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

04/09/2025

F/SER31:SG
SERO-2024-02130

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Ref.: SWG-2023-00231, Fish and Wildlife Service, Dune Restoration and Beach Nourishment, Texas Point National Wildlife Refuge, Jefferson County, Texas

Dear Tim Cooper,

The enclosed Biological Opinion responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.) for the above referenced action. The Opinion has been given the NMFS tracking number SERO-2024-02130. Please use the NMFS tracking number in all future correspondence related to this action.

The Opinion considers the effects of the U.S. Fish and Wildlife Service's (USFWS) proposal to carry out (as the lead consulting Federal agency), the Bureau of Ocean Energy Management's (BOEM) proposal to authorize, and the U.S. Army Corps of Engineers' (USACE) proposal to permit the use of offshore borrow sites for dredging, and the placement of sand fill for the purpose of beach nourishment and shoreline stabilization at Texas Point National Wildlife Refuge (NWR) in Jefferson County, Texas, on the following listed species and critical habitat: green (North Atlantic DPS), Kemp's ridley, hawksbill, leatherback, and loggerhead (Northwest Atlantic DPS) sea turtles, giant manta ray, oceanic whitetip shark, sperm whale, designated critical habitat for loggerhead sea turtle (Unit LOGG-S-02), and proposed critical habitat for green sea turtle (Unit NA01: Sargassum). The Opinion is based on information provided by the USFWS, USACE, and the published literature cited within. NMFS concludes that the proposed action will have no effect on oceanic whitetip shark and sperm whale. NMFS concludes that the proposed action is not likely to adversely affect hawksbill, leatherback sea turtles, designated critical habitat for loggerhead sea turtle (Unit LOGG-S-02) or proposed critical habitat for green sea turtle (Unit NA01: Sargassum). NMFS concludes that the proposed action is likely to adversely affect, but is not likely to jeopardize the continued existence of, green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray.

NMFS is providing an Incidental Take Statement with this Opinion. The Incidental Take Statement describes Reasonable and Prudent Measures that NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The Incidental Take Statement also specifies Terms and Conditions, including monitoring and reporting requirements with which the USFWS must comply, to carry out the Reasonable and Prudent Measures.

USFWS is voluntarily conferring with NMFS under ESA section 7(a)(4) on effects of the proposed action to critical habitat proposed for green sea turtle (Unit NA01: Sargassum). The conference is being conducted following the procedures for formal consultation. This conference opinion may be adopted as the biological opinion when this critical habitat is designated, but only if no significant new information is developed (including that developed during the rulemaking process on the proposed critical habitat designation) and no significant changes to the Federal action are made that would alter the content of the opinion.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and critical habitat. If you have any questions regarding this consultation, please contact Sarah Garvin, Consultation Biologist, by phone at (727) 342-0249, or by email at Sarah.Garvin@noaa.gov.

Sincerely,

AMENDOLA.KIMBERLY.BARBARA.1365830769
Digitally signed by AMENDOLA.KIMBERLY.BARBARA.1365830769
Date: 2025.04.09 12:48:59 -04'00'

for Andrew J. Strelcheck
Regional Administrator

Enclosure:
NMFS Biological Opinion SERO-2024-02130
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nmfs.ser.esa.consultations@noaa.gov
File: 1514-22.i

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	U.S. Fish and Wildlife Service (Lead Consulting Agency) Bureau of Ocean Energy Management U.S. Army Corps of Engineers Permit number: SWG-2023-00231
Activity:	Sand Mining and Beach Nourishment
Location:	Jefferson County, Texas
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida NMFS Tracking Number: SERO-2024-02130

Approved by:

AMENDOLA.KIMBERLY.BARBARA.1365830769 Digitally signed by AMENDOLA.KIMBERLY.BARBARA.1365830769 Date: 2025.04.09 12:49:29 -04'00'

for Andrew J. Strelcheck, Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

Date Issued: 04/09/2025

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

ac	acre(s)
BOEM	Bureau of Ocean Energy Management
°C	degrees Celsius
CCL	curved carapace length
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
cm	centimeter(s)
CONAMP	National Commission of Natural Protected Areas
CPUE	catch per unit effort
cy	cubic yard(s)
DDT	Dichlorodiphenyltrichloroethane
DPS	Distinct Population Segment
DTRU	Dry Tortugas Recovery Unit
DW	disc width
DWH	Deepwater Horizon
ECO	Environmental Consultation Organizer
EFH	Essential Fish Habitat
EFP	Exempted Fishing Permit
ESA	Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.)
°F	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
FGBNMS	Flower Garden Banks National Marine Sanctuary
FMP	Fishery Management Plan
FP	Fibropapillomatosis
FR	Federal Register
ft	foot/feet
ft^2	square foot/feet
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit
GRBO	*Biological Opinion on Dredging of Gulf of Mexico Navigation Channels and Sand Mining ("Borrow") Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts*; NMFS Tracking Number SER-2000-01287, issued November 19, 2003 and revised June 24, 2005, January 9, 2007, and March 3, 2016
the Gulf	Gulf of America
in	inch(es)
IPCC	Intergovernmental Panel on Climate Change
kg	kilograms(s)
km	kilometer(s)
kt	knot(s)
lb	pound(s)
lin ft	linear foot/feet

LNG	liquid natural gas
m	meter(s)
mcy	million cubic yards
MEC	Munitions and Explosives of Concern
MHW	Mean High Water
mi	mile(s)
mi^2	square mile(s)
MLLW	Mean Lower Low Water
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
MMF	Marine Megafauna Foundation
mph	miles per hour
MSA	Magnuson-Stevens Fishery Conservation and Management Act
N/A	not applicable
NAD 83	North American Datum of 1983
NCWRC	North Carolina Wildlife Resources Commission
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center
NGARU	Northern Gulf of America Recovery Unit
nm	nautical mile(s)
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRU	Northern Recovery Unit
O&M	Operations and Maintenance
ODMDS	Offshore Dredge Material Disposal Site
Opinion	Biological Opinion, Conference Biological Opinion, or Draft Biological Opinion
oz	ounce(s)
PCB	Polychlorinated biphenyls
PDCs	project design criteria
PFB	Perfluorobutane
PFRU	Peninsular Florida Recovery Unit
POPs	persistent organic pollutants
PRDNR	Puerto Rico Department of Natural and Environmental Resources
PSO	Protected Species Observer
SARBO	*South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States (2020 SARBO);* NMFS Tracking Number SERO-2019-03111, issued March 27, 2020 and revised July 30, 2020
SAV	Submerged Aquatic Vegetation
SCDNR	South Carolina Department of Natural Resources
SCL	straight carapace length
SEFSC	Southeast Fisheries Science Center
SERO PRD	NMFS Southeast Regional Office, Protected Resources Division
SSRIT	Smalltooth Sawfish Recovery Implementation Team
STSSN	Sea Turtle Stranding and Salvage Network
TED	turtle excluder device
TEWG	Turtle Expert Working Group

U.S.	United States of America
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USN	United States Navy
UXO	Unexploded Ordnances

1 INTRODUCTION

1.1 Overview

Section 7(a)(2) of the ESA, requires that each federal agency ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary in carrying out these responsibilities. The NMFS and the USFWS share responsibilities for administering the ESA. Consultations on most ESA-listed marine species and their critical habitat are conducted between the federal action agency and NMFS (hereafter, may also be referred to as we, us, or our).

Consultation is required when a federal action agency determines that a proposed action "may affect" ESA-listed species or critical habitat and can be conducted informally or formally. Informal consultation is concluded after NMFS issues a Letter of Concurrence that concludes that the action is "not likely to adversely affect" ESA-listed species or critical habitat. Formal consultation is concluded after we issue a Biological Opinion (hereafter, referred to as an/the Opinion) that identifies whether a proposed action is "likely to jeopardize the continued existence of an ESA-listed species" or "destroy or adversely modify critical habitat," in which case Reasonable and Prudent Alternatives to the action as proposed must be identified to avoid these outcomes. An Opinion often states the amount or extent of anticipated incidental take of ESA-listed species that may occur, develops Reasonable and Prudent Measures necessary or appropriate to minimize such impact of incidental take on the species, and lists the Terms and Conditions to implement those measures. An Opinion may also develop Conservation Recommendations that help benefit ESA-listed species.

