or hooking site. Based on observations of stranded sawfish and anecdotal reports, this is the preferred approach of fishers to deal with hooked smalltooth sawfish. This form of release will result in the escape of sawfish with embedded hooks and varying amounts of monofilament fishing line which may cause post-release injury or death. Post-release mortality is unknown at this time, but is believed to be very low based on the few stranding reports of sawfish. According to a study, only 0.6% of reported sightings to the ISED between 1998 and 2008 were reported stranded dead, indicating a very low rate of mortality from captures (Wiley and Simpfendorfer 2010). In addition, the applicant proposes to install educational signs to inform fishers of how to handle an accidentally captured smalltooth sawfish. Therefore, we believe that the 1 estimated smalltooth sawfish capture every 9 years at the proposed project will not result in mortality and therefore no lethal take of smalltooth sawfish is anticipated.



## 5.4 Hook-and-Line Captures of Sea Turtles

Hook-and-line gear commonly used by recreational anglers fishing from fishing piers can adversely affect sea turtles via entanglement, hooking, and trailing line. Sea turtles released alive may later succumb to injuries sustained at the time of capture or from exacerbated trauma from fishing hooks or lines that were ingested, entangling, or otherwise still attached when they were released. Of the sea turtles hooked or entangled that do not die from their wounds, some may suffer impaired swimming or foraging abilities, altered migratory behavior, and altered breeding or reproductive patterns.

The current understanding of the effects of hook-and-line gear on sea turtles is related primarily to the effects observed in association with commercial fisheries (particularly longline fisheries); few data exist on the effects of recreational fishing captures on sea turtles. Dead sea turtles found stranded with hooks in their digestive tract have been reported, though it is assumed that most sea turtles hooked by recreational fishers are released alive (Thompson 1991). Little information exists on the frequency of recreational fishing captures and the status of the sea turtles after they are caught. Regardless, effects sea turtles are likely to experience as a result of interactions with recreational hook-and-line gear (i.e., entanglement, hooking, and trailing line) are expected to be the same as those that might occur in commercial fisheries. The following discussion summarizes in greater detail the available information on how individual sea turtles may be affected by interactions with hook-and-line gear.

### *Hooking*

In addition to being entangled in hook-and-line gear, sea turtles are also injured and killed by being hooked. Hooking can occur as a result of a variety of scenarios, some depend 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 et al. 1995). Observer data (not specific to recreational fishing) indicate entanglement and foul-hooking are the primary forms of gear interactions with leatherback sea turtles, whereas internal hooking is much more prevalent in hardshell sea turtles, especially loggerheads (NMFS unpublished data). Almost all interactions with loggerheads result from the turtle taking the bait and hook; only a very small percentage of loggerheads are foul-hooked externally or entangled.

Swallowed hooks are of the greatest concern. 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 a hook does not lodge into, or pierce, a sea turtle's digestive organs, it can pass through the sea turtle entirely (Aguilar et al. 1995; Balazs 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 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.

#### *Trailing Line*

Trailing line (i.e., line left on a sea turtle after it has been captured and released), particularly line trailing from a swallowed hook, 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 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 likely to entangle the sea turtle, eventually, leading to impaired movement, constriction wounds, and potentially death.

### **5.5 Estimating Injury and Post-Release Mortality Rates for Anticipated Future Takes**

The injury to sea turtles from hook-and-line captures and ultimately the post-release mortality (PRM) will depend on numerous factors including how deeply the hook is embedded, whether it was swallowed or was an external hooking, 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.

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. If that cannot 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. We have no way of estimating how many will break free with trailing line and/or ingested or embedded hooks. Because of considerations such as the tide, weather, and the weight and size of the captured sea turtle, some will not be able to be de-hooked (when applicable), and will be cut free by fishers, and intentionally released. These sea turtles will escape with embedded or swallowed hooks, or trailing varying amounts of monofilament 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. In 2006, those criteria were revised and finalized (Ryder et al. 2006). In February 2012, the SEFSC updated the 2006 criteria by adding 3 additional hooking scenarios. Overall mortality ratios are dependent upon the type of

interaction (i.e., hooking, entanglement), the location of hooking if applicable (i.e., hooked externally, hooked in the mouth), and the amount/type of gear remaining on the animal at the time of release (i.e., hook remaining, amount of line remaining, entangled or not). Therefore, the experience, ability, and willingness of anglers to remove the gear, and the availability of gear-removal equipment, are very important factors that influence PRM. The new criteria also take into account differences in PRM between hardshell sea turtles and leatherback sea turtles, with slightly higher rates of PRM assigned to leatherbacks. No specific criteria for recreational hook-and-line gear are currently available (Table 4).

To anticipate future PRM, we used the revised NMFS and SEFSC (2012) criteria. This study assessed hook-and-line captures from pelagic long-lining where there are a lot of sea turtle hooking and entanglement criteria data and these data are analogous to infer how sea turtles are captured during recreational hook-and-line fishing. Post-release mortality varies based on the initial injury the animal sustained and the amount of gear left on the animal at the time of release. At this time, the best available information that we have regarding these two factors for recreational fishing captures in the NMFS Southeast Region is reported by the Mississippi STSSN. According to the STSSN, Mississippi has approximately 44 mi of tidal shoreline with nearly 200 public fishing access points including fishing piers, fishing bridges, boat launches, and marinas. In cooperation with the Institute of Marine Mammal Studies (IMMS), the Mississippi STSSN has compiled extensive data on the hook-and-line captures of 924 sea turtles at fishing piers in Mississippi from 2010 to mid-2015 (Table 5). This data includes the location of where the sea turtle was hooked. We looked at this data to determine the types of hooking injuries and potential post-release mortality for sea turtles captured at fishing piers. The data provided includes 24.24% of turtle interactions that did not report the specific sea turtle hooking location. We believe that it is more accurate to estimate the future injury and post-release mortality by only analyzing the reported hook-and-line captures that also reported the hooking location since we do not know where unreported turtles were hooked and how to classify their potential injury category in Table 4. Using this data, we estimate that 7% of turtles hooked at fishing piers will suffer a Category I injury defined in Table 5, followed by 4% of turtles that will suffer a Category II injury, 85% of turtles that will suffer a Category III injury, and 4% of turtles that will suffer a Category IV injury (Table 5).

**Table 4. Criteria for Assessing PRM, With Mortality Rates Shown as Percentages for Hardshell Sea Turtles and Leatherbacks (in Parentheses) (NMFS and SEFSC 2012)**

| Injury Category  | Release Condition  |  |   |                                    |
|--|--|--|---|------------------------------------|
|  | (A) Released entangled (line is trailing or not trailing, turtle is entangled <sup>6</sup> ) | (B) Released with hook and with trailing line greater than or equal to half the length of the carapace (line is trailing, turtle is not entangled) | (C) Released with hook and with trailing line less than half the length of the carapace (line is trailing, turtle is not entangled) | (D) Released with all gear removed |
|  | Hardshell (Leatherback)  | Hardshell (Leatherback)  | Hardshell (Leatherback)   | Hardshell (Leatherback)            |
| I Hooked externally with or without entanglement   | 55% (65%)  | 20% (30%)  | 10% (15%)   | 5% (10%)                           |
| II Hooked in upper or lower jaw with or without entanglement—includes ramphotheca (i.e., beak), but not any other jaw/mouth tissue parts (see Category III)  | 65% (75%)  | 30% (40%)  | 20% (30%)   | 10% (15%)                          |
| 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. | 75% (85%)  | 45% (55%)  | 35% (45%)   | 25% (35%)                          |
| 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  | 85% (95%)  | 60% (70%)  | 50% (60%)   | 75% (85%) <sup>7</sup>             |
| V Entangled only, no hook involved   | Released Entangled<br>50% (60%)  | n/a  |   | Fully Disentangled<br>1% (2%)      |
| VI Comatose/resuscitated   | n/a <sup>8</sup>   |  | 70% (80%)   | 60% (70%)                          |

<sup>6</sup> Length of line, as well as the presence or absence of the hook, is not relevant as turtle remains entangled at release.

<sup>7</sup> Although per veterinary recommendations, hooks would not be removed if the insertion point of the hook is not visible when viewed through the open mouth, this has occurred and must be accounted for. We have interpolated the table's value to insert a value for this cell base on veterinary and expert opinion. Also, there are times when the hook location is unknown, but the hook and line are retrieved. Because these are coded in this row, we must also allow for the removal of all gear.

<sup>8</sup> Assumes that the resuscitated turtle will always have the line cut to a length less than half the length of the carapace, even if the hook remains. Assumes that the turtle is not released entangled in the remaining line.

**Table 5. Category of Injury from Hook-and-Line Captures at Fishing Piers in Mississippi (January 1, 2010- June 10, 2015)**

| <b>All Reporting Hook-and-Line Captures</b>                  | <b>I</b> | <b>II</b> | <b>III</b> | <b>IV</b> | <b>Unknown/Blank/NA</b> | <b>Total - All</b> |
|--|----------|-----------|------------|-----------|-------------------------|--------------------|
| Records  | 52       | 26        | 596        | 26        | 224                     | 924                |
| Percent of Total   | 5.63%    | 2.81%     | 64.50%     | 2.81%     | 24.24%                  | 100.00%            |
|  |          |           |            |           |                         |                    |
| <b>Hook-and-Line Captures with hooking location reported</b> | <b>I</b> | <b>II</b> | <b>III</b> | <b>IV</b> | <b>Total - Known</b>    |                    |
| Records  | 52       | 26        | 596        | 26        | 700                     |                    |
| Percent of Total   | 7.43%    | 3.71%     | 85.14%     | 3.71%     | 100.00%                 |                    |

## 5.6 Estimating Sea Turtle Take

We believe that there is probably underreporting at fishing piers in Tampa Bay (discussed in Section 5.1). Looking at all fishing piers in Tampa Bay still does not accurately reflect the number of turtles likely being captured at these locations, since reporting is known to be so low. Below we discuss the available information regarding hook-and-line captures at fishing piers and how we can use this information to estimate the number of sea turtles likely to be captured at the St. Petersburg Pier.

We believe the STSSN capture data reported in the Tampa Bay area is the best data available concerning the incidental capture of sea turtles at the proposed project, though this number likely represents only a portion of the number of incidental captures due to underreporting. Based on the reported encounter data in Section 3.2, only 2 sea turtles has been reported captured by hook-and-line at the old St. Petersburg Pier plus 1 additional turtle at another public fishing pier within Tampa Bay (more were reported near the mouth of the bay). Since the other piers in Tampa Bay are smaller with likely less fishing pressure, likely lack educational signs informing fishers to report captures if they occurred, and are located further into the bay away from the Gulf of Mexico, we believe the 2 captures at the St. Petersburg Pier are the best estimate of potential hook-and-line captures for this pier.

Therefore we estimated the potential number of hook-and-line captures at the new St. Petersburg Pier based on 2 captures at the old St. Petersburg Pier in 15 years, as shown below:

Estimated annual sea turtle capture at the St. Petersburg Pier:  
 $2 \text{ sea turtles} / 15 \text{ years} = 0.133 \text{ captures per year}$

Estimated annual sea turtle capture per year at the St. Petersburg Pier assuming 88% underreporting (i.e., 12% actually reported):  
 $0.133 \text{ captures per year} \times 12\% \text{ reported} = 1.108 \text{ estimated future captures per year at the St Pete Pier. This is equal to } 3.324 \text{ capture every } 3 \text{ years at this pier } (1.108 \text{ per year} \times 3 \text{ years} = 3.325).$

Based on the underreporting and the potential for increases in reported takes with increased education and outreach at the proposed redesigned and rebuilt pier, using underreporting to determine estimated future take is prudent. Therefore, we anticipate 3.324 sea turtle captures every 3 years at this pier. Though our final estimate of sea turtles captured by hook-and-line for this Opinion will be provided in whole numbers, the calculations for the remainder of Section 5 will not be rounded until the end of Section 5.

## 5.7 Future Sea Turtle Takes and Mortalities at the New St. Petersburg Pier

In the previous section we estimated the number of sea turtles that will be captured by hook-and-line at this location, including accounting for underreporting. We believe using the data from this timeframe will help us determine future takes more accurately. However, this reasoning does not apply to considering the type/severity of the interactions reported across years. We have no reason to believe that the type/severity of the captures that occurred across all years will be different going forward. Therefore, we will consider all the injuries previously documented as we go through our analysis evaluating the type of future interactions and possible mortalities.

Now we must evaluate how many of these future interactions may result in mortality. The St. Petersburg Pier will have an attendant working at the bait shop, fishing will be restricted to that area, and signs will be posted informing fisherman to report hooked turtles and smalltooth sawfish. Since we lack data on the outcome of sea turtles captured at fishing piers in Florida, we will rely on data provided in Mississippi as a proxy, since Mississippi has more data available. Sea turtles that are captured and reported as accidentally being captured in fishing gear in Mississippi's waters are evaluated by IMMS to determine if they can immediately be released or require rehabilitation. According to IMMS data provided by the STSSN, 939 turtles were accidentally captured at Mississippi fishing piers between 2010 and mid-2015 (Table 6). Table 6 provides IMMS's breakdown of the number and percent of reported captures that were released alive at the pier (12%) versus those sent to rehabilitation (88%). This is further divided into the fate of those sent to rehabilitation as shown in Table 6.

**Table 6. Disposition of Sea Turtles Captured at Mississippi Fishing Piers (January 1, 2010-June 10, 2015)**

| Final Disposition | Released immediately alive | At IMMS | Died in rehabilitation facility | Non-releasable from rehabilitation | Rehabilitated and released alive | Released and later stranded dead* |
|-------------------|----------------------------|---------|---------------------------------|------------------------------------|----------------------------------|-----------------------------------|
| Total Number      | 113                        | 77      | 20                              | 6                                  | 682                              | 37                                |
| Percent           | 12%                        | 8%      | 2%                              | 1%                                 | 73%                              | 4%                                |

\*Turtles released and later stranded dead often died months to year(s) later and death may not have been a result of incidental capture.

### *Estimated Future Captures Released at the Pier (not sent to rehabilitation)*

We now use the data provided by IMMS in Mississippi to estimate the number of sea turtles that will be released directly from the pier compared to those that will be sent to a rehabilitation center. Sea turtles may be released immediately from the pier because the animals break the line of their own volition or the anglers cut the line. According to IMMS (Table 6), 12% of reported

captures are released alive at the piers and 88% are sent to a rehabilitation center. In Section 5.5, we estimated that 3.324 turtles would be reported captured per 3-year period to account for annual variability.

Using this information we estimate:

- Turtles released immediately from the pier = 0.399 turtles  
(3.324 reported turtle captures x 0.12 = 0.399)
- Turtles sent to a sea turtle rehabilitation center = 2.925 turtles  
(3.324 reported turtle captures x 0.88 = 2.925)

*Estimating Post-Release Mortality Rates for Sea Turtles Released Immediately from the Pier*

Calculating PRM requires 2 steps: (1) determining where the animal was hooked or entangled (“Injury Category”; Table 4), and (2) how much gear remains on the animal at the time of release (“Release Condition”; Table 4). Based on the information in Table 5, we estimate that approximately 7% of turtles hooked at fishing piers will suffer a Category I injury defined in Table 4 above, 4% will suffer a Category II injury, 85% will suffer a Category III injury, and 4% will suffer a Category IV injury.

We believe it is reasonable (and conservative) to conclude that fishers will choose not to or will not be able to cut the line at the hook and turtles will be released with trailing line likely longer than half the length of its carapace. This assumption would put the turtle in Release Condition B (Table 5). Assuming Release Condition B allows us to identify the likely PRM rate for each Injury Category. For example, the information in Table 4 indicates an animal with a Category I injury that is returned to the water in Release Condition B is likely to suffer 20% PRM (hardshell sea turtles). Likewise, hardshell sea turtles with a Category II injury that is returned to the water in Release Condition B is likely to suffer 30% PRM, and so on. To estimate PRM for turtles released immediately from a pier, we took our estimates of the number of captures that fall into each Injury Category (see previous paragraph) and multiplied them by the corresponding PRM rates associated with Release Condition B. Table 7 summarizes those results.

Since the hooking location of the injury affects the likelihood of survival and the hooking location varies greatly, it is difficult to determine which PRM rate we should use regarding anticipated future takes released immediately from a pier. We address this issue by calculating weighted mortality rates and an overall mortality rate. For example, we anticipate 7% of our future captures are likely to have Category I injuries, and only 20% of those animals are likely to suffer PRM as a result of that injury. Therefore, of *all* future anticipated captures, we expect 1.4% of them (7% x 20%) would suffer PRM as a result of a Category I injury. By following this same approach for each injury category and its corresponding mortality rate, we establish the weighted mortality rates. By summing the weighted mortality rates we can estimate the overall mortality rate that we can apply to all future turtles captured and released immediately from a pier. This overall rate helps us account for the varying severity of future injuries and varying PRM rates associated with them.

**Table 7. Estimated Weighted and Overall PRM Rates for Turtles Released Immediately from the Pier Potentially with Trailing Line**

| <b>Injury Category</b>  | <b>Percentage of Total Captures in Each Injury Category from Table 5</b> | <b>PRM Rate per Category from Table 4</b> | <b>Weighted Mortality Rate</b> |
|---|--|---|--------------------------------|
| I   | 7%   | 20%                                       | 1.4%                           |
| II  | 4%   | 30%                                       | 1.2%                           |
| III   | 85%  | 45%                                       | 38.3%                          |
| IV  | 4%   | 60%                                       | 2.4%                           |
| <b>Overall Post-Release Mortality Rate</b>  |  |   | <b>43.2%*</b>                  |
| *Overall mortality rate = Percent of Total Captures in Each Injury Category x PRM Rate per Category = Weighted Mortality; Weighted Mortality Rate for Injury Category I + Weighted Mortality Rate for Injury Category II + Weighted Mortality Rate for Injury Category III + Weighted Mortality Rate for Injury Category IV = Overall mortality rate. |  |   |                                |

Based on the assumptions we have made about the likely location on sea turtles of future hookings and the amount of fishing gear likely to remain on animals released immediately at a pier, we estimate a PRM rate of 43.2% for sea turtles released at the pier (not sent to rehabilitation).

For this Opinion, we divided the captured sea turtles into 2 categories (those released immediately from the pier and those sent to a sea turtle rehabilitation center). For the 0.399 turtles we estimate will be released immediately from the pier, we will apply the 43.2% PRM to estimate the number expected to die as a result of injuries associated with being hooked:

- Turtles released immediately from the pier that suffer PRM= 0.172 turtles  
(0.399 turtles x 0.432 = 0.172)
- Turtles released immediately from the pier that live = 0.227 turtles  
(0.399 turtles – 0.172 = 0.227)

#### *Estimating Future Mortalities of Turtles Captured and Sent to Rehabilitation*

Above, we determined that 2.925 turtles are expected to be sent to rehabilitation per 3-year period. To determine the future mortality of these turtles, again we look to the data provided by IMMS for turtles captured in Mississippi. In Table 5, IMMS reported that only 3% of the turtles captured that they assisted with either died after capture or were unable to be returned to the wild. Although IMMS also releases some captured turtles directly from the pier when they arrived at the pier to take turtles to rehabilitation, we are considering all turtle captures handled by rehabilitation staff in the same category as those sent to a rehabilitation center. Therefore, we assume that the other 97% are released back to the wild with no injuries or attached hooks or line and we do not need to estimate a PRM for these turtles attended to by rehabilitation staff.

- Successfully returned to the wild = 2.837 turtles  
(2.925 turtles x 0.97 = 2.837)
- Died or were unable to be released = 0.088 turtles  
(2.925 turtles x 0.03 = 0.088)

#### *Summary of Total Estimated Captures and Mortalities*



As discussed at the beginning of Section 5.2, we divided the estimated captures and mortalities into different categories. These were then described in detail and PRM was calculated. The result of this analysis discussed in Sections 5 is summarized in Table 8 below.

**Table 8. Total Estimated Sea Turtle Take for 3-Year Periods at St. Petersburg Pier**

|  | Non-lethal Take | Lethal Take |
|--|-----------------|-------------|
| <b>Released Immediately at the Pier (0.399 turtles)</b>              |                 |             |
| Turtles released immediately from the pier that suffer PRM           |                 | 0.172       |
| Turtles released immediately from the pier that live                 | 0.227           |             |
| <b>Sent to Rehabilitation (2.925 turtles)</b>                        |                 |             |
| Successfully returned to the wild                                    | 2.837           |             |
| Died or were unable to be released                                   |                 | 0.088       |
| <b>Total Estimated Take including underreporting (3.324 turtles)</b> | 3.064           | 0.26        |

*Expected Non-lethal and Lethal Sea Turtle Takes by Species*

Now that we have determined the numbers of estimated non-lethal and lethal takes for consecutive 3-year periods, we need to determine the number of each sea turtle species that will be affected. According to the stranding data provided in Table 2 in Section 3.2, the strandings were loggerhead (43%), green (39%), and Kemp's ridley (17%) sea turtles. These percent ratios by species are used in Table 9 to determine non-lethal take estimates per species based on a total estimated 3.064 non-lethal takes from Table 8 above.

**Table 9. Anticipated Non-lethal Take by Species During Any 3-Year Period**

| <b>Sea Turtles</b>                 | <b>Non-lethal Take</b><br>(Percent capture by species x 3.064 non-lethal take) |
|------------------------------------|--|
| Loggerhead<br>(43% of captures)    | $0.43 \times 3.064 = 1.318$  |
| Green<br>(39% of captures)         | $0.39 \times 3.064 = 1.195$  |
| Kemp's ridley<br>(17% of captures) | $0.17 \times 3.064 = 0.521$  |

Based on the calculations in Table 9 above, we estimate that 2 loggerhead (rounded up from 1.318), 2 green (rounded up from 1.195), and 1 Kemp's ridley sea turtle (rounded up from 0.521) will be non-lethally captured during any 3-year period.

Since the estimated lethal take is so low (0.026 lethal take per 3-year period), we will err on the side of the species and round this up to 1 potential lethal take per 3 year period. This take could be any one of the sea turtle species (loggerhead, green, or Kemp's ridley).

## 6 CUMULATIVE EFFECTS

---

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section.

Cumulative effects are effects from unrelated, non-federal actions that are reasonably certain to occur in the action area in the future. At this time, we are not aware of any non-federal actions being planned or under development in the action area beyond those discussed in the environmental baseline section; we expect those effects to continue at similar or slightly elevated levels into the foreseeable future. While we do not know of any specific actions, there may be other projects under consideration, planned, or developed within or in the vicinity of the action area in the future (e.g., hotel project, property development) that may add or compound existing issues for sea turtles or sawfish.

## 7 JEOPARDY ANALYSIS

---

The analyses conducted in the previous sections of this Opinion provide a basis to determine whether the proposed action is likely to jeopardize the continued existence of loggerhead, green, or Kemp's ridley sea turtles or smalltooth sawfish, by identifying the nature and extent of adverse effects (take) expected to impact each species. Next we consider how these species will be impacted by the proposed action in terms of overall population effects and whether those effects of the proposed action will jeopardize the continued existence of the species when considered in the context of the status of the species and their habitat (Section 3), the environmental baseline (Section 4), and cumulative effects (Section 6).

To jeopardize the continued existence of is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The following jeopardy analysis first considers the effects of the action to determine if we would reasonably expect the action to result in reductions in reproduction, numbers, or distribution of these species. The analysis next considers whether any such reduction would in turn result in an appreciable reduction in the likelihood of survival of these species in the wild, and the likelihood of recovery of these species in the wild.

All life stages are important to the survival and recovery of a species; however, it is important to note that individuals of one life stage are not equivalent to those of other life stages. For example, the take of male juveniles may affect survivorship and recruitment rates into the reproductive population in any given year, and yet not significantly reduce the reproductive potential of the population. Yet, the death of mature, breeding females can have an immediate effect on the reproductive rate of a species. Sublethal effects on adult females may also reduce reproduction by hindering foraging success, as sufficient energy reserves are probably necessary for producing multiple clutches of eggs in a breeding year. Different age classes may be subject to relative rates of mortality, resilience, and overall effects of population dynamics. Ontogenetic shifts, or changes in location and habitat, have a major impact on where sea turtles occur and what human hazards they may encounter. Young juvenile sea turtles are generally not subject to

hook-and-line capture because of their pelagic oceanic stage of life. Still, a shift in diet for all sea turtles occurs when juvenile sea turtles shift to a neritic habitat and benthic feeding, at which time they would become more susceptible to fishing impacts. For the proposed action, we would not expect early juvenile stage sea turtles of any of these species to be subject to take from any aspect of the pier reconstruction or continued use of the pier/jetty. However, later stage juveniles and adults of these species are more likely to be subject to incidental take as a result of foraging in the area of increased fishing activity which would occur as a result of the proposed project.