For species and critical habitat proposed for listing, each federal agency shall confer on any agency action that is likely to jeopardize the continued existence of any species proposed for listing or result in the destruction or adverse modification of proposed critical habitat (ESA section 7(a)(4)). Federal agencies may also request a conference on any proposed action that may affect proposed species or proposed critical habitat. Federal action agencies may request that the conference be conducted following the procedures for formal consultation and, subject to our agreement, the conference may be conducted formally.

A formal conference results in a Conference Biological Opinion in the same format and with the same content as a Biological Opinion. The Conference Biological Opinion may be adopted as the biological opinion when the species is listed or critical habitat is designated, but only if no significant new information is developed (including that developed during the rulemaking process on the proposed listing or critical habitat designation) and no significant changes to the Federal action are made that would alter the content of the opinion. An Incidental Take Statement provided with a conference opinion does not become effective unless we adopt the Opinion once the listing is final (50 CFR 402.10(d)).

This document represents NMFS's Opinion based on our review of potential effects of the USFWS's proposal to carry out (as the lead consulting Federal agency), USACE's proposal to permit, and BOEM's proposal to authorize the use of offshore borrow sites for dredging and placement of sand for beach nourishment in Sabine Pass, Jefferson County, Texas, on the following listed species and critical habitat: green (North Atlantic DPS), hawksbill, Kemp's ridley, leatherback, and loggerhead (Northwest Atlantic DPS) sea turtles, giant manta ray, oceanic whitetip shark, sperm whale, designated critical habitat for loggerhead sea turtle (Unit LOGG-S-02), and proposed critical habitat for green sea turtle (Unit NAO1: Sargassum). Our Opinion is based on information provided by the USFWS, the USACE, and the published literature cited within.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 FR 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act (89 FR 24268; 84 FR 45015). We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this Opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

The Gulf of Mexico was renamed the Gulf of America pursuant to Executive Order 14172, and Secretary of the Interior Order No. 3423. All geographical references to the Gulf of America or "the Gulf" in this Opinion refer to the same body of water formerly known as the Gulf of Mexico.

1.2 Consultation History

The following is the consultation history for the NMFS ECO tracking number SERO-2024-02130, Texas Point NWR Nourishment.

On August 23, 2024, we received a request for formal consultation under section 7 of the ESA from the USFWS's proposal to carry out (as the lead consulting Federal agency), USACE's proposal to permit (SWG-2023-00231), and BOEM's proposal to authorize the use of offshore borrow sites for dredging and placement of sand for beach nourishment in Jefferson County, Texas, in a letter dated August 23, 2024.

On September 25, 2024, we requested additional information related to project details and project design criteria for hopper dredging activities. We received a final response on October 24, 2024, and initiated formal consultation that day.

2 PROPOSED ACTION

2.1 Project Details

2.1.1 Project Description

The USFWS proposes to carry out (as the lead consulting Federal agency), the use of offshore borrow sites for dredging, and the placement of sand fill for the purpose of beach nourishment and shoreline stabilization at Texas Point NWR in Jefferson County, Texas. USACE will serve as the permitting federal agency (SWG-2023-00231), and BOEM will authorize the use of the offshore (federal waters) borrow areas as the sand fill source for the project. The proposed project will require the deposit of 3.2 mcy of sand in a 700-ft-wide swath along a 5.8-mi-long portion of the Texas Point NWR shoreline. The proposed project would result in the creation of a continuous beach and dune system, as well as in the restoration of beach functions. These functions include, but are not limited to, reducing the frequency and extent of sea water inundation to the interior of the Texas Point NWR, providing habitat for a variety of species, including threatened, endangered, and sensitive species, and preserving functions and values of thousands of acres of wetlands inland of the project area.

Temporary Mooring Areas
To facilitate the transport of dredged material, two temporary 1,000-ft-long by 350-ft-wide mooring areas will be constructed, one on each side of the Sabine Pass Channel. These temporary mooring areas will allow for dredges and barges to berth and offload beach fill material to the project site. Additionally, these temporary mooring areas will be designated for direct pump-out operations only. No bottom dumping from the hopper dredges or scow barges will be allowed in these areas. No excavation of the existing bed bottom is proposed at either mooring area, and excavation is not required for the proposed berthing operations at either mooring area.

In order to secure dredges and barges during sand material offloading, a mooring dolphin system consisting of approximately 6 temporary mooring piles, measuring up to a diameter of approximately 12 in, may be installed along the edge of the Eastern Temporary Mooring Area. Piles may be timber, concrete, or metal. The temporary mooring piles will be installed via vibratory or impact hammer, and will be removed once construction of the beach fill template is complete. Removal of temporary mooring piles will occur using direct pull, vibratory extraction, or clamshell bucket extraction. No mooring dolphin system will be installed for the Western Temporary Mooring Area.

Access Corridors and Staging Areas
Staging areas and access corridors will be established for temporary storage of construction equipment and construction access to the beach nourishment template from both the east and west sides of the project site.

The Eastern Access Corridor and Staging Area will be located immediately east of the Sabine Pass Jetties, and will measure 900-ft-long by 400-ft-wide. This area will serve to store construction equipment, to facilitate transit of construction vehicles and crew to and from the project site, to minimize impacts to existing wetlands, and to allow the pipeline from the pump out area to reach the project site.

The Western Staging area will be located next to Sea Rim Estates Road, and will measure 500-ft-long by 250-ft-wide. This area will serve to temporarily store construction equipment on the western end of the project.

The Western Access Corridor, measuring 60-ft-wide by 1.4-mi-long, will facilitate vehicular and construction access from Sea Rim Estates Road to the beach nourishment template.

Sand Mining
Assuming a conservative 1.3:1 cut to fill ratio, a maximum of 4.2 mcy of sand material will be excavated from 2 separate offshore borrow areas in the Gulf of America (hereinafter referred to as "the Gulf"). Offshore Borrow Area 1 and Offshore Borrow Area 2 are located in the Sabine Banks, approximately 20 mi offshore from the proposed project site. Offshore Borrow Area encompasses approximately 462 ac, and Offshore Borrow Area 2 encompasses approximately 470 ac. Either a hopper or hydraulic (cutterhead) dredge will be used to remove beach quality sand from the borrow areas. Material excavated by hopper dredge will be transported to one of the temporary mooring areas via either a hopper dredge or on a hopper barge propelled by a tug. Material excavated by cutterhead dredge will be conveyed via pipeline to scow barges within the borrow area, then transported to one of the temporary mooring areas. A summary of operational considerations for proposed dredging equipment is provided in Table 1, below. The sailing distance from the offshore borrow areas to the temporary mooring areas varies between 17.5 mi and 19 mi.

Table 1. Dredging Operational Considerations.

	Hydraulic Cutterhead with Scow Barges	**Hopper Dredge**
Anchoring & Spudding System	In the borrow areas, cutterhead dredges have 3-point anchoring systems, and scow barges would have 4 anchors. The unloading barge in the pump out area would have 4 anchors.	A hopper dredge would have a 3-point anchor.
Wave Height Operational Restrictions	Approximate 4-ft wave height limit	Approximate 6-ft wave height limit
Approximate Speed During Excavation Operations	Approximately 0.4-0.6 kt	Approximately 1.8-2.0 kt
Anticipated Number of Vessels Onsite	Anticipated equipment at the borrow site include a support tug, surveying boat, crew boat, and cutterhead dredge. The number of scow barges would vary, but it is estimated that up to 8 scow barges would be accompanied by the tug in transit from the borrow area to the pump out area.	A survey, crew boat(s), or both, would accompany hopper dredge (two max assumed) at the borrow area and pump-out area.
Anticipated Daily Working Time in the Borrow Area	Up to 24 hours per day	Up to 24 hours per day

Sand Placement
Dredge material will be transported from the temporary mooring areas to the 5.8-mi-long by 700-ft-wide placement area along the shoreline of the Texas Point NWR using a temporary hydraulic pipeline and booster pumps.

From the Western Temporary Mooring Area, the pipeline will be floated or submerged to come close to the Sabine Pass Western Jetty. Once in the vicinity of the jetty, the pipeline will be floated up and cross over the jetties to the project shoreline. The contractor may use timber mats or other means to ensure no damage to the existing jetty from pipeline crossing operations.