## **7.1 NWA DPS of Loggerhead Sea Turtles**

The proposed action is anticipated to result in the capture and live release of up to 2 loggerhead sea turtles during any consecutive 3-year period due to fishing activities or entanglement in fishing gear associated with the proposed pier, of which 1 capture may result in PRM. One loggerhead sea turtle is anticipated to be captured and released immediately alive from the pier with no anticipated PRM, or taken to a rehabilitation center and released later in time after the turtle has recovered from the hook-and-line capture. Turtles successfully returned to the wild population are not expected to have any measurable impact on the numbers, reproduction, or distribution of loggerhead sea turtles in the wild. .

The estimated lethal sea turtle capture may be a turtle captured at the pier that is expected to suffer PRM, or a turtle captured and transported to a rehabilitation center that either dies in captivity or is unable to be successfully released back into the wild population. This lethal take of 1 loggerhead sea turtle in any 3-year period will result in a reduction in both numbers (the individual lethally taken) and reproduction as a result of lost reproductive potential, as the individual could be a female who could have survived other threats and reproduced in the future, thus eliminating the female's individual contribution to future generations. For example, an adult female loggerhead sea turtle can lay 3 or 4 clutches of eggs every 2-4 years, with 100-130 eggs per clutch. The loss of an adult female sea turtle could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. Because the NWA DPS of loggerhead sea turtles has a large range in which they disperse, including along the coast of the United States, from southern Virginia to Alabama, where nesting may occur, the distribution of loggerhead sea turtles is expected to be unaffected by the lethal take of 1 sea turtle in the action area surrounding this pier.

Whether the loss of 1 loggerhead sea turtle per 3-year period would appreciably reduce the likelihood of survival for loggerheads depends on what effect this reduction in numbers and reproduction would have on overall population sizes and trends; we consider whether the reduction would be of such magnitude that adverse effects on population dynamics would be appreciable when viewed within the context of the environmental baseline and status of the species. In Section 3.2.2, we reviewed the status of the species in terms of nesting and female population trends and several recent assessments based on population modeling (e.g., (Conant et al. 2009b; NMFS-SEFSC 2009). Below, we synthesize what that information means in general terms and also in the more specific context of the proposed action and the environmental baseline.

Loggerhead sea turtles are a slow growing, late-maturing species. Because of their longevity, loggerhead sea turtles require high survival rates throughout their life to maintain a population. In other words, late-maturing species cannot tolerate much anthropogenic mortality without going into decline. Conant et al. (2009b) concluded because loggerhead natural growth rates are low, natural survival needs to be high, and even low to moderate mortality can drive the population into decline. Because recruitment to the adult population is slow, population modeling studies suggest even small increases in mortality rates in adults and subadults could substantially impact population numbers and viability (Chaloupka and Musick 1997b; Crouse et al. 1987; Crowder et al. 1994; Heppell et al. 1995).

NOAA's Southeast Fisheries Science Center [SEFSC (2009)] estimates the adult female population size for the NWA DPS is likely between approximately 20,000 and 40,000 individuals, with a low likelihood of being up to 70,000 individuals. A more recent conservative estimate for the entire western North Atlantic population was a mean of 38,334 adult females using data from 2001-2010 (Richards et al. 2011). A much less robust estimate for total benthic females in the western North Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million. Further insight into the numbers of loggerhead sea turtles along the U.S. coast is available in NMFS-NEFSC (2011), which reported a conservative estimate of 588,000 juvenile and adult loggerhead sea turtles present on the continental shelf from the mouth of the Gulf of St. Lawrence to Cape Canaveral, Florida, when using only positively identified loggerhead sightings from an aerial survey. A less conservative analysis from the same study resulted in an estimate of 801,000 loggerheads in the same geographic area when a proportion of the unidentified hardshell turtles were categorized as loggerheads. This study did not include Florida's east coast south of Cape Canaveral or the Gulf of Mexico, which are areas where large numbers of loggerheads are also documented to occur.

A detailed analysis of Florida's long-term loggerhead nesting data (1989-2014) revealed 3 distinct annual trends (Figure 4). From 1989-1998 there was a 30% increase that was then followed by a sharp decline over the subsequent decade. Large increases in loggerhead nesting have occurred since then. FWRI examined the trend from the 1998 nesting high through 2013 and found the decade-long post-1998 decline had reversed and there was no longer a demonstrable trend. Looking at the data from 1989 through 2014 (an increase of over 32%), FWRI concluded that there was an overall positive change in the nest counts (<http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/>).

We believe that the incidental take and resulting mortality of 1 loggerhead sea turtle associated with the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the NWA DPS of loggerhead sea turtles. We believe the current population is large (i.e., several hundred thousand individuals) and is showing encouraging signs of stabilizing and possibly increasing. We also expect that the proposed action will not cause the population to lose genetic heterogeneity, broad demographic representation, or successful reproduction, nor affect loggerheads' ability to meet their lifecycle requirements, including reproduction, sustenance, and shelter.

With respect to whether the proposed action would appreciably reduce the likelihood of the species' recovery, we evaluated the Services' recovery plan for the Northwest Atlantic

population of the loggerhead sea turtle (NMFS and USFWS 2008a), which is the same population of sea turtles as the NWA DPS. The recovery plan anticipates that, with implementation of the plan, the western North Atlantic population will recover within 50-150 years, but notes that reaching recovery in only 50 years would require a rapid reversal of the then declining trends of the Northern, Peninsular Florida, and Northern Gulf of Mexico Recovery Units.

The objectives of the recovery plan most pertinent to the threats posed by the proposed actions are Objectives Nos. 1 and 2 (listed below):

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.

Recovery Objective 1, “Ensure that the number of nests in each recovery unit is increasing...,” is the plan’s overarching objective and has associated demographic criteria. Currently, none of the plan’s criteria are being met, but the plan acknowledges that it will take 50-150 years to do so. Further reduction of multiple threats throughout the North Atlantic, Gulf of Mexico, and Greater Caribbean will be needed for strong, positive population growth, following implementation of more of the plan’s actions. Although any continuing mortality can affect the potential for population growth, we believe the very low mortality levels expected from the proposed actions would not impede or prevent achieving this recovery objective over the anticipated 50- to 150-year time frame.

Recovery Objective No. 2 states, “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.” Currently, there are not enough data on the population trends of juvenile loggerhead sea turtles to determine if this objective is being met. More information is available on loggerhead sea turtle nesting since nests are easier to accurately identify, count, and track annually. In Section 3.2.2 (Figure 4) and discussed above, the nesting trend of loggerhead sea turtles has had 3 distinct population trends with a sharp decline between 1998-2007 followed by a general population increase for the last decade from 2007-2016, with a few biannual decreases in 2009, 2011, and 2013. Stranding data also fluctuates annually depending on a number of factors including stochastic events such as cold snaps, reporting effort, and population fluctuations. We are currently working with the stranding networks to tease out the data comparing juvenile and adult stranding for loggerhead sea turtles. As with Recovery Objective No. 1 above, the mortality of a single sea turtle in the action area combined with the fluctuating population trends discussed above is not expected to impede or prevent achieving this recovery objective over the anticipated 50- to 150-year time frame. Because of high inter-annual variation in nesting and stranding data, and due to the relatively long-term lens needed to discern species recovery for the NWA population of loggerheads, recovery trends are assessed over decades. The loss of a single NWA DPS loggerhead over the 3 year periods for the proposed action would not impede recovery or significantly add to any negative recovery trend for this DPS.

The potential lethal interaction of a single loggerhead sea turtle during consecutive 3-year periods is not reasonably expected to cause an appreciable reduction in the likelihood of recovery of the NWA DPS of loggerheads. The potential lethal interaction associated with the proposed action would not impede progress on achieving the identified relevant recovery objectives or achieving the overall recovery strategy

## **7.2 Green Sea Turtles**

The proposed action is anticipated to result in the capture and live release of up to 2 green sea turtles during any consecutive 3-year period due to fishing activities or entanglement in fishing gear associated with the proposed pier, of which 1 capture may result in PRM. To complete the Jeopardy analysis, we need to determine how many of these green sea turtles occur from the NA and SA DPS of green sea turtles. One green sea turtle may be captured from the pier and released immediately alive with no anticipated PRM, or be taken to a rehabilitation center and released later in time after the turtle has recovered from the hook-and-line capture. Turtles successfully returned to the wild population are not expected to have any measurable impact on the numbers, reproduction, or distribution of loggerhead sea turtles in the wild.

The estimated lethal sea turtle capture may be a turtle captured at the pier that is expected to suffer PRM, or a turtle captured and transported to a rehabilitation center that either dies in captivity or is unable to be successfully released back into the wild population. For lethal injuries we need to determine the percent of the lethal take that will affect NA and SA DPSs of green sea turtles. Mixed-stock analyses of foraging grounds show that green sea turtles from multiple nesting beaches commonly mix at feeding areas across the Caribbean and Gulf of Mexico, with higher contributions from nearby large nesting sites and some contribution estimated from nesting populations outside the DPS (Bass et al. 1998; Bass and Witzell 2000; Bjorndal and Bolten 2008; Bolker et al. 2007). In other words, the proportion of animals on the foraging grounds from a given nesting beach is proportional to the overall importance of that nesting beach to the entire DPS. For example, Tortuguero, Costa Rica, is by far the largest nesting beach in the NA DPS and the number of animals from that nesting beach on foraging grounds in the same area was much higher than from any other nesting beach within the NA DPS. However, in some nesting locations within the NA DPS closer to the border of the SA DPS, there may be significant mixing between the DPSs. More specifically, Lahanas et al. (1998) showed through genetic sampling that juvenile green sea turtles in The Bahamas originate mainly from the western Caribbean (Tortuguero, Costa Rica) (79.5%) (NA DPS) but that a significant proportion may be coming from the eastern Caribbean (Aves Island/Suriname; 12.9%) (SA DPS).

Flipper tagging studies provide additional information on the co-mingling of turtles from the NA DPS and SA DPS. Flipper tagging studies on foraging grounds and/or nesting beaches have been conducted in Bermuda (Meylan et al. 2011), Costa Rica (Troeng et al. 2005), Cuba (Moncada et al. 2006), Florida (Johnson and Ehrhart 1996; Kubis et al. 2009), Mexico (Zurita et al. 2003a; Zurita et al. 1994), Panama (Meylan et al. 2011), Puerto Rico (Collazo et al. 1992; Patricio et al. 2011), and Texas (Shaver 1994; Shaver 2002). Nesters have been satellite tracked from Florida, Cuba, Cayman Islands, Mexico, and Costa Rica. Troeng et al. (2005) report that while there is some crossover of adult female nesters from the NA DPS into the SA DPS,

particularly in the equatorial region where the DPS boundaries are in closer proximity to each other, NA DPS nesters primarily use the foraging grounds within the NA DPS boundaries.

As discussed in Section 3.2.3, 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, 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 and that the remainder were from the NA DPS. 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 SA DPS (Bass and Witzell 2000). All of the individuals in both studies were benthic juveniles.

Taken together, this information suggests that the vast majority of the anticipated captures in the Gulf of Mexico and South Atlantic regions are likely to come from the NA DPS. However, it is possible that animals from the SA DPS could be captured during the proposed action.

For these reasons, we will act conservatively and conduct jeopardy analyses on the assumption that both the NA DPS and the SA DPS will be captured by the proposed action. The NA DPS analysis will assume that 96% of animals captured during the proposed action are from that DPS. Our analysis of the SA DPS will consider that 4% of the green sea turtles affected by the proposed action are from the SA DPS.

We anticipate up to 1 green sea turtle may be lethally taken at the pier during any consecutive 3-year period. However, because of the much lower probability that green captures will be from the SA DPS and because we conservatively inflate that probability because we only expect 2 captures every 3-year period, we further anticipate that the take from the SA DPS will be non-lethal (discussed below). The remaining capture from the NA DPS will be attributed as a lethal take.

### ***NA DPS***

The potential lethal take of 1 green sea turtle over 3 years would reduce the number of green sea turtles in the NA DPS, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. This take would also result in a potential reduction in future reproduction, assuming some of the lethally impacted individuals would be females and would have survived otherwise to reproduce. For example, an adult green sea turtle can lay 1-7 clutches (usually 2-3) of eggs every 2-4 years, with 110-115 eggs/nest, of which a small percentage is expected to survive to sexual maturity. Since the NA DPS of green sea turtles has a large range in which they disperse; the anticipated lethal take of 1 green sea turtle in the action area around the pier is not expected to reduce the distribution of the NA DPS of green sea turtles.