From the Eastern Temporary Mooring Area, the pipeline may be submerged or trenched into the existing bed bottom, as required, to maintain safe navigation operations in the Sabine Pass Channel. Trenching operations may require dredging up to 10,000 cy of fat clay material from the existing bed bottom of the Sabine Pass Channel so that the top of the pipeline is at least 2 ft below the authorized channel depths (). The Sabine Pass Channel varies in depth between -45 ft and -54 ft NAVD88 in the proposed trench location. The proposed pipeline trench will measure approximately 0.3-mi-long by 150-ft-wide to reach the Sabine Pass Western Jetty. Once the pipeline is in the vicinity of the jetty, the pipeline will be floated up and cross over the jetties to the project shoreline. The contractor may use timber mats or other means to ensure no damage to the existing jetty from pipeline crossing operations. Upon completion of the proposed project, the trenched pipeline will be dismantled, and the trench will be left as is. The trench is expected to silt in over time.

Once material has been placed within the beach fill template, bulldozers, excavators, and other mechanical equipment will be used to work the fill material to the lines and grades of the design beach and dune profile. The dune will be constructed with a target elevation of +8.0 ft NAVD88, with fore and backslopes of 10H:1V and a crest width of 16 ft. The top elevation of the beach fill will be +4.5 ft NAVD88, with a slope of approximately 200H:1V extending a maximum of 400 ft seaward to an elevation of 2.5 ft NAVD88 at which point the slope would transition to 25H:1V (or repose) extending to the end of the beach nourishment template in the Gulf.

Mechanical equipment will access the beach fill template during construction via a 1.4 mi-long by 60-ft-wide western access corridor beginning at Sea Rim Estates Road and a 900-ft long by 400-ft wide eastern access corridor beginning at the eastern Sabine Pass jetties. Timber matting and beach quality sand obtained from Sabine Banks may be placed in the proposed staging areas or access corridors, if necessary, to facilitate equipment and vehicle access, equipment storage, etc. This is most likely to occur in wetland and beach washout areas. Everything placed in these areas, with the exception of beach quality sand, would be removed upon completion of construction. These areas would not be maintained as permanent features post-construction and are expected to re-vegetate naturally. The proposed beach nourishment placement will result in impacts to a total of 466.24 ac of existing habitat, the majority of which are 351.64 ac of existing waters below MHW.

Access Channel
Up to 5,000 cy of material may be excavated from the access channel corridor (located immediately east of the Sabine Pass Jetties) to allow shallow-draft barges and construction vessels to access the proposed project site. Material dredged from the pipeline route or access corridor will be placed along the beach fill template or along the eastern staging area, then covered with beach quality sand excavated from the offshore borrow areas. Excavated material from the access channel corridor will be tested for contaminants prior to placement. Contaminated sediments not suitable for placement within the beach fill template or the eastern staging area will be disposed of at an approved site.

Once construction of the beach nourishment project is complete, all mechanical equipment and hydraulic pipeline and booster pumps will be removed from the project site, and up to 122,000 plants will be installed on the back dune, dune crest, and foredune. Fertilizers and water-retaining gels will not be permitted. Dune planting shall not be performed along portions of the beach where active nesting by birds or sea turtles is occurring. Temporary fencing may be installed to protect planted areas from vehicles, pedestrians, grazing animals, etc. during plant implementation and acceptance. Temporary fencing shall be removed within 15 days of final acceptance of planting.

Construction is expected to be complete within 12 months. Construction is anticipated to occur year round and 24 hours per day.

2.1.2 Mitigation Measures

- The applicant and their designated agents will implement and comply with NMFS SERO's *Protected Species Construction Conditions* (NMFS 2021a).
- The applicant and their designated agents will implement and comply with NMFS SERO's *Vessel Strike Avoidance Measures* (NMFS 2021b).
- Project monitoring will be an ongoing process throughout operations. Construction and engineering representatives will meet periodically to discuss work completed, work to be completed, issues identified, and clarifications or additional directions.
- A designated biological monitor will be onsite throughout the duration of the proposed project activities.
- In the event sea turtle nesting activity occurs in the project area, no activities will occur within 1,000 ft of any identified nest location prior to notifying the appropriate authorities and receiving permission to resume work in that area.
- Dune planting shall not be performed along portions of the beach where active nesting by birds or sea turtles is occurring.
- Fertilizers and water-retaining gels will not be permitted.
- Excavated material from the access channel corridor will be tested for contaminants prior to placement, as required by USACE.
- Vessel crews shall report sightings of any injured or dead protected species immediately to the onsite biological monitor, regardless of whether injury or death was caused by their equipment or vessels.
- Any interaction with a protected species shall be reported immediately to NMFS SERO PRD and the local, authorized stranding or rescue organization.

- All known interactions with ESA-listed species during the proposed action will be reported to the NMFS SERO PRD via the NMFS SERO Endangered Species Take Report Form (https://forms.gle/85fP2da4Ds9jEL829).
- All known interactions with sea turtles during construction will be reported to the Texas Stranding Hotline: (866)-TURTLE-5/(866) 887-8535
- All sightings of giant manta ray will be reported to the NMFS by E-mail at: manta.ray@noaa.gov.
- Any collision with or injury to marine mammals shall be reported immediately to the NMFS Southeast Marine Mammal Standing Hotline: 877-433-8299.
- If the injury or death of a marine mammal was caused by a collision with a project vessel, the responsible parties shall remain available to assist with respective salvage and stranding network as needed. NMFS SERO shall be notified immediately of the strike by email (nmfs.mireport@noaa.gov) using the vessel strike reporting form.

The following mitigation measure shall be implemented during cutterhead dredging operations:

- The cutterhead will not be engaged or turned on when not embedded in the sediment, to the maximum extent possible.

The following mitigation measures shall be implemented during hopper dredging operations:

- All contract personnel involved in operating hopper dredges will receive thorough training on measures of dredge operation that will minimize effects to sea turtle species.

- To prevent impingement or entrainment of sea turtles in the water column, dredging pumps will be disengaged by the operator when the dredgheads are not firmly on the bottom. Pumps will be disengaged when lowering dragheads to the bottom to start dredging, turning, or lifting dragheads off the bottom at the completion of dredging. Hopper dredges may utilize a bypass or other system that would allow pumps to remain engaged, but result in no suction passing through the draghead. This dredge modification (when employed) is commonly referred to as a turtle bypass valve. This precaution is especially important during the cleanup phase of navigation dredging operations to remove remaining high spots or when a shallow veneer of compatible sediment remains within a borrow area; thus limiting overdepth dredging and plowing efficacy of the turtle deflector. In these example circumstances, the draghead may frequently come off the bottom and can suck in turtles/sturgeon resting or foraging in shallow depressions.

- A state-of-the-art solid-faced deflector that is attached to the draghead will be used on all hopper dredges associated with operations at all times.

- During all hopper dredging operations, NMFS-approved PSOs will be on board hopper dredges to monitor the hopper bin, inflow and overflow screening, and dragheads for sea turtles and their remains.

- PSO coverage will provide for 100% monitoring coverage and will comply with NMFS PSO conditions (see Appendix A).

- All ESA-listed species that are observed or encountered while conducting dredging or relocation trawling activities, will be handled and reported as described in Appendix A, NMFS *Safe Handling and Release Guidelines*. These guidelines outline the requirements of vessel crew to report observations and for the PSO to observe for and handle ESA-listed species captured during dredging or relocation trawling.

- Pumping water through the dragheads is not allowed while maneuvering or during travel to or from the disposal or pumpout area. The dredge operator will ensure the draghead is embedded in sediment when pumps are operational, to the maximum extent practicable.

- All waterport or other openings on the hopper dredge are required to be screened to prevent ESA-listed species from entering the dredge.

The following mitigation measures shall be implemented during relocation trawling operations:

- Relocation trawling will be undertaken during hopper dredging operations if any of the following conditions are met.
    - 2 or more sea turtles are taken within a 24-hr period.
    - 4 or more turtles are taken during the project.
    - 75% of any ITS limits stipulated in this Opinion (SERO-2024-02130 TX Point NWR Renourishment) have been met.
    - Handling of sea turtles captured during relocation trawling will be accomplished by NMFS-approved PSOs.

- Trawling specifications listed below and in Appendix A, NMFS *Safe Handling and Release Guidelines*, will be followed.
    - Trawl tow-time duration will not exceed 42 min (doors in - doors out).
    - Trawl speeds will not exceed 3.5 kt for normal operations; however, speeds may be increased to the minimum speed needed to maintain control of the vessel.
    - Lazy lines will be designed according to the design specifications in Appendix B to minimize the risk of entanglement with captured species.

2.2 Action Area

The action area is defined by regulation as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). For the purposes of this federal action, the action area includes the Sabine Banks Offshore Borrow Areas 1 and 2, the Eastern and Western Temporary Mooring Areas, the pipeline corridors, the vessel transit routes, the sand fill placement area in Texas NWR, and the areal extent of turbidity plumes generated during construction in the waters of the Gulf and Sabine Pass, Jefferson County, Texas (see Figure 1). The action area includes lands controlled by the Texas Point NWR, the GLO, BOEM, and private landowners. The proposed project will affect a total of approximately 1.49 ac of wetlands and 420.31 ac of waters below MHW.

The action area is within the boundary of designated critical habitat for loggerhead sea turtle (Northwest Atlantic DPS; Unit LOGG-S-02 Sargassum Habitat), and within the boundary of proposed critical habitat for green sea turtle (North Atlantic DPS; Unit NA01: Sargassum).

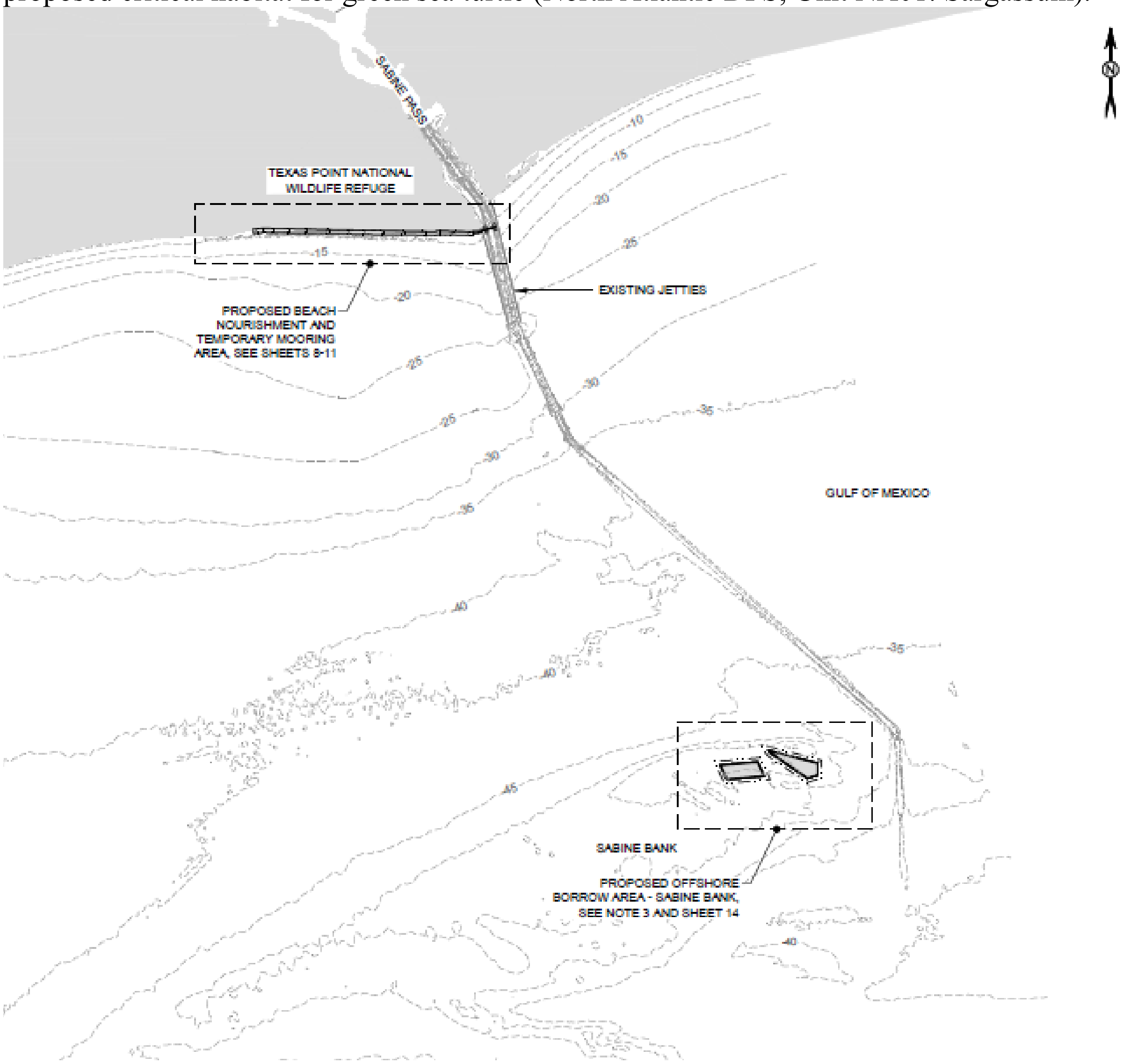


Figure 1. Proposed Action Area in the Gulf, Sabine Pass, Jefferson County, Texas (Image provided by USACE).

Sand Placement Area

The beach area proposed for beach and dune reestablishment is located along approximately 5.8 mi of shoreline within the Texas Point NWR, Sabine Pass, Jefferson County, Texas (latitude: 29.680667, latitude: -93.879775). Texas Point NWR was established in 1979, with limited access to the beach within the refuge. Within the proposed nourishment area, MHW is at 0.69 ft NAVD88, and water depths range between 0 ft and 6 ft. The eastern boundary of Texas Point NWR shoreline begins approximately 1,000 ft south-southwest of Sabine Point Jetty and Sabine Pass. The beach face at the Texas Point NWR consists generally of a fat clay shelf in the intertidal zone with a vertical scarp at approximately the MLLW line with sand and shell hash behind it that gets progressively thicker as you go landward and slopes back until it intersects the adjacent marsh. No SAV were observed during wetland delineation or habitat characterization efforts. In recent history, the beach ridge, separating the Gulf from interior marshes was sufficiently high to prevent seawater inundation from the Gulf, with the exception of storm surge episodes associated with significant tropical storms or hurricanes; however, in the beach's present state, overwash into adjacent marshes occurs on a regular basis in some areas. Unlike that of a more typical sand beach, the upper portions of the eroding clay shore face cannot be regenerated between storms by the action of non-storm waves, and average annual rates of shoreline retreat on most of Texas Point NWR are over 40 ft per year (Paine et. al. 2014).

Temporary Mooring Areas

The proposed project includes the creation of 2 temporary mooring areas, one on each side of the Sabine Pass. Each mooring area will measure 1,000-ft-long by 350-ft-wide. Substrate in these areas consists of fat clay, based on available core logs from the USACE.

The Western Temporary Mooring Area is offset 50 ft channelward from the western channel limit line. Water depths in this area range between 8 ft and 46 ft below mean sea level.

The Eastern Temporary Mooring Area is offset 200 ft landward the eastern channel setback line of the Sabine Pass. Water depths in this area range between 19 ft and 40 ft below mean sea level.

Sabine Bank Offshore Borrow Area 1

Sabine Bank Offshore Borrow Area 1 is a rectangular area with a maximum boundary length of 5,290 ft and a maximum boundary width of 2,360 ft. It is located approximately 17 mi offshore in the Gulf, with water depths ranging between -23 ft and -27 ft NAVD88. The borrow area includes a 500 ft offset on either side of the proposed borrow area for the maximum limits of disturbance. The surface area of the borrow area, including the maximum limits of disturbance offset, is approximately 462 ac. Based on geophysical and geotechnical investigations, the estimated maximum sand thickness is 20 ft, with a maximum disturbance elevation of -42 ft NAVD88. The preliminary estimate of maximum available cut volume for sand is estimated to be a maximum of 5,670,000 cy for Offshore Borrow Area 1. The borrow area maximum limits of disturbance includes a minimum 3,000 ft offset from any active or abandoned pipelines identified adjacent to the borrow area. A geophysical anomaly was detected in the northwest corner of Borrow Area 1 and an offset from the outer boundary of the anomaly was included in the proposed project design.