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. Seminoff et al. (2015) estimate there are greater than 167,000 nesting females in the NA DPS. The nesting at Tortuguero, Costa Rica, accounts for approximately 79% of that estimate (approximately 131,000 nesters), with Quintana

Roo, Mexico, (approximately 18,250 nesters; 11%), and Florida, USA, (approximately 8,400 nesters; 5%) also accounting for a large portion of the overall nesting (Seminoff et al. 2015).

At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2003, was approximately 104,411 nests/year, which corresponds to approximately 17,402–37,290 nesting females each year (Troëng and Rankin 2005). That number of nests laid increased to an estimated 180,310 nests during 2010; corresponding to 30,052–64,396 nesters. This increase has occurred despite substantial human impacts to the population at the nesting beach and at foraging areas (Campell and Lagueux 2005; Troëng 1998; Troëng and Rankin 2005).

Nesting locations in Mexico along the Yucatan Peninsula also indicate the number of nests laid each year has increased (Seminoff et al. 2015). In the early 1980s, approximately 875 nests/year were deposited, but by the year 2000 this increased to over 1,500 nests/year (NMFS and USFWS 2007a). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, Centro de Investigaciones de Quintana Roo, unpubl. data, 2013, in Seminoff et al. 2015)

In Florida, most nesting occurs along the Atlantic coast of eastern central Florida, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). As described in Section 3.2.3, nesting has increased substantially over the last 20 years and peaked in 2015 with 27,975 nests statewide in 2015. In-water studies conducted over 24 years in the Indian River Lagoon, Florida, suggest similar increasing trends, with green sea turtle captures up 661% (Ehrhart et al. 2007b). Similar in-water work at the St. Lucie Power Plant site revealed a significant increase in the annual rate of capture of immature green sea turtles over 26 years (Witherington et al. 2006).

Seminoff et al. (2015) also conducted a population viability analysis for the Tortuguero, Costa Rica, and Florida, USA nesting sites (as well as 2 others: Isla Aguada, Mexico and Guanahacabibes, Cuba).<sup>9</sup> The population viability analysis evaluated the probabilities of nesting populations declining to 2 separate biological thresholds after 100 years: (1) a trend-based reference point where nesting populations decline by 50% and (2) the number of total adult females falls to 300 or fewer at these sites (Seminoff et al. 2015).<sup>10</sup> Seminoff et al. (2015) point out that population viability analyses do not fully incorporate spatial structure or threats. They also assume all environmental and man-made pressures will remain constant in the forecast period, while also relying solely on nesting data.

The Tortuguero, Costa Rica, population viability analysis indicated a 0.7% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability that this population will fall below the absolute abundance reference point of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). For the Florida, USA, population, the population viability analysis indicated there is a 0.3% probability that this

---

<sup>9</sup> Not enough information was available to conduct a population viability analysis on the Quintana Roo, Mexico, nesting population.

<sup>10</sup> Since green sea turtles are believed to nest every 3 years, the analysis evaluated the likelihood that population would fall to 100 or fewer nesters annually ( $300 \text{ adult females} \div \text{nesting every 3 years} = 100 \text{ adult female nesters annually}$ ).



population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability this population falls below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015).

Nesting at the primary nesting beaches has been increasing over the course of the decades. Additionally, the population viability analysis for the Florida and Tortuguero, Costa Rica, nesting beaches indicate no more than a 0.7% probability those populations will reach the 50% decline threshold at the end of 100 years, and a 0% probability these populations will fall below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for green sea turtles is clearly increasing, we believe the potential lethal take of 1 green sea turtle from the NA DPS over consecutive 3 year periods into the future attributed to the proposed action will not have any measurable effect on that trend. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the NA DPS of green sea turtle in the wild.

The NA DPS of green sea turtles did not have a recovery plan in place at the time of listing. 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:

*Objective: The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.*

*Objective: A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.*

Sea turtle nesting in Florida is rising. An average of 5,039 green turtle nests were laid annually in Florida between 2001 and 2006 with a low of 581 in 2001 and a high of 9,644 in 2005 (NMFS and USFWS 2007a). Data from the index nesting beaches program in Florida substantiate the dramatic increase in nesting. Across the entire state, nesting increased from 2008-2012. An average of 10,377 green sea turtle nests were laid annually in Florida during the period with a low of 4,462 in 2009 and a high of 15,352 in 2011 (FWRI 2013). There was a drop in 2012 (9,617 nests), and then in 2013 there were 25,553 nests, in 2014 3,502 nests, and in 2015 27,975 nests (<http://myfwc.com/research/wildlife/sea-turtles/nesting/2015-nesting-trends/>). 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 will also have increased.

The potential lethal take of up to 1 green sea turtle from the NA DPS over consecutive 3 year periods will result in a reduction in numbers when takes occur, but it is unlikely to have any detectable influence on the recovery objectives and trends noted above. In addition, because of

the relatively small number of lethal takes (1 green sea turtles every 3 years) as compared to the overall NA DPS' likely population size, we would not anticipate any impact on the species' reproduction described above to have a detectable difference in the first recovery objective for this DPS noted above. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the NA DPS of green sea turtles' recovery in the wild.

### **SA DPS**

Again, the proposed action may result in 2 green sea turtle takes over consecutive 3 year periods, with 1 non-lethal take per 3-year period attributed to the SA DPS.

One green sea turtle may be captured from the pier and released immediately alive with no anticipated PRM, or taken to a rehabilitation center and released later in time after the turtle has recovered from the hook-and-line capture. Turtles successfully returned to the wild population are not expected to have any measurable impact on the numbers, reproduction, or distribution of loggerhead sea turtles in the wild. Since the distribution of the SA DPS of green turtles generally has a large range in which they can disperse, the nonlethal take of 1 turtle in the small action area around this pier is not expected to result in a reduction in the distribution of SA DPS of green turtles. Therefore, we do not expect the proposed action will impede the SA DPSs likelihood of survival or recovery.

### **7.3 Kemp's Ridley Sea Turtles**

The proposed action is anticipated to result in the capture and live release of up to 1 Kemp's ridley sea turtle during any consecutive 3-year period due to fishing activities or entanglement in fishing gear associated with the proposed pier, of which up to 1 capture may result in PRM. One Kemp's ridley sea turtle may be captured at the pier and released immediately alive with no anticipated PRM or taken to a rehabilitation center and released later in time after the turtle has recovered from the hook-and-line capture. Turtles successfully returned to the wild population are not expected to have any measurable impact on the numbers, reproduction, or distribution of loggerhead sea turtles in the wild.

The estimated lethal sea turtle capture may be a turtle captured at the pier that is expected to suffer PRM, or a turtle captured and transported to a rehabilitation center that either dies in captivity or is unable to be successfully released back into the wild population. The potential lethal take of 1 Kemp's ridley sea turtle during consecutive 3 year periods would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. Lethal takes 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. The Turtle Expert Working Group (TEWG 1998b) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998b). The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season. Thus, the loss of 1 adult female Kemp's ridley sea turtle could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage is 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. The anticipated take will only occur at this pier thus, no reduction in the distribution of Kemp's ridley sea turtles is expected from the take of these individuals.

In the absence of any total population estimates for Kemp's ridley sea turtles, nesting trends are the best proxy we have for estimating population changes (Figure 8). Heppell et al. (2005a) predicted in a population model that the Kemp's ridley sea turtle population was expected to increase at least 12-16% per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2015. Research by NMFS et al. (2011b) included an updated model, which predicted that the population was expected to increase 19% per year and that the population could 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 nesting females on the beach, based on an average 2.5 nests/nesting female. While counts did not reach 25,000 nests by 2012, it is clear that the population is steadily increasing over the long term. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database 2013). In 2013 through 2014, there was a second significant decline in nesting in Mexico, with only 16,385 and 11,279 nests recorded, respectively followed by 14,006 nest in 2015. 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 209 nests in 2012 (National Park Service data, <http://www.nps.gov/pais/naturescience/strp.htm>, <http://www.nps.gov/pais/naturescience/current-season.htm>). The number of nests in Texas decreased in 2013 to 153 (Gladys Porter Zoo nesting database 2013). It is important to remember that with sea turtle species that exhibit normal inter-annual variation in nesting levels, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population increase in Kemp's ridleys. With the recent boom in nesting data (2015) and recent declining numbers of nesting females (2013-2014), it is too early to tell whether the long-term trend line is impacted. The trend line may change from an asymptotic upward curve to a more leveled increase. Either way, long-term data from 1990 to present support that Kemp's ridleys are 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 also believe these nesting trends are indicative of a species with a large number of sexually mature individuals. Assuming a 50:50 sex ratio, there is only a 50% chance that any given take would actually involve a female and have an impact on the species' reproduction. However, 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. We do not believe the small number of anticipated takes of Kemp's ridley associated with the proposed action will have a measurable effect on the increasing nesting trends seen over the last several years. Furthermore, we have no reason to believe that the proposed action would disproportionately affect females from one nesting beach over another. Nor do we believe the anticipated takes will cause a change in the number of sexually mature individuals producing viable offspring to an extent that changes in nesting trends will occur. Therefore, we do not believe the proposed action will cause an appreciable reduction in the likelihood of survival.

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 et al. 2011b) lists the following relevant recovery objectives:

- 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. However, in 2013 through 2014, there was a second significant decline, with only 16,385 and 11,279 nests recorded, respectively, followed by 14,006 nests in 2016. If 14,006 nests were observed in 2016, that would equate to approximately 5,602 nesting females (14,006 nests / 2.5 females per nest = 5,602.4 females).

The lethal take of up to 1 Kemp's ridley sea turtle by the proposed action in consecutive 3-year periods will result in a reduction in numbers and those turtles may be female, but the take is unlikely to have any detectable influence on the trends noted above. Thus, we believe the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtles' recovery in the wild.

#### **7.4 Smalltooth Sawfish**

The proposed action is anticipated to result in up to 1 capture and live release of a smalltooth sawfish every 9 year period. Injuries resulting from nonlethal take that could impact the reproductive potential, fitness, or growth of the captured smalltooth sawfish are unlikely occur because they will be released unharmed shortly after capture or released with only minor injuries from which they are expected to recover. Since there is no expected lethal take of smalltooth sawfish, there will be no reduction in smalltooth sawfish numbers, reproduction, and distribution; therefore, the proposed action will not jeopardize the continued existence of the species because it will have no effect on the survival and recovery of smalltooth sawfish.

### **8 CONCLUSION**

---

Using the best available data, we analyzed the effects of the proposed action in the context of the status of the species, the environmental baseline, and cumulative effects, and determined that the proposed action is not likely to jeopardize the continued existence of the NWA DPS of loggerhead, NA and SA DPSs of green, and Kemp's ridley sea turtles, and smalltooth sawfish.

### **9 INCIDENTAL TAKE STATEMENT**

---

Section 9 of the ESA and federal 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 to 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. Section 7(b)(4) and Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, if that action is performed in compliance with the terms and conditions of an incidental take statement.

### 9.1 Anticipated Amount or Extent of Incidental Take

Based on the above information and analyses, NMFS believes that the proposed action will adversely affect green, loggerhead, and Kemp's ridley sea turtles and smalltooth sawfish. These effects will result from capture on hook-and-line and entanglement in fishing line or debris. NMFS anticipates the following incidental takes may occur in the future as a result of the proposed fishing pier. We anticipate sea turtle takes will occur over consecutive 3-calendar-year periods (e.g., 2017-2019; 2018-2020, etc.), while smalltooth sawfish takes will occur over consecutive 9-year periods.

**Table 10. Estimated Captures and PRM by Species**

| Species                  | Nonlethal Estimated Captures | Lethal Estimated Captures (resulting in PRM)                                      |
|--------------------------|------------------------------|---|
| Green sea turtle         | 2 every 3 years              | Up to a total of 1 sea turtle (loggerhead, green, or Kemp's ridley) every 3 years |
| Loggerhead sea turtle    | 2 every 3 years              |   |
| Kemp's ridley sea turtle | 1 every 3 years              |   |
| Smalltooth sawfish       | 1 every 9 years              | None  |

### 9.2 Effect of the Take

NMFS has determined the anticipated incidental take specified in Table 10 is not likely to jeopardize the continued existence of the NA and SA DPS of green, NWA DPS of loggerhead, and Kemp's ridley sea turtles, or smalltooth sawfish.