Sabine Bank Offshore Borrow Area 2

Sabine Bank Offshore Borrow Area 1 is a trapezoidal-shaped area with a maximum boundary length of 7,770 ft and a maximum boundary width of 2,800 ft. It is located approximately 19 mi offshore in the Gulf, with water depths ranging between -24 ft and -29 ft NAVD88. The surface area of the borrow area, including the maximum limits of disturbance offset, is approximately 470 ac. Based on geophysical and geotechnical investigations, the estimated maximum sand thickness is 19 ft, with a maximum disturbance elevation of -41 ft NAVD88. The preliminary estimate of maximum available cut volume for sand is estimated to be maximum 6,150,000 cy for Offshore Borrow Area 2. The borrow area maximum limits of disturbance includes a minimum 1,000 ft offset from any active or abandoned pipelines identified within the borrow area. Material from this borrow area may be used to construct the dune or beach nourishment at the Texas Point NWR shoreline.

3 EFFECTS DETERMINATIONS

Please note the following abbreviations are only used in Table 2 and Table 3 and are not, therefore, included in the list of acronyms: E = endangered; T = threatened; P = Proposed; LAA = likely to adversely affect; NLAA = may affect, not likely to adversely affect; NE = no effect.

3.1 Effects Determinations for ESA-Listed Species

3.1.1 Agency Effects Determinations

We have assessed the ESA-listed species that may be present in the action area and our determination of the project's potential effects is shown in **Table 2** below.

Table 2. ESA-listed Species in the Action Area and Effect Determinations

Species (DPS)	ESA Listing Status	Listing Rule/Date	Most Recent Recovery Plan (or Outline Date)	USFWS Effect Determination	NMFS Effect Determination
Sea Turtles					
Green sea turtle (North Atlantic DPS)	T	81 FR 20057/ April 6, 2016	October 1991	LAA	LAA
Hawksbill sea turtle	E	35 FR 8491/ June 2, 1970	December 1993	LAA	NLAA
Kemp's ridley sea turtle	E	35 FR 18319/ December 2, 1970	September 2011	LAA	LAA
Leatherback sea turtle	E	35 FR 8491/ June 2, 1970	April 1992	LAA	NLAA
Loggerhead sea turtle (Northwest Atlantic DPS)	T	76 FR 58868/ September 22, 2011	December 2008	LAA	LAA
Fishes					
Giant manta ray	T	83 FR 2916/ January 22, 2018	2019 (Outline)	NLAA	LAA
Oceanic whitetip shark	T	83 FR 4153/ January 30, 2018	2018 (Outline)	NLAA	NE
Marine Mammals					

Species (DPS)	ESA Listing Status	Listing Rule/Date	Most Recent Recovery Plan (or Outline Date)	USFWS Effect Determination	NMFS Effect Determination
Sperm whale	E	35 FR 12222/ December 2, 1970	December 2010	NLAA	NE

We believe there will be no effect to the oceanic whitetip shark because it is a highly migratory species of shark that is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deep water, occurring from the surface to at least 152 m depth. Because of the location of the proposed project activities, including associated vessel traffic, we do not expect this species to present within the action area.

We believe there will be no effect to the sperm whale because this species is found in deeper waters seaward of the continental shelf. Because of the location of the proposed project activities, including associated vessel traffic, we do not expect this species to present within the action area.

On March 5, 2024, NMFS issued an Opinion for USACE's proposal to widen and deepen the Sabine-Neches Waterway Channel in Texas and Louisiana (SERO-2024-00049). A portion of the Sabine-Neches Waterway Channel is included as part of the action area. Subsequently, we believe the data from hopper dredging and relocation trawling activities in the Sabine-Neches Waterway are covered by the March 5, 2024, Opinion and is the best available data for estimating the adverse effects to sea turtle species likely to be present in the action area for the proposed project. According to data provided by USACE, the USACE recorded 7 lethal takes of sea turtles during O&M dredging events within the Sabine-Neches Waterway Channel (i.e., 3 Kemp's ridley, 3 loggerhead, and 1 green sea turtles). Of those 7 lethal takes, there was no documented lethal take of hawksbill or leatherback sea turtles during hopper dredging activities. Additionally, no green, hawksbill, or leatherback sea turtles were captured during any relocation trawling events for hopper dredging conducted within the Sabine-Neches Waterway Channel. Therefore, we believe the proposed action is not likely to adversely affect hawksbill or leatherback sea turtles.

3.1.2 Effects Analysis for ESA-Listed Species Not Likely to be Adversely Affected by the Proposed Action

Hydraulic Dredging and Construction Activities

Effects to ESA-listed sea turtles and giant manta ray include the risk of direct physical impact from hydraulic dredging and in-water construction activities. We believe the risk of physical injury is extremely unlikely to occur due to the species' ability to move away from the project site and into adjacent suitable habitat, if disturbed. NMFS has previously determined in other dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, including sea turtles, non-hopper-type dredging methods, such as the hydraulic pipeline dredging proposed for use in this project, are slower and extremely unlikely to overtake or adversely affect them (NMFS 2007, 2020). Additionally, the applicant's implementation of NMFS SERO's *Protected Species Construction Conditions* (NMFS 2021) will require all construction workers to observe in-water related activities for the presence of these species. If a protected species is seen within 150 ft of operations, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 150 ft of a protected species. Operation of any mechanical construction equipment shall cease immediately if a protected species is observed within a 150-ft radius of the equipment. Activities may not resume until the species has departed the project area of its own volition.

Vessel Strike

Vessels can strike ESA-listed sea turtles and giant manta ray, leading to injury or death. NMFS believes that it is highly unlikely that a dredge vessel, relocation trawler, or other support vessel will strike a protected species. Vessel collisions with protected species from the proposed action are not expected due to the slow speed of the dredge (e.g., 3.5 kt or less while dredging), relocation trawlers, and support vessels; the avoidance behavior of these species to slow moving vessels; and the presence of NMFS-approved observers on board every dredge and relocation trawler to watch for ESA-listed species in the area. Additionally, implementation of SERO's Vessel Strike Avoidance Measures will further reduce the risk of vessel strikes. NMFS believes it is extremely unlikely that protected species will be struck by vessels associated with the proposed action.

Dredged Material Placement

The proposed project will require deposition of 3.2 mcy of sand in a 700-ft-wide swath along 5.8-mi-long portion of the Texas Point NWR shoreline. The potential for interaction from dredged material placement equipment while it is depositing the material is limited to the potential of ESA-listed sea turtles and giant manta ray being directly below the material as it is passing through the water column and landing on the sea floor at the pump-out areas. We believe that risk of these mobile species being caught in the discharge through the water column and buried on the sea floor is extremely unlikely. Protected species would be able to detect the presence of the material and avoid being harmed by its placement. Placement in an open water environment would allow room for these species to move away from and around the placement. In addition, the implementation of NMFS SERO's *Protected Species Construction Conditions* will require all construction workers to observe in-water activities for the presence of these species. Operation of any mechanical construction equipment shall cease immediately if a protected species is seen within a 150-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition or 20 minutes have passed since the animal was last seen in the area.

Entanglement

ESA-listed sea turtles and giant manta ray may become entangled in flexible materials in the water, such as buoy lines used to mark pipelines; however, we believe entanglement from flexible materials in the water associated with dredging and placement activities is extremely unlikely to occur. As stated in Section 2.1.2, in order to reduce the risk of entanglement to ESA-listed species the USACE will follow the general PDCs in Appendix B on the use of in-water lines.

Water Quality
ESA-listed sea turtles and giant manta ray may be affected by changes in water quality from turbidity caused by hopper dredging and material placement. We believe this effect is extremely unlikely to occur due to these species' mobility. ESA-listed sea turtles and giant manta ray are highly mobile and can avoid localized areas of increased turbidity.

Access
ESA-listed sea turtles and giant manta ray may frequently feed in nearshore coastal waters and may be affected by their inability to access the project area due to their avoidance of dredging and placement activities. We believe the effect of the temporary loss of foraging/shelter opportunities for these species will be insignificant, given the availability of similar habitat nearby and the abundance of habitat outside of the project area.

Pile Installation
Noise created by pile driving activities can physically injure animals or change animal behavior in the affected areas. Animals can be physically injured in 2 ways. First, immediate adverse effects can occur if a single noise event exceeds the threshold for direct physical injury. Second, adverse physical effects can result from prolonged exposure to noise levels that exceed the daily cumulative sound exposure level for the animals. Noise can also interfere with an animal's behavior, such as migrating, feeding, resting, or reproducing and such disturbances could constitute adverse behavioral effects.