### 9.3 Reasonable and Prudent Measures (RPMs)

Section 7(b)(4) of the ESA requires NMFS to issue a statement specifying the impact of any incidental take on listed species, which results from an agency action otherwise found to comply with Section 7(a)(2) of the ESA. It also states that NMFS shall identify the RPMs necessary to minimize the impacts of take and the terms and conditions to implement the RPMs. Only incidental taking by the federal agency or applicant that complies with the specified terms and conditions is authorized.

The RPMs and terms and conditions 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 on sea turtles. These measures and terms and conditions are nondiscretionary, and must be implemented by USACE or the applicant in order for the protection of Section 7(o)(2) to apply. USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement (ITS). If USACE or the applicants fail to adhere to the terms and conditions of the ITS through enforceable terms, and/or fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of the

incidental take, USACE or the applicant must report the progress of the action and its impact on the species to NMFS as specified in the ITS [50 CFR 402.14(i)(3)].

NMFS has determined that the following RPMs and associated terms and conditions are necessary and appropriate to minimize impacts of the incidental take of sea turtles and smalltooth sawfish related to the proposed action.

1. The USACE shall include a special permit condition that requires the applicant to monitor and report the impacts of its activities on sea turtles and smalltooth sawfish. Reports shall be forwarded to the USACE and NMFS.
2. The USACE shall include a special permit condition that requires the applicant to reduce the likelihood of injury or mortality resulting from hook-and-line capture or entanglement from fishing line of sea turtles and smalltooth sawfish by activities at the St. Petersburg Pier, by installing educational signage at the pier and by installing monofilament recycling bins. The signage should be placed in the designated fishing area of the St. Petersburg Pier where the view of these signs is unobstructed. These signs should contain information on the possibility of sea turtle captures by hook-and-line and what to do in the event of a capture.
3. The USACE shall include a special permit condition that requires the applicant to reduce the impacts to incidentally captured sea turtles and smalltooth sawfish by ensuring that incidentally captured sea turtles and smalltooth sawfish are appropriately handled and released or injured sea turtles are sent to rehabilitation facilities.

### **3.1 Terms and Conditions**

The following terms and conditions (T&Cs) implement the above RPMs:

1. To implement RPM No. 1, USACE must make it a condition of their permit that the applicant shall report all hook-and-line captures of sea turtles and smalltooth sawfish at the proposed pier to the NMFS's Southeast Regional Office.
  - a. Within 24 hours, the applicant must notify NMFS by email ([takereport.nmfsser@noaa.gov](mailto:takereport.nmfsser@noaa.gov)) that the capture has occurred. Emails must reference this Opinion by the respective identifier number SER-2016-18030 (St. Petersburg Pier) and date of issuance. The email shall also state the type of species captured, date and time of capture, location and activity resulting in capture (i.e., fishing from the pier by hook-and-line), condition of the sea turtle or smalltooth sawfish (i.e., alive, dead, turtle 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. Reports must also be provided on an annual basis. These reports shall be emailed to the applicable lead action agency and to NMFS's Southeast Regional Office ([takereport.nmfsser@noaa.gov](mailto:takereport.nmfsser@noaa.gov)) with the following information: the total number of sea turtle and smalltooth sawfish captures, entanglements, and strandings that

occurred at or adjacent to the pier included in this Opinion. The report must include the same details listed in T&C No. 1 above.

2. To implement RPM No. 2, the applicant shall install NMFS protected species educational signs including the “Save the Sea Turtles, Sawfish, and Dolphins” sign. The applicant stated that informational signs will be displayed on the pier educating the public on safe fishing practices that will reduce or prevent sea turtle and smalltooth sawfish injuries and who to notify in the event a dead, injured, or entangled sea turtle and smalltooth sawfish is located (see Section 2.1). Sign designs and installation methods are provided on our website at:  
[http://sero.nmfs.noaa.gov/protected\\_resources/section\\_7/protected\\_species\\_educational\\_signs/index.html](http://sero.nmfs.noaa.gov/protected_resources/section_7/protected_species_educational_signs/index.html). The applicant shall send a photo of the installed signs to the USACE and to NMFS’s Southeast Regional Office ([takereport.nmfs@noaa.gov](mailto:takereport.nmfs@noaa.gov)) to confirm installation is complete prior to the opening of the new pier.
3. To implement RPM No. 2, the applicant shall install and maintain both monofilament recycling bins and trash receptacles at the piers to reduce the probability of trash and debris entering the water. The applicant has agreed to place monofilament recycling bins at the dedicated fishing area of the pier (see Section 2.1).
4. To implement RPM No. 2, the applicant shall ensure that annual underwater fishing debris cleanup around the subject fishing piers is implemented. The applicant has agreed to coordinate with local organizations to support and encourage annual underwater cleanups at the pier (see Section 2.1). The applicant shall send confirmation of cleanup to the USACE and to NMFS’s Southeast Regional Office ([takereport.nmfs@noaa.gov](mailto:takereport.nmfs@noaa.gov)) including dates of cleanup efforts and results of the clean-up.
5. To implement RPM No. 3, the applicant shall ensure that incidentally captured sea turtles are sent to a rehabilitation facility that holds an appropriate U.S. Fish and Wildlife Native Endangered and Threatened Species Recovery permit. If a sea turtle is captured at the pier, the applicant has agreed that it or its agents or employees will contact the hotline number on the educational signs and follow directions to ensure turtles are properly handled and transported to a rehabilitation center, if necessary. The applicant shall send an annual report to the USACE and to NMFS’s Southeast Regional Office ([takereport.nmfs@noaa.gov](mailto:takereport.nmfs@noaa.gov)) documenting captures and results of capture (e.g., released alive, sent to rehabilitation, died).

## **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 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 conservation recommendations further the conservation of the listed species that will be impacted by the USACE’s proposed action. NMFS strongly recommends that these measures be considered and implemented by:

1. USACE encouraging the Florida sea turtle rehabilitation centers to work with other state sea turtle rehabilitation facilities on the best handling techniques, data collection and reporting, and public outreach.
2. USACE encouraging research to develop deterrents to discourage turtles from using fishing piers as a habitualized food source.
3. Perform pier surveys to determine the percent of captured sea turtles and smalltooth sawfish that are captured and/or reported.

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 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 taking 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 Biological 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. Pages 83-106 in P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.
- Addison, D. S. 1997. Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996. Bahamas Journal of Science 5:34-35.
- Addison, D. S., and B. Morford. 1996. Sea turtle nesting activity on the Cay Sal Bank, Bahamas. Bahamas Journal of Science 3:31-36.
- Aguilar, R., J. Mas, and X. Pastor. 1994. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean. Pages 91-96 in J. I. Richardson, and T. H. Richardson, editors. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.



- Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, *Caretta caretta*, population in the western Mediterranean. Pages 1 *in* 12th Annual Workshop on Sea Turtle Biology and Conservation, Jekyll Island, Georgia.
- Aguirre, A., G. Balazs, T. Spraker, S. K. K. Murakawa, and B. Zimmerman. 2002. Pathology of oropharyngeal fibropapillomatosis in green turtles *Chelonia mydas*. *Journal of Aquatic Animal Health* 14:298-304.
- Aguirre, A. A., G. H. Balazs, B. Zimmerman, and F. D. Galey. 1994. Organic Contaminants and Trace Metals in the Tissues of Green Turtles (*Chelonia mydas*) Afflicted with Fibropapillomas in the Hawaiian Islands. *Marine Pollution Bulletin* 28(2):109-114.
- Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun, and A. L. Harting. 2006. Hawaiian monk seal (*Monachus schauinslandi*): Status and conservation issues. *Atoll Research Bulletin* 543:75-101.
- Arendt, M., J. Byrd, A. Segars, P. Maier, J. Schwenter, D. Burgess, B. Boynton, J. D. Whitaker, L. Ligouri, L. Parker, D. Owens, and G. Blanvillain. 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.
- Baker, J., C. Littnan, and D. Johnston. 2006. Potential effects of sea-level rise on terrestrial habitat and biota of the northwestern Hawaiian Islands. Pages 3 *in* Twentieth Annual Meeting Society for Conservation Biology Conference, San Jose, California.
- Balazs, G. H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago. Pages 117-125 *in* K. A. Bjorndal, editor. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington D.C.
- 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, NOAA-TM-NMFS-SWFC-36.
- Balazs, G. H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. R. S. Shomura, and H. O. Yoshida, editors. *Proceedings of the workshop on the fate and impact of marine debris*. NOAA-NMFS, Honolulu, HI.
- Balazs, G. H., S. G. Pooley, and S. K. Murakawa. 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. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu.
- Bass, A. L., C. J. Lagueux, and B. W. Bowen. 1998. Origin of green turtles, *Chelonia mydas*, at "Sleeping Rocks" off the northeast coast of Nicaragua. *Copeia* 1998(4):1064-1069.

- 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.
- Baughman, J. L. 1943. Notes on Sawfish, *Pristis perotteti* Müller and Henle, not previously reported from the waters of the United States. *Copeia* 1943(1):43-48.
- Bigelow, H. B., and W. C. Schroeder. 1953. Sawfishes, guitarfishes, skates, and rays. J. Tee-Van, C. M. Breder, A. E. Parr, W. C. Schroeder, and L. P. Schultz, editors. *Fishes of the Western North Atlantic, Part Two*. Sears Foundation for Marine Research, New Haven, CT.
- Bjorndal, K. A. 1982. The consequences of herbivory for life history pattern of the Caribbean green turtle, *Chelonia mydas*. Pages 111-116 in *Biology and Conservation of Sea Turtles*. Smithsonian Institution, Washington, D. C.
- Bjorndal, K. A., and A. B. Bolten. 2008. Annual variation in source contributions to a mixed stock: Implications for quantifying connectivity. *Molecular Ecology* 17(9):2185-2193.
- Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the Greater Caribbean. *Ecological Applications* 15(1):304-314.
- Bjorndal, K. A., A. B. Bolten, T. Dellinger, C. Delgado, and H. R. Martins. 2003. Compensatory growth in oceanic loggerhead sea turtles: Response to a stochastic environment. *Ecology* 84(5):1237-1249.
- Bjorndal, K. A., J. A. Wetherall, A. B. Bolten, and J. A. Mortimer. 1999. Twenty-six years of green turtle nesting at Tortuguero, Costa-Rica: An encouraging trend. *Conservation Biology* 13(1):126-134.
- Bolker, B. M., T. Okuyama, K. A. Bjorndal, and A. B. Bolten. 2007. Incorporating multiple mixed stocks in mixed stock analysis: 'many-to-many' analyses. *Molecular Ecology* 16(4):685-695.
- Bolten, A. B., K. A. Bjorndal, and H. R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. Pages 48-55 in G. J. Balazs, and S. G. Pooley, editors. *Research Plan to Assess Marine Turtle Hooking Mortality*, volume Technical Memorandum NMFS-SEFSC-201. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.
- Bolten, A. B., K. A. Bjorndal, H. R. Martins, T. Dellinger, M. J. Biscoito, S. E. Encalada, and B. W. Bowen. 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. *Ecological Applications* 8:1-7.
- Bolten, A. B., and B. E. Witherington. 2003. *Loggerhead sea turtles*. Smithsonian Books, Washington, D.C.

- Bouchard, S., K. Moran, M. Tiwari, D. Wood, A. Bolten, P. Eliazar, and K. Bjorndal. 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., A. B. Meylan, J. P. Ross, C. J. Limpus, G. H. Balazs, and J. C. Avise. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. *Evolution* 46(4):865-881.
- Bresette, M., R. A. Scarpino, D. A. Singewald, and E. P. de Maye. 2006. Recruitment of post-pelagic green turtles (*Chelonia mydas*) to nearshore reefs on Florida's southeast coast. Pages 288 in M. Frick, A. Panagopoulou, A. F. Rees, and K. Williams, editors. Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.
- Broderick, A. C., R. Frauenstein, F. Glen, G. C. Hays, A. L. Jackson, T. Pelembe, G. D. Ruxton, and B. J. Godley. 2006. Are green turtles globally endangered? *Global Ecology and Biogeography* 15(1):21-26.
- Caldwell, D. K., and A. Carr. 1957. Status of the sea turtle fishery in Florida. Pages 457-463 in J. B. Trefethen, editor Twenty-Second North American Wildlife Conference. Wildlife Management Institute, Statler Hotel, Washington, D. C.
- Caldwell, S. 1990. Texas sawfish: Which way did they go? *Tide* Jan.-Feb.:16-19.
- 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., C. Olabarria, and T. G. Osuna. 2002. Analysis of four macroalgal assemblages along the Pacific Mexican coast during and after the 1997-98 El Niño. *Ecosystems* 5(8):749-760.
- Carlson, J. K., and J. Osborne. 2012. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on the Everglades National Park Creel Survey, NOAA Technical Memorandum NMFS-SEFSC-626.
- Carlson, J. K., J. Osborne, and T. W. Schmidt. 2007. Monitoring the recovery of smalltooth sawfish, *Pristis pectinata*, using standardized relative indices of abundance. *Biological Conservation* 136(2):195-202.
- Carr, A. 1986. New perspectives on the pelagic stage of sea turtle development. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center, Panama City Laboratory, Panama City, FL.
- Carr, T., and N. Carr. 1991. Surveys of the sea turtles of Angola. *Biological Conservation* 58(1):19-29.