When an impact hammer strikes a pile, a pulse is created that propagates through the pile and radiates sound into the water, the ground substrate, and the air. Pulsed sounds underwater are typically high volume events that have the potential to cause hearing injury. Vibratory pile driving produces continuous, non-pulsed sounds that can be tonal or broadband. In terms of acoustics, the sound pressure wave is described by the peak sound pressure level (PK, which is the greatest value of the sound signal), the root-mean-square pressure level (RMS, which is the average intensity of the sound signal over time), and the sound exposure level (SEL, which is a measure of the energy that takes into account both received level and duration of exposure). Further, the cumulative sound exposure level (SELcum) is a measure of the energy that takes into account the received sound pressure level over a 24-hour period. Please see the following website for more information related to measuring underwater sound and the NMFS-accepted pile driving sound measurement thresholds for species in the NMFS Southeast Region: https://www.fisheries.noaa.gov/southeast/consultations/section-7-consultation-guidance. Please note that for vibratory pile driving, only behavioral sound measurement thresholds exist for fishes; NMFS does not recognize any injurious sound thresholds for fishes when vibratory pile driving is used.

We use the NMFS Multi-species Pile Driving Tool (dated May 2022) to calculate the radii of physical injury and behavioral effects on ESA-listed species that may be located in the action area based on the NMFS-accepted pile driving sound measurement thresholds for species in the NMFS Southeast Region referenced above. The USFWS proposes to install approximately 6 temporary mooring piles, measuring up to approximately 12 in in diameter. Piles may be timber, concrete, or metal. The piles will be installed via vibratory or impact hammer, and will be removed once construction of the beach fill template is complete.

Because an array of pile-types (i.e., timber, concrete, or metal) and installation methods (i.e., impact hammer not using noise abatement measures and vibratory hammer) are proposed, the noise analysis in this consultation evaluates the pile-type and installation method with the greatest potential effects and largest potential effect radius (i.e., 12-in diameter steel piles). Each pile will require approximately 200 strikes to install. Pile driving will occur in a confined space. We define a confined space as any area that has a solid, vertical structure (e.g., jetty or seawall) or natural shoreline that would effectively serve as a barrier or otherwise prevent an animal from exiting the area. That is, in order for the animal to move away from the noise source, the animal would be forced to pass through the radius of noise effects. Any potential effects of pile driving noise from other proposed pile types and methods would not exceed those described below. Therefore, the potential pile driving noise effects from the other proposed pile types and methods, if any, are expected to occur within a radius of that size or smaller and would result in, at most, the potential effects described below.

The installation of 12-in diameter steel piles by impact hammer not using noise abatement measures will cause PK injurious noise effects to ESA-listed fishes and sea turtles at a radius of up to 3.8-ft-away from the pile driving operations. We believe PK injurious noise effects are extremely unlikely to occur because this distance is within the 150-ft (46-m) "stop-work" radius defined in SERO's *Protected Species Construction Conditions* (revised 2021). Additionally, the SELcum may cause injury to ESA-listed fishes and sea turtles at a radius of up to 172-ft-away from the pile-driving operations over a 24-hour period. We believe SELcum injurious noise effects are extremely unlikely to occur due to the mobility of these species. That is, we expect the species to move away from the noise disturbances before the exposure to the noise causes physical injury. Movement away from the injurious sound radius is a behavioral response and is discussed below.

The installation of 12-in diameter steel piles by impact hammer not using noise abatement measures could result in behavioral effects to ESA-listed fishes and sea turtles at a radius of up to 2,070-ft-away from the pile driving operations. We believe behavioral noise effects to these species will be insignificant. Although we generally expect mobile species to move away from noise disturbances, the proposed action will occur in a confined space. If an animal remains within the project area, it could be exposed to behavioral noise effects during pile installations. Because only 6 piles total are proposed for installation and pile installation will occur intermittently, species will be able to resume normal activities during quiet periods between pile installations and when pile installation is complete.

3.1.3 ESA-Listed Species Likely to be Adversely Affected by the Proposed Action

We have determined that green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray are likely to be adversely affected by the proposed action and thus requires further analysis. We provide greater detail on the potential effects to these species from the proposed action in the Effects of the Action (Section 6.1) and whether those effects, when considered in the context of the Status of the Species (Section 4.1), the Environmental Baseline (Section 5), and the Cumulative Effects (Section 7), are likely to likely to jeopardize the continued existence of these ESA-listed species in the wild.

3.2 Effects Determinations for Critical Habitat

3.2.1 Agency Effects Determinations

We have assessed the critical habitats that overlap with the action area and our determination of the project's potential effects is shown in **Table 3** below.

Table 3. Critical Habitat in the Action Area and Effect Determinations.

Species (DPS)	Critical Habitat Unit in the Action Area	Critical Habitat Rule/Date	USFWS Effect Determination	NMFS Effect Determination (Critical Habitat)
Sea Turtles				
Loggerhead sea turtle (Northwest Atlantic DPS)	LOGG-S-02 Sargassum	79 FR 39856/ July 10, 2014	NE	NLAA
Proposed				
Sea Turtle				
Green sea turtle	NA01: Sargassum	88 FR 46572, July 19, 2023	NE	NLAA

3.2.2 Effects Analysis for Critical Habitat Not Likely to be Adversely Affected by the Proposed Action

The project is located within the boundary of loggerhead sea turtle critical habitat (Unit LOGG-S-02) and proposed green sea turtle critical habitat (unit NA01: Sargassum). The unit LOGG-S-02 habitat is defined as a developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*. The following primary constituent elements (PCEs) are present in unit LOGG-S-02:

(i) Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerhead turtles;

(ii) *Sargassum* in concentrations that support adequate prey abundance and cover;

(iii) Available prey and other material associated with *Sargassum* habitat, including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community, such as hydroids and copepods; and

(iv) Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone) and foraging and cover requirements by *Sargassum* for post-hatchling loggerhead sea turtles (i.e., > 10-meter depth).

The following proposed physical or biological features essential for the conservation of green sea turtle (North Atlantic DPS) ("essential features") are present in Unit NA01: *Sargassum*:

> Convergence zones, frontal zones, surface-water downwelling areas, the margins of major boundary currents, and other areas that result in concentrated components of the *Sargassum*-dominated drift community, as well as the currents which carry turtles to *Sargassum*-dominated drift communities, which provide sufficient food resources and refugia to support the survival, growth, and development of post-hatchlings and surface-pelagic juveniles, and which are located in sufficient water depth (at least 10 m) to ensure offshore transport via ocean currents to areas which meet forage and refugia requirements.

The proposed project may affect *Sargassum* concentration if vessels transit through patches of *Sargassum* or incidentally remove *Sargassum* upon retrieval of sampling equipment. However, we believe these effects are insignificant because the activities associated with the proposed action are extremely limited in space and time, the wakes and surface water distribution associated with vessels are not of sufficient magnitude to effect the distribution of *Sargassum* mats, and any temporary or incidental removal of *Sargassum* via vessel movement is not anticipated to be at such a level that functionality of the LOGG-S-02 PCEs or the proposed essential feature for NA01 will be affected.

4 STATUS OF ESA-LISTED SPECIES CONSIDERED FOR FURTHER ANALYSIS

4.1 Overview of Status of Sea Turtles

There are 5 species of sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead) that travel widely throughout the South Atlantic, the Gulf, and the Caribbean. These species are highly migratory and therefore could occur within the action area. Section 4.1.1 will address the general threats that confront all sea turtle species. The remainder of Section 4.1 (Sections 4.1.2-4.2.4) will address information on the distribution, life history, population structure, abundance, population trends, and unique threats to each species of sea turtle.

4.1.1 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. The threats identified in this section are discussed in a general sense for all sea turtles. Threat information specific to a particular species are then discussed in the corresponding Status of the Species sections where appropriate.

This Opinion refers to the Northern Gulf of Mexico Recovery Unit (NGMRU) identified in the final rule listing for the nine distinct population segments of loggerhead sea turtle (78 FR 58868, Sept. 22, 2011) as the Northern Gulf of America Recovery Unit (NGARU). The geographical location of the recovery unit remains the same.

Fisheries
Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991; NMFS and USFWS 1992; NMFS and USFWS 1993; NMFS and USFWS 2008; NMFS et al. 2011).

Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to 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 2020). 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 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. 1997). 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 hatchlings 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 oil rig affected sea turtles in the Gulf. An assessment has been completed on the injury to Gulf 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 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 lost, abandoned or discarded fishing gear) as they feed along oceanographic fronts where debris and their natural food items converge. Marine debris can cause significant habitat destruction from derelict vessels, further exacerbated by tropical storms moving debris and scouring and destroying corals and seagrass beds, for instance. Sea turtles that spend significant portions of their lives in the pelagic environment (i.e., juvenile loggerheads, and juvenile green turtles) are especially susceptible to threats from entanglement in marine debris when they return to coastal waters to breed and nest.