- Catry, P., C. Barbosa, B. Indjai, A. Almeida, B. J. Godley, and J. C. Vie. 2002. First census of the green turtle at Poilifilo, Bijagos Archipelago, Guinea-Bissau: The most important nesting colony on the Atlantic coast of Africa. *Oryx* 36(4):400-403.
- Catry, P., C. Barbosa, B. Paris, B. Indjai, A. Almeida, B. Limoges, C. Silva, and H. Pereira. 2009. Status, ecology, and conservation of sea turtles in Guinea-Bissau. *Chelonian Conservation and Biology* 8(2):150-160.
- Caurant, F., P. Bustamante, M. Bordes, and P. Miramand. 1999. Bioaccumulation of cadmium, copper and zinc in some tissues of three species of marine turtles stranded along the French Atlantic coasts. *Marine Pollution Bulletin* 38(12):1085-1091.
- 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., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. 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. 1997a. Age growth and population dynamics. Pages 233-276 in P. L. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*. CRC Press, Boca Raton, Florida.
- Chaloupka, M. Y., and J. A. Musick. 1997b. Age, growth, and population dynamics. Pages 233-276 in P. L. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*. CRC Press, Boca Raton.
- Colburn, T., D. Dumanoski, and J. P. Myers. 1996. *Our stolen future*. Dutton/ Penguin Books, New York.
- Collazo, J. A., R. Boulan, and T. L. Tallevast. 1992. Abundance and growth patterns of *Chelonia mydas* in Culebra, Puerto Rico. *Journal of Herpetology* 26(3):293-300.
- Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schreder, J. A. Seminoff, M. L. Snover, C. M. Upite, and B. E. Witherington. 2009a. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009.
- Conant, T. A., P. H. Dutton, T. Eguchi, S. P. Epperly, C. C. Fahy, M. H. Godfrey, S. L. MacPherson, E. E. Possardt, B. A. Schroeder, J. A. Seminoff, M. L. Snover, C. M. Upite, and B. E. Witherington. 2009b. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service.

- Cook, M. C., A. Coleman, D. Shannon, V. Dunch, B. Carmon, J. Klaus, and V. Howard. 2014. Hooked on Kemp's - Preliminary Results of Mississippi's Angler Survey. International Sea Turtle Symposium-2014, New Orleans, LA.
- Corsolini, S., S. Aurigi, and S. Focardi. 2000. Presence of polychlorobiphenyls (PCBs) and coplanar congeners in the tissues of the Mediterranean loggerhead turtle *Caretta caretta*. Marine Pollution Bulletin 40(11):952-960.
- Crouse, D. T., L. B. Crowder, and H. Caswell. 1987. A Stage-Based Population Model for Loggerhead Sea Turtles and Implications for Conservation. Ecology 68(5):1412-1423.
- Crowder, L. B., D. T. Crouse, S. S. Heppell, and T. H. Martin. 1994. Predicting the Impact of Turtle Excluder Devices on Loggerhead Sea Turtle Populations. Ecological Applications 4(3):437-445.
- D'Ilio, S., D. Mattei, M. F. Blasi, A. Alimonti, and S. Bogialli. 2011. The occurrence of chemical elements and POPs in loggerhead turtles (*Caretta caretta*): an overview. Marine Pollution Bulletin 62(8):1606-1615.
- Dahl, T. E., and C. E. Johnson. 1991. Status and trends of wetlands in the conterminous United States, mid-1970s to mid-1980s. U.S. Fish and Wildlife Service, Washington, D.C.
- Daniels, R. C., T. W. White, and K. K. Chapman. 1993. Sea-level rise - destruction of threatened and endangered species habitat in South Carolina. Environmental Management 17(3):373-385.
- Dodd, C. K. 1988. Synopsis of the biological data on the loggerhead sea turtle: *Caretta caretta* (Linnaeus, 1758). U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C.
- Doughty, R. W. 1984. Sea turtles in Texas: A forgotten commerce. Southwestern Historical Quarterly 88:43-70.
- Dow, W., K. Eckert, M. Palmer, and P. Kramer. 2007. An atlas of sea turtle nesting habitat for the wider Caribbean region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy, Beaufort, North Carolina.
- 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., W. E. Redfoot, and D. Bagley. 2007a. Marine turtles of the central region of the Indian River Lagoon system. Florida Scientist 70(4):415-434.

- Ehrhart, L. M., W. E. Redfoot, and D. A. Bagley. 2007b. 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 Center, Florida. Pages 25-30 *in* G. E. Henderson, editor *Proceedings of the Florida and Interregional Conference on Sea Turtles*. Florida Marine Research Publications.
- EPA. 2012. Climate Change. [www.epa.gov/climatechange/index.html](http://www.epa.gov/climatechange/index.html).
- Epperly, S. P., J. Braun-McNeill, and P. M. Richards. 2007. Trends in the catch rates of sea turtles in North Carolina, U.S.A. *Endangered Species Research* 3:283-293.
- Evermann, B. W., and B. A. Bean. 1897. Report on the Fisheries of Indian River, Florida. United States Commission of Fish and Fisheries, Washington D.C.
- Fish, M. R., I. M. Cote, J. A. Gill, A. P. Jones, S. Renshoff, and A. R. Watkinson. 2005. Predicting the Impact of Sea-Level Rise on Caribbean Sea Turtle Nesting Habitat. *Conservation Biology* 19(2):482-491.
- FitzSimmons, N. N., L. W. Farrington, M. J. McCann, C. J. Limpus, and C. Moritz. 2006. Green turtle populations in the Indo-Pacific: A (genetic) view from microsatellites. Pages 111 *in* N. Pilcher, editor *Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation*.
- Foley, A. M., B. A. Schroeder, and S. L. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerhead turtles (*Caretta caretta*). Pages 75-76 *in* H. J. Kalb, A. Rohde, K. Gayheart, and K. Shanker, editors. *Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation*.
- Foley, A. M., B. A. Schroeder, A. E. Redlow, K. J. Fick-Child, and W. G. Teas. 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.
- Foley, A. M., K. E. Singel, P. H. Dutton, T. M. Summers, A. E. Redlow, and J. Lessman. 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.
- Formia, A. 1999. Les tortues marines de la Baie de Corisco. *Canopee* 14: i-ii.
- Frazer, N. B., and L. M. Ehrhart. 1985a. Preliminary growth models for green, (*Chelonia mydas*) and loggerhead, (*Caretta caretta*), turtles in the wild. *Copeia* 1985(1):73-79.
- Frazer, N. B., and L. M. Ehrhart. 1985b. 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.
- Fritts, T. H., and M. A. McGehee. 1982. Effects of Petroleum on the Development and Survival of Marine Turtle Embryos. U.S. Department of the Interior/Minerals Management Service, Gulf of Mexico Outer Continental Shelf Regional Office, Washington, D.C.
- 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, GBAP Publication No. EC/GB/04/79.
- Gavilan, F. M. 2001. Status and distribution of the loggerhead turtle, (*Caretta caretta*), in the wider Caribbean region. Pages 36-40 in K. L. Eckert, and F. A. Abreu Grobois, editors. Marine turtle conservation in the wider Caribbean region: a dialogue for effective regional management, St. Croix, U.S. Virgin Islands.
- Geraci, J. R. 1990. Physiologic and toxic effects on cetaceans. Pages 167-197 in J. R. Geraci, and D. J. S. Aubin, editors. Sea Mammals and Oil: Confronting the Risks. Academic Press, San Diego.
- Gilman, E. L., J. Ellison, N. C. Duke, and C. Field. 2008. Threats to mangroves from climate change and adaptation options: A review. *Aquatic Botany* 89(2):237-250.
- Gilmore, G. R. 1995. Environmental and Biogeographic Factors Influencing Ichthyofaunal Diversity: Indian River Lagoon. *Bulletin of Marine Science* 57(1):153-170.
- Girard, C., A. D. Tucker, and B. Calmettes. 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.
- Glen, F., A. C. Broderick, B. J. Godley, and G. C. Hays. 2006. Thermal control of hatchling emergence patterns in marine turtles. *Journal of Experimental Marine Biology and Ecology* 334(1):31-42.
- Gonzalez Carman, V., K. Alvarez, L. Prosdocimi, M. C. Inchaurreaga, R. Dellacasa, A. Faiella, C. Echenique, R. Gonzalez, J. Andrejuk, H. Mianzan, C. Campagna, and D. Albareda. 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. Department of Fisheries and Oceans Canada, Sidney, B.C.

- 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. Pages 50 in M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.
- Hart, K. M., M. M. Lamont, I. Fujisaki, A. D. Tucker, and R. R. Carthy. 2012. Common coastal foraging areas for loggerheads in the Gulf of Mexico: Opportunities for marine conservation. *Biological Conservation* 145(1):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., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. *Global Change Biology* 13(5):923-932.
- Hays, G. C., S. Åkesson, A. C. Broderick, F. Glen, B. J. Godley, P. Luschi, C. Martin, J. D. Metcalfe, and F. Papi. 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.
- Hays, G. C., A. C. Broderick, F. Glen, B. J. Godley, J. D. R. Houghton, and J. D. Metcalfe. 2002. Water temperature and interesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. *Journal of Thermal Biology* 27(5):429-432.
- Heppell, S., D. Crouse, L. Crowder, S. Epperly, W. Gabriel, T. Henwood, R. Marquez, and N. Thompson. 2005a. A population model to estimate recovery time, population size, and management impacts on Kemp's ridleys. *Chelonian Conservation and Biology* 4(4):767-773.
- Heppell, S. S., D. T. Crouse, L. B. Crowder, S. P. Epperly, W. Gabriel, T. Henwood, R. Márquez, and N. B. Thompson. 2005b. 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., L. B. Crowder, D. T. Crouse, S. P. Epperly, and N. B. Frazer. 2003. Population models for Atlantic loggerheads: past, present, and future. Pages 255-273 in A. B. Bolten, and B. E. Witherington, editors. *Loggerhead Sea Turtles*. Smithsonian Books, Washington.



- Heppell, S. S., L. B. Crowder, and J. Priddy. 1995. Evaluation of a fisheries model for hawksbill sea turtle (*Eretmochelys imbricata*) harvest in Cuba. NOAA Tech. Memor. NMFS-OPR-5.
- Herbst, L. H. 1994. Fibropapillomatosis of marine turtles. *Annual Review of Fish Diseases* 4:389-425.
- Herbst, L. H., E. R. Jacobson, R. Moretti, T. Brown, J. P. Sundberg, and P. A. Klein. 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 kempfi* (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. Pages 447-453 in K. A. Bjorndal, editor. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington, D. C.
- Hill, A. 2013. Rough Draft of Fishing Piers and Protected Species: An Assessment of the Presence and Effectiveness of Conservation Measures in Charlotte and Lee County, Florida. Pages 50 in. University of Miami, Rosenstiel School of Marine and Atmospheric Science.
- 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.
- IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC, Geneva, Switzerland.
- ISED. 2014. *International Sawfish Encounter Database*. F. M. o. N. History, editor, Gainesville, Florida.
- Iwata, H., S. Tanabe, N. Sakai, and R. Tatsukawa. 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., J. L. Mansell, J. P. Sundberg, L. Hajjar, M. E. Reichmann, L. M. Ehrhart, M. Walsh, and F. Murru. 1989. Cutaneous fibropapillomas of green turtles (*Chelonia mydas*). *Journal Comparative Pathology* 101:39-52.