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 2007a). 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 2007a).

The effects from increased temperatures may be intensified on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and USFWS 2007b). 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 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, etc.) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc.) which could ultimately affect the primary foraging areas of sea turtles.

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

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

4.1.2 Green Sea Turtle (North Atlantic DPS)

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 DPSs (81 FR 20057 2016) (Figure 2). The Mediterranean, Central West Pacific, and Central South Pacific DPSs were listed as endangered. The North Atlantic, South Atlantic, Southwest Indian, North

Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific DPSs were listed as threatened. Only individuals from the South Atlantic DPS and North Atlantic DPS may occur in waters under the purview of the NMFS SE Region, with South Atlantic DPS individuals only expected to occur in the U.S. Caribbean.

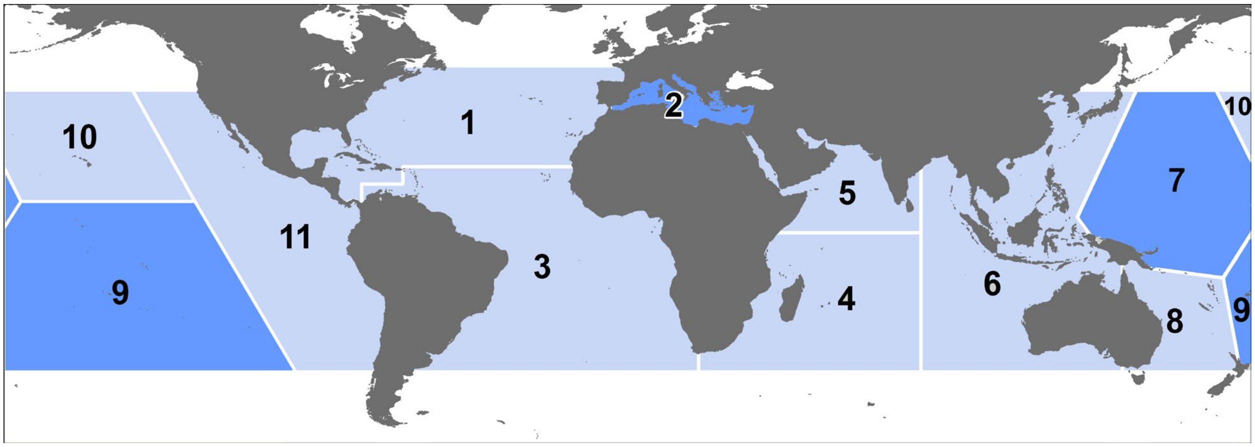


Figure 2. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11.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

Species Description and Distribution

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) with a SCL 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 two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica (part of the North Atlantic 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. Limited early information indicated that within U.S. waters benthic juveniles from both the North Atlantic and South Atlantic DPSs may be found on foraging grounds. Two small-scale studies provided an insight into the possible degree of mixing on the foraging grounds. An analysis of cold-stunned green turtles in St. Joseph

Bay, Florida (northern Gulf) found approximately 4% of individuals came from nesting stocks in the South Atlantic 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 South Atlantic DPS (Bass and Witzell 2000). 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). However, with additional research it has been determined that South Atlantic juveniles are not likely to be occurring in U.S. mainland coastal waters in anything more than negligible numbers. Jensen et al. (2013) indicated that the earlier studies might represent a statistical artifact as they lack sufficient precision, with error intervals that span zero. More recent studies with better rookery baseline representation found negligible (<1%) contributions from the South Atlantic DPS among Texas and Florida GoM juvenile green turtle assemblages (Shamblin et al. 2016, 2018). Finally, an as-yet unpublished genetic analysis of samples from various coastal areas in the Gulf and Atlantic has now solidified the conclusion that South Atlantic juveniles represent at best a negligible number of individuals in mainland United States waters (Peter Dutton, SWFSC, pers. comm. April 2022). Therefore, we will not consider South Atlantic DPS individuals when conducting consultations for projects in the waters off the mainland United States.

The North Atlantic DPS boundary is illustrated in Figure 2. Four regions support nesting concentrations of particular interest in the North Atlantic 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 North Atlantic 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 the Gulf 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 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.

Life History Information

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches and along migratory routes. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 1985) every 2-4 years while males are known to reproduce every year (Balazs 1983). In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 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 2007). 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 1997; Hirth 1997).

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

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

The North Atlantic 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.

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

Tortuguero, Costa Rica is by far the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff 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 2007). 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. However, a recent long-term study spanning over 50 years of nesting at Tortuguero found that while nest numbers increased steadily over 37 years from 1971-2008, the rate of increase slowed gradually from 2000-2008. After 2008 the nesting trend has been downwards, with current nesting levels having reverted to that of the mid 1990's and the overall long-term trend has now become negative (Restrepo, et al. 2023).

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (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 (up to tens of nests) (nesting databases maintained on www.seaturtle.org).

Florida accounts for approximately 5% of nesting for this DPS (Seminoff et al. 2015). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more resulted in an estimate of the Florida nesting stock at the Archie Carr NWR growing at an annual rate of 13.9% at that time. Increases have been even more rapid in recent years. In Florida, index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989, the pattern of green sea turtle nesting has generally shown biennial peaks in abundance with a positive trend during the 10 years of regular monitoring (Figure 3). According to data collected from Florida's index nesting beach survey from 1989-2021, green sea turtle nest counts across Florida have increased dramatically, from a low of 267 in the early 1990s to a high of 40,911 in 2019. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011. The pattern departed from the low lows and high peaks in 2020 and 2021 as well, when 2020 nesting only dropped by half from the 2019 high, while 2021 nesting only increased by a small amount over the 2020 nesting, with another increase in 2022 still well below the 2019 high (Figure 3). While nesting in Florida has shown dramatic increases over the past decade, individuals from the Tortuguero, the Florida, and the other Caribbean and Gulf populations in the North Atlantic DPS intermix and share developmental habitat. Therefore, threats that have affected the Tortuguero population as described previously, may ultimately influence the other population trajectories, including Florida. Given the large size of the Tortuguero nesting population, which is currently in decline, its status and trend largely drives the status of North Atlantic DPS.