- Jacobson, E. R., S. B. Simpson Jr., and J. P. Sundberg. 1991. Fibropapillomas in green turtles. Pages 99-100 in G. H. Balazs, and S. G. Pooley, editors. Research Plan for Marine Turtle Fibropapilloma, volume NOAA-TM-NMFS-SWFSC-156.
- Johnson, S. A., and L. M. Ehrhart. 1994. Nest-site fidelity of the Florida green turtle. Pages 83 in B. A. Schroeder, and B. E. Witherington, editors. Thirteenth Annual Symposium on Sea Turtle Biology and Conservation.
- Johnson, S. A., and L. M. Ehrhart. 1996. Reproductive ecology of the Florida green turtle: Clutch frequency. *Journal of Herpetology* 30(3):407-410.
- Kubis, S. A., M. Chaloupka, L. M. Ehrhart, and M. Bresette. 2009. Growth rates of juvenile green turtles *Chelonia mydas* from three ecologically distinct foraging habitats along the east central coast of Florida, USA. *Marine Ecology Progress Series* 389:257-269.
- Lagueux, C. J. 2001. Status and distribution of the green turtle, *Chelonia mydas*, in the wider Caribbean region. Pages 32-35 in K. L. Eckert, and F. A. Abreu Grobois, editors. *Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management*, Santo Domingo, Dominican Republic.
- Lahanas, P. N., K. A. Bjorndal, A. B. Bolten, S. E. Encalada, M. M. Miyamoto, R. A. Valverde, and B. W. Bowen. 1998. Genetic composition of a green turtle (*Chelonia mydas*) feeding ground population: Evidence for multiple origins. *Marine Biology* 130(3):345-352.
- Laurent, L., P. Casale, M. N. Bradai, B. J. Godley, G. Gerosa, A. C. Broderick, W. Schroth, B. Schierwater, A. M. Levy, and D. Freggi. 1998. Molecular resolution of marine turtle stock composition in fishery bycatch: a case study in the Mediterranean. *Molecular Ecology* 7:1529-1542.
- Law, R. J., C.F. Fileman, A.D. Hopkins, J.R. Baker, J. Harwood, D.B. Jackson, S. Kennedy, A.R. Martin, and R. J. Morris. 1991a. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. *Marine Pollution Bulletin* 22:183-191.
- Law, R. J., C. F. Fileman, A. D. Hopkins, J. R. Baker, J. Harwood, D. B. Jackson, S. Kennedy, A. R. Martin, and R. J. Morris. 1991b. 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., M. T. D. Melo, and P. C. R. Barata. 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., G. O. Longo, and E. L. A. Monteiro-Filho. 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.

- López-Mendilaharsu, M., A. Estrades, M. A. C. Caraccio, V., M. Hernández, and V. Quirici. 2006. Biología, ecología y etología de las tortugas marinas en la zona costera uruguay, Montevideo, Uruguay: Vida Silvestre, Uruguay.
- Lutcavage, M., P. Plotkin, B. Witherington, and P. Lutz. 1997a. Human impacts on sea turtle survival. Pages 387–409 in P. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*, volume 1. CRC Press, Boca Raton, Florida.
- Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. 1997b. Human impacts on sea turtle survival. Pages 432 in P. L. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*. CRC Press.
- Marcovaldi, N., B. B. Gifforni, H. Becker, F. N. Fiedler, and G. Sales. 2009. Sea Turtle Interactions in Coastal Net Fisheries in Brazil. U.S. National Marine Fisheries Service, Southeast Fisheries Science Center: Honolulu, Gland, Switze, Honolulu, Hawaii, USA.
- Márquez M, R. 1990. Sea turtles of the world: an annotated and illustrated catalogue of sea turtle species known to date. Food and Agriculture Organization of the United Nations, Rome.
- 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*). *Exxon Valdez Oil Spill Trustee Council*, Anchorage, Alaska.
- McKenzie, C., B. J. Godley, R. W. Furness, and D. E. Wells. 1999. Concentrations and patterns of organochlorine contaminants in marine turtles from Mediterranean and Atlantic waters. *Marine Environmental Research* 47:117-135.
- McMichael, E., R. R. Carthy, and J. A. Seminoff. 2003. Evidence of homing behavior in juvenile green turtles in the northeastern Gulf of Mexico. Pages 223-224 in J. A. Seminoff, editor *Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation*.
- Meehl, G. A., T. F. Stocker, W. D. Collins, P. Friedlingstein, A. T. Gaye, J. M. Gregory, A. Kitoh, R. Knutti, J. M. Murphy, A. Noda, S. C. B. Raper, I. G. Watterson, A. J. Weaver, and Z.-C. Zhao. 2007. Global climate projections. Pages 747-846 in S. Solomon, D. Qin, M. Manning, M. Marquis, K. Averyt, M. M. B. Tignor, J. Henry LeRoy Miller, and Z. Chen, editors. *Climate Change 2007: The Physical Science Basis*. Cambridge University Press, Cambridge, UK and New York, NY.
- Meylan, A., B. Schroeder, and A. Mosier. 1994. Marine turtle nesting activity in the State of Florida, 1979-1992. Pages 83 in K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, editors. *Fourteenth Annual Symposium on Sea Turtle Biology and Conservation*.
- Meylan, A. B., B. A. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the State of Florida 1979-1992. *Florida Department of Environmental Protection* (52):63.

- Meylan, A. B., B. E. Witherington, B. Brost, R. Rivero, and P. S. Kubilis. 2006. Sea turtle nesting in Florida, USA: Assessments of abundance and trends for regionally significant populations of *Caretta*, *Chelonia*, and **Dermochelys**. Pages 306-307 in M. Frick, A. Panagopoulou, A. F. Rees, and K. Williams, editors. Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.
- Meylan, P. A., A. B. Meylan, and J. A. Gray. 2011. The ecology and migrations of sea turtles 8. Tests of the developmental habitat hypothesis. *Bulletin of the American Museum of Natural History* 357:1-70.
- Milton, S. L., and P. L. Lutz. 2003. Physiological and genetic responses to environmental stress. Pages 163-197 in P. L. Lutz, J. A. Musick, and J. Wyneken, editors. *The Biology of Sea Turtles*, volume II. CRC Press, Boca Raton, Florida.
- Mo, C. L. 1988. Effect of bacterial and fungal infection on hatching success of Olive Ridley sea turtle eggs. *World Wildlife Fund-U.S.*
- Moncada, F., F. A. Abreu-Grobois, D. Bagley, K. A. Bjorndal, A. B. Bolten, J. A. Caminas, L. M. Ehrhart, A. Muhlia-Melo, G. Nodarse, B. A. Schroeder, J. Zurita, and L. A. Hawkes. 2010. Movement patterns of loggerhead turtles *Caretta caretta* in Cuban waters inferred from flipper tag recaptures. *Endangered Species Research* 11(1):61-68.
- Moncada, F., F. A. Abreu-Grobois, A. Muhlia-Melo, C. Bell, S. Tröeng, K. A. Bjorndal, A. B. Bolten, A. B. Meylan, J. Zurita, G. Espinosa, G. Nodarse, R. Márquez-Millán, A. Foley, and L. Ehrhart. 2006. Movement patterns of green turtles (*Chelonia mydas*) in Cuba and adjacent Caribbean waters inferred from flipper tag recaptures. *Journal of Herpetology* 40(1):22-34.
- Monzón-Argüello, C., L. F. López-Jurado, C. Rico, A. Marco, P. López, G. C. Hays, and P. L. M. Lee. 2010. Evidence from genetic and Lagrangian drifter data for transatlantic transport of small juvenile green turtles. *Journal of Biogeography* 37(9):1752-1766.
- Mortimer, J. A., and A. Carr. 1987. Reproduction and migrations of the Ascension Island green turtle (*Chelonia mydas*). *Copeia* 1987(1):103-113.
- Murphy, T. M., and S. R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. NMFS-SEFSC.
- Musick, J. A. 1999. Life in the Slow Lane: Ecology and Conservation of Long-Lived Marine Animals. Pages 1-10 in *Symposium Conservation of Long-Lived Marine Animals*. American Fisheries Society, Monterey, California, USA
- Musick, J. A., and C. J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pages 137-163 in P. L. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*. CRC Press, New York, New York.

- Naro-Maciel, E., J. H. Becker, E. H. S. M. Lima, M. A. Marcovaldi, and R. DeSalle. 2007. Testing dispersal hypotheses in foraging green sea turtles (*Chelonia mydas*) of Brazil. *Journal of Heredity* 98(1):29-39.
- Naro-Maciel, E., A. C. Bondioli, M. Martin, A. de Padua Almeida, C. Baptistotte, C. Bellini, M. A. Marcovaldi, A. J. Santos, and G. Amato. 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, Reference Document 11-03.
- NMFS-SEFSC. 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. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL.
- NMFS-SEFSC. 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS 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. Submitted on May 15, 1997.
- NMFS. 2000. Smalltooth Sawfish Status Review. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Saint Petersburg, FL.
- 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.
- NMFS. 2009. Smalltooth Sawfish Recovery Plan, Silver Spring, MD.
- NMFS. 2010. Smalltooth Sawfish 5-Year Review: Summary and Evaluation. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Protected Resources Division, St. Petersburg, FL.
- NMFS, and SEFSC. 2012. Protocols for Categorizing Sea Turtles for Post-release Mortality Estimates. August 2001, revised February 2012. PRD Contribution: #PRD-2011-07.
- NMFS, and USFWS. 1991. Recovery plan for U.S. population of the Atlantic green turtle (*Chelonia mydas*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Washington, D. C.

- NMFS, and USFWS. 1992. Recovery plan for leatherback turtles *Dermochelys coriacea* in the U. S. Caribbean, Atlantic and Gulf of Mexico. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 1993. Recovery plan for the hawksbill turtle *Eretmochelys imbricata* in the U.S. Caribbean, Atlantic and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, St. Petersburg, Florida.
- NMFS, and USFWS. 2007a. Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2007c. Loggerhead sea turtle (*Caretta caretta*) 5-year review: Summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2008a. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*), Second Revision National Marine Fisheries Service, Silver Spring, MD.
- NMFS, and USFWS. 2008b. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.
- NMFS, USFWS, and SEMARNAT. 2011a. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. Pages 156 in. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS, USFWS, and SEMARNAT. 2011b. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, Silver Spring, Maryland.
- NOAA. 2012. Understanding Climate. <http://www.climate.gov/#understandingClimate>.
- Norman, J. R., and F. C. Fraser. 1937. Giant fishes, whales and dolphins. Putman and Company, Limited, London.
- NRC. 1990a. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, 030904247X, Washington, D.C.
- NRC. 1990b. Decline of the sea turtles: Causes and prevention. National Research Council, Washington, D. C.

- Ogren, L. H. 1989a. Distribution of juvenile and subadult Kemp's ridley sea turtles: Preliminary results from 1984-1987 surveys. Pages 116-123 in C. W. Caillouet Jr., and A. M. Landry Jr., editors. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. Texas A&M University, Sea Grant College, Galveston, Texas.
- Ogren, L. H. 1989b. Status report of the green turtle. Pages 89-94 in L. Ogren, F. Berry, K. A. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham, editors. Second Western Atlantic Turtle Symposium.
- Orlando, S. P., Jr., P. H. Wendt, C. J. Klein, M. E. Patillo, K. C. Dennis, and H. G. Ward. 1994. Salinity Characteristics of South Atlantic Estuaries. NOAA, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.
- Patricio, A. R., X. Velez-Zuazo, C. E. Diez, R. Van Dam, and A. M. Sabat. 2011. Survival probability of immature green turtles in two foraging grounds at Culebra, Puerto Rico. Marine Ecology Progress Series 440:217-227.
- Pfeffer, W. T., J. T. Harper, and S. O'Neel. 2008. Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise. Science 321(5894):1340-1343.
- Pike, D. A., R. L. Antworth, and J. C. Stiner. 2006. Earlier Nesting Contributes to Shorter Nesting Seasons for the Loggerhead Seaturtle, *Caretta caretta*. Journal of Herpetology 40(1):91-94.
- Poulakis, G. R. 2012. Distribution, Habitat Use, and Movements of Juvenile Smalltooth Sawfish, *Pristis pectinata*, in the Charlotte Harbor Estuarine System, Florida. Florida Institute of Technology, Melbourne, FL.
- Poulakis, G. R., and J. C. Seitz. 2004. Recent occurrence of the smalltooth sawfish, *Pristis pectinata* (Elasmobranchiomorpha: Pristidae), in Florida Bay and the Florida Keys, with comments on sawfish ecology. Florida Scientist 67(27):27-35.
- Poulakis, G. R., P. W. Stevens, A. A. Timmers, T. R. Wiley, and C. A. Simpfendorfer. 2011. Abiotic affinities and spatiotemporal distribution of the endangered smalltooth sawfish, *Pristis pectinata*, in a south-western Florida nursery. Marine and Freshwater Research 62(10):1165-1177.
- Pritchard, P. C. H. 1969. The survival status of ridley sea-turtles in America. Biological Conservation 2(1):13-17.
- Prosdocimi, L., V. González Carman, D. A. Albareda, and M. I. Remis. 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.
- Rebel, T. P. 1974. Sea Turtles and the Turtle Industry of the West Indies, Florida and the Gulf of Mexico. University of Miami Press, Coral Gables, Florida.

- Reddering, J. S. V. 1988. Prediction of the effects of reduced river discharge on estuaries of the south-eastern Cape Province, South Africa. *South African Journal of Science* 84:726-730.
- Richards, P. M., S. P. Epperly, S. S. Heppell, R. T. King, C. R. Sasso, F. Moncada, G. Nodarse, D. J. Shaver, Y. Medina, and J. Zurita. 2011. Sea turtle population estimates incorporating uncertainty: a new approach applied to western North Atlantic loggerheads *Caretta caretta*. *Endangered Species Research* 15(2):151-158.
- 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., T. A. Conant, and B. A. Schroeder. 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.
- SAFMC. 1998. Final Plan for the South Atlantic Region: Essential Fish Habitat Requirements for the Fishery Management Plan of the South Atlantic Fishery Management Council. South Atlantic Fishery Management Council, Charleston, SC.
- Schmid, J. R., and J. A. Barichivich. 2006. *Lepidochelys kempii*—Kemp’s ridley. Pages 128-141 in P. A. Meylan, editor. *Biology and conservation of Florida turtles*. Chelonian Research Monographs, volume 3.
- 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. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.
- Schroeder, B. A., and A. M. Foley. 1995. Population studies of marine turtles in Florida Bay. J. I. Richardson, and T. H. Richardson, editors. *Twelfth Annual Workshop on Sea Turtle Biology and Conservation*.
- Schulz, J. P. 1982. Status of sea turtle populations nesting in Surinam with notes on sea turtles nesting in Guyana and French Guiana. Pages 435-438 in K. A. Bjorndal, editor. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington, D. C.
- SEFSC. 2009. STSSN - Sea Turtle Stranding Narrative Report. Pages Sea turtle stranding database in. Southeast Fisheries Science Center, Miami.
- Seitz, J. C., and G. R. Poulakis. 2002. Recent Occurrence of Sawfishes (*Elasmobranchiomorphi: Pristidae*) Along the Southwest Coast of Florida (USA) *Florida Scientist* 65(4):11.
- Seminoff, J. A., C. D. Allen, G. H. Balazs, P. H. Dutton, T. Eguchi, H. L. Haas, S. A. Hargrove, M. P. Jensen, D. L. Klemm, A. M. Lauritsen, S. L. MacPherson, P. Opay, E. E. Possardt, S. L. Pultz, E. E. Seney, K. S. Van Houtan, and R. S. Waples. 2015. Status review of the green turtle (*Chelonia Mydas*) under the endangered species act. NOAA Technical Memorandum, NMFS-SWFSC-539.



- 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.
- Shaver, D. J. 2002. Green sea turtles (*Chelonia mydas*) in a south Texas (USA) developmental habitat. Pages 9 in A. Mosier, A. Foley, and B. Brost, editors. Twentieth Annual Symposium on Sea Turtle Biology and Conservation.
- Simpfendorfer, C. A. 2000. Predicting Population Recovery Rates for Endangered Western Atlantic Sawfishes Using Demographic Analysis. *Environmental Biology of Fishes* 58(4):371-377.
- Simpfendorfer, C. A. 2001. Essential habitat of the smalltooth sawfish (*Pristis pectinata*). Report to the National Fisheries Service's Protected Resources Division. Mote Marine Laboratory Technical Report.
- Simpfendorfer, C. A. 2002. Smalltooth sawfish: The USA's first endangered *elasmobranch*. *Endangered Species Update* (19):53-57.
- Simpfendorfer, C. A. 2003. Abundance, movement and habitat use of the smalltooth sawfish. Final Report. Mote Marine Laboratory Mote Technical Report No. 929, Sarasota, FL.
- Simpfendorfer, C. A. 2006. Movement and habitat use of smalltooth sawfish. Final Report. Mote Marine Laboratory, Mote Marine Laboratory Technical Report 1070, Sarasota, FL.
- Simpfendorfer, C. A., G. R. Poulakis, P. M. O'Donnell, and T. R. Wiley. 2008. Growth rates of juvenile smalltooth sawfish, *Pristis pectinata* (Latham), in the western Atlantic. *Journal of Fish Biology* 72(3):711-723.
- Simpfendorfer, C. A., and T. R. Wiley. 2004. Determination of the distribution of Florida's remnant sawfish population, and identification of areas critical to their conservation. Mote Marine Laboratory Technical Report. Mote Marine Laboratory, Sarasota, FL.
- Simpfendorfer, C. A., and T. R. Wiley. 2005. Determination of the distribution of Florida's remnant sawfish population and identification of areas critical to their conservation. Final Report. Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Simpfendorfer, C. A., T. R. Wiley, and B. G. Yeiser. 2010. Improving conservation planning for an endangered sawfish using data from acoustic telemetry. *Biological Conservation* 143:1460-1469.
- Simpfendorfer, C. A., B. G. Yeiser, T. R. Wiley, G. R. Poulakis, P. W. Stevens, and M. R. Heupel. 2011. Environmental Influences on the Spatial Ecology of Juvenile Smalltooth Sawfish (*Pristis pectinata*): Results from Acoustic Monitoring. *PLoS ONE* 6(2):e16918.
- Snelson, F. F., and S. E. Williams. 1981. Notes on the occurrence, distribution, and biology of elasmobranch fishes in the Indian River Lagoon System, Florida. *Estuaries* 4(2):110-120.

- Snover, M. L. 2002. Growth and ontogeny of sea turtles using skeletochronology: Methods, validation and application to conservation. Duke University.
- Stedman, S., and T. E. Dahl. 2008. Status and trends of wetlands in the coastal watersheds of the Eastern United States 1998-2004. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, and U.S. Department of the Interior, U.S. Fish and Wildlife Service.
- Storelli, M. M., G. Barone, A. Storelli, and G. O. Marcotrigiano. 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* 70:908-913.
- TEWG. 1998a. 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.
- TEWG. 1998b. 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.
- TEWG. 2000a. 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.
- TEWG. 2000b. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic: a report of the Turtle Expert Working Group. U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL.
- TEWG. 2009. An Assessment of the Loggerhead Turtle Population in the Western North Atlantic Ocean. NOAA.
- Thompson, N. 1991. Preliminary Information on Turtle Captures Incidental to Fishing in Southeastern U.S. Waters. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, NOAA Technical Memorandum NMFS-SEFSC-285, Miami, FL.
- Thorson, T. B. 1976. Observations on the reproduction of the sawfish *Pristis perotteti*, in Lake Nicaragua, with recommendations for its conservation. T. B. Thorson, editor. Investigations of the Ichthyofauna of Nicaraguan Lakes. Univ. Nebraska, Lincoln, NB.
- Thorson, T. B. 1982. Life history implications of a tagging study of the largetooth sawfish, *Pristis perotteti*, in the Lake Nicaragua-Río San Juan system. *Environmental Biology of Fishes* 7(3):207-228.
- Troëng, S. 1998. Poaching threatens the green turtle rookery at Tortuguero, Costa Rica. *Marine Turtle Newsletter* 80(11-12).

- Troeng, S., D. R. Evans, E. Harrison, and C. J. Lagueux. 2005. Migration of green turtles *Chelonia mydas* from Tortuguero, Costa Rica. *Marine Biology* 148(2):435-447.
- 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 Consultation Handbook. Procedures for Conducting Section 7 Consultations and Conferences. U.S. Fish and Wildlife Service and National Marine Fisheries Service, March 1998.
- Vermeer, M., and S. Rahmstorf. 2009. Global sea level linked to global temperature. *Proceedings of the National Academy of Sciences* 106(51):21527-21532.
- Watson, J. W., S. P. Epperly, A. K. Shah, and D. G. Foster. 2005. Fishing methods to reduce sea turtle mortality associated with pelagic longlines. *Canadian Journal of Fisheries and Aquatic Sciences* 62(5):965-981.
- Weijerman, M. L., H. G. V. Tienen, A. D. Schouten, and W. E. J. Hoekert. 1998. Sea turtles of Galibi, Suriname. Pages 142-144 in R. Byles, and Y. Fernandez, editors. Sixteenth Annual Symposium on Sea Turtle Biology and Conservation.
- Weishampel, J. F., D. A. Bagley, and L. M. Ehrhart. 2004. Earlier nesting by loggerhead sea turtles following sea surface warming. *Global Change Biology* 10:1424-1427.
- Weishampel, J. F., D. A. Bagley, L. M. Ehrhart, and B. L. Rodenbeck. 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. Pages 121-123 in M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation.
- White, F. N. 1994. Swallowing dynamics of sea turtles. Pages 89-95 in G. H. Balazs, and S. G. Pooley, editors. Research Plan to Assess Marine Turtle Hooking Mortality. National Oceanic and Atmospheric Administration, Honolulu, Hawaii.
- Whitfield, A. K., and M. N. Bruton. 1989. Some biological implications of reduced freshwater inflow into eastern Cape estuaries: a preliminary assessment. *South African Journal of Science* 85:691-694.
- Wiley, T. R., and C. A. Simpfendorfer. 2007. The ecology of elasmobranchs occurring in the Everglades National Park, Florida: implications for conservation and management. *Bulletin of Marine Science* 80(1):171-189.

- Wiley, T. R., and C. A. Simpfendorfer. 2010. Using public encounter data to direct recovery efforts for the endangered smalltooth sawfish, *Pristis pectinata*. *Endangered Species Research* 12:179-191.
- Witherington, B., M. Bresette, and R. Herren. 2006. *Chelonia mydas* - Green turtle. *Chelonian Research Monographs* 3:90-104.
- Witherington, B., S. Hirama, and A. Moiser. 2003. Effects of beach armoring structures on marine turtle nesting. U.S. Fish and Wildlife Service.
- Witherington, B., S. Hirama, and A. Moiser. 2007. Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches. U.S. Fish and Wildlife Service.
- Witherington, B. E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. *Herpetologica* 48(1):31-39.
- Witherington, B. E. 1999. Reducing threats to nesting habitat. Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois, and M. Donnelly (editors). *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group Publication 4:179-183.
- 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. 1989a. 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. 1989b. Status, and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Pages 351-352 in L. Ogren, F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham, editors. *Second Western Atlantic Turtle Symposium*. .
- 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.
- 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.

- Zurita, J. C., R. Herrera, A. Arenas, M. E. Torres, C. Calderón, L. Gómez, J. C. Alvarado, and R. Villavicencia. 2003a. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pages 25-127 *in* J. A. Seminoff, editor Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation, Miami, Florida.
- Zurita, J. C., R. Herrera, A. Arenas, M. E. Torres, C. Calderon, L. Gomez, J. C. Alvarado, and R. Villavicencio. 2003b. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pages 125-126 *in* Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation, Miami, FL.
- Zurita, J. C., B. Prezas, R. Herrera, and J. L. Miranda. 1994. Sea turtle tagging program in Quintana Roo, Mexico. Pages 300-303 *in* K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, editors. Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.
- 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.

# Save Sea Turtles and Dolphins

## While Fishing, Following These Tips:

- Report injured, entangled, hooked, or stranded dolphins and sea turtles to the 24-hour hotline:

**1-877-942-5343**

Download the  
Dolphin & Whale 911 app  
on your iPhone or Android  
for reporting  
marine mammals.

- Never cast towards dolphins or sea turtles.
- Change location or reel in your line if a dolphin or sea turtle shows interest in your bait or catch.
- Release catch away from dolphins when and where possible without violating any state or federal fishing regulations.
- Do not feed or attempt to feed wild dolphins or sea turtles - it's harmful and illegal.
- Do not dispose of leftover bait or cleaned fish remains in water.
- Use circle or corrodible (non-stainless steel) hooks to reduce injury.
- Use recycling bins for fishing line and do not throw trash or unwanted line in the water.
- If you hook a **SEA TURTLE**, immediately call the 24-hour hotline at **1-877-942-5343** and follow response team instructions.

If you cannot reach a response team, follow these guidelines to reduce injuries:

- 1) If possible, use a net or lift by the shell to bring the turtle on pier or land. Do NOT lift by hook or line.
- 2) Cut the line close to the hook, removing as much line as possible.
- 3) Release turtle.