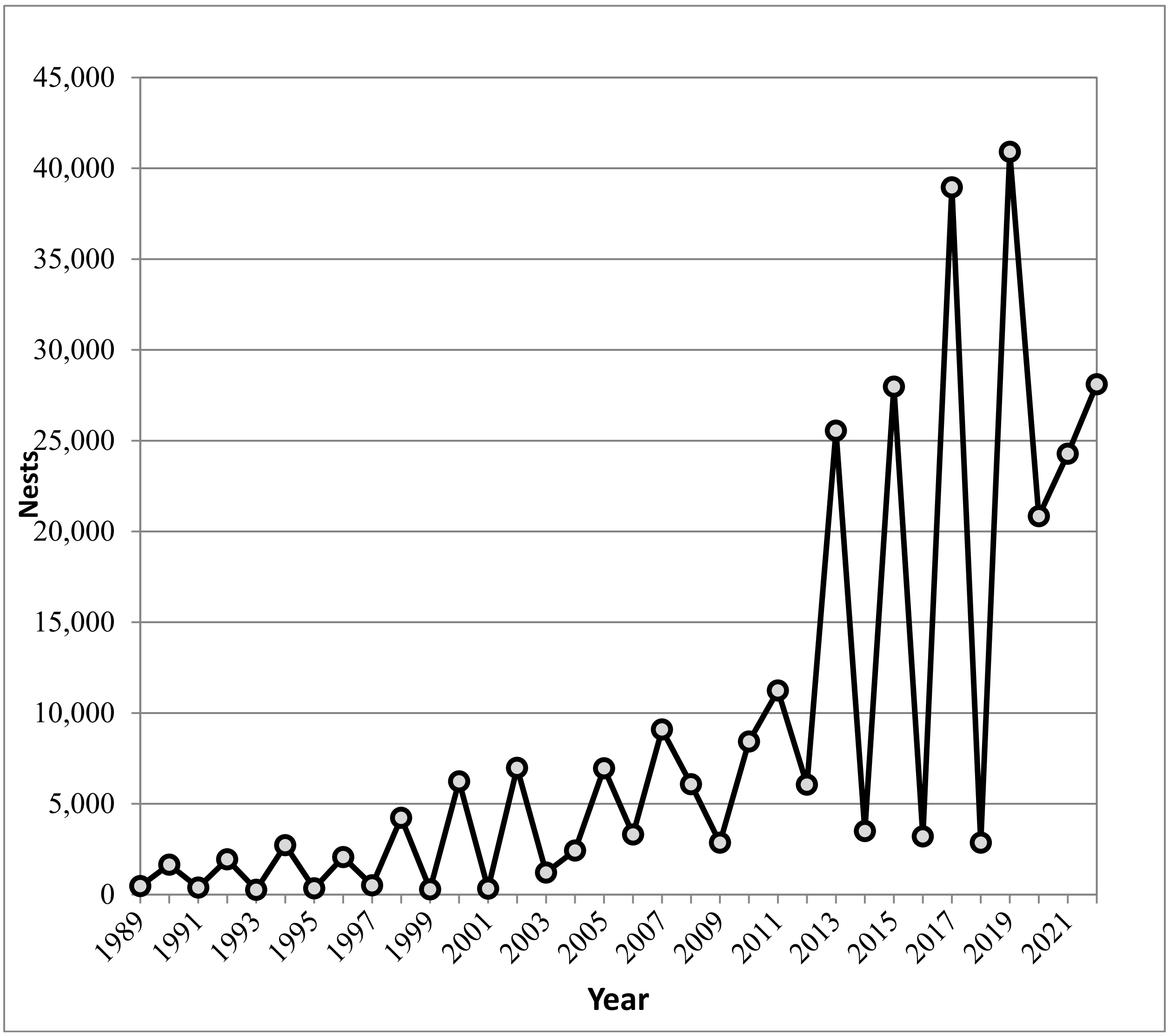


Figure 3. Green sea turtle nesting at Florida index beaches since 1989.

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

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 4.1.1.

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 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 4.1.1, 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 dispersants, and loss of foraging resources, which could lead to compromised growth and 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, they have a widespread distribution throughout the entire Gulf , Caribbean, and Atlantic, and the proportion of the population using the northern Gulf at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf 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 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).

4.1.3 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 2000; 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 basin, though they also occur in coastal and offshore waters of the U.S. Atlantic Ocean. Juvenile Kemp's ridley sea turtles, possibly carried by oceanic currents, have been recorded as far north as Nova Scotia. Historic records indicate a nesting range from Mustang Island, Texas, in the north to Veracruz, Mexico, in the south. Kemp's ridley sea turtles have recently been nesting along the Atlantic Coast of the United States, with nests recorded from beaches in Florida, Georgia, and the Carolinas. In 2012, the first Kemp's ridley sea turtle nest was recorded in Virginia. The Kemp's ridley nesting population had been exponentially increasing prior to the recent low nesting years, which may indicate that the population had been experiencing a similar increase. Additional nesting data in the coming years will be required to determine what the recent nesting decline means for the population trajectory.

Life History Information

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

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

Population Dynamics

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

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. More recent data, however, indicated an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017). Nesting for 2018 declined to 17,945, with another steep drop to 11,090 nests in 2019 (Gladys Porter Zoo data, 2019), but rebounded in 2020 (18,068 nests), 2021 (17,671 nests), and 2022 (17,418) (CONANP data, 2022). At this time, it is unclear whether the increases and declines in nesting seen over the past decade-and-a-half represents a population oscillating around an equilibrium point, if the recent three years (2020-2022) of relatively steady nesting indicates that equilibrium point, or if nesting will decline or increase in the future. So at this point we can only conclude that the population has dramatically rebounded from the lows seen in the 80's and 90's, but we cannot ascertain a current population trend or trajectory at this time.

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data). It is worth noting that nesting in Texas has somewhat paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015, the record nesting in 2017, and then a drop back down to 190 nests in 2019, rebounding to 262 nests in 2020, back to 195 nests in 2021, and then rebounding to 284 nests in 2022 (National Park Service data).

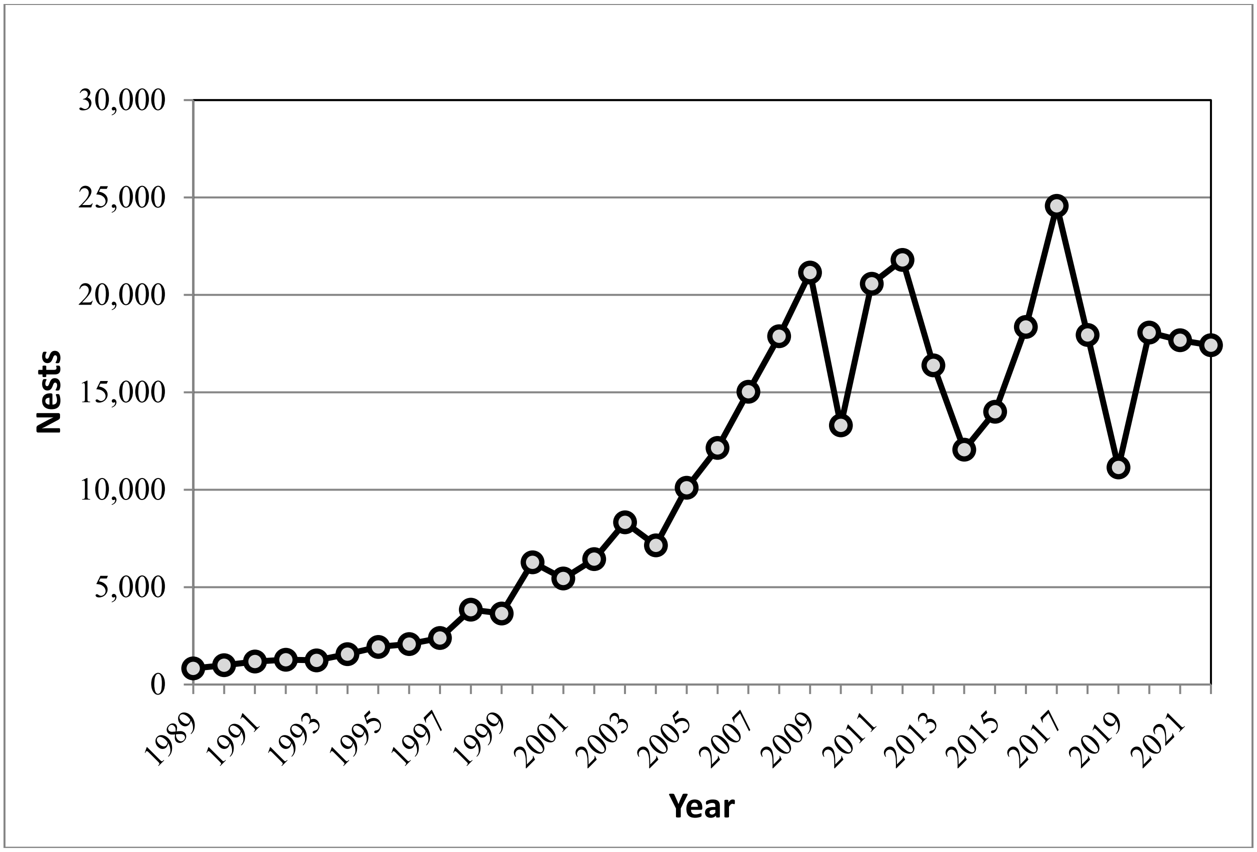


Figure 4. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019 and CONANP data 2020-2022).

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

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

Since 2010, we have documented (via the Sea Turtle Stranding and Salvage Network data, https://www.fisheries.noaa.gov/national/marine-life-distress/sea-turtle-stranding-and-salvage-network) elevated sea turtle strandings in the Northern Gulf, particularly throughout the Mississippi Sound area. For example, in the first 3 weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87%) of which were Kemp's ridley sea turtles. During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters alone. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) having occurred from March through July, 390 (86%) of which were Kemp's ridley sea turtles. During 2012, a total of 384 sea turtles were reported from Louisiana, Mississippi, and Alabama waters. Of these reported strandings, 343 (89%) were Kemp's ridley sea turtles. During 2014, a total of 285 sea turtles were reported from Louisiana, Mississippi, and Alabama waters, though the data is incomplete. Of these reported strandings, 229 (80%) were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively. In subsequent years stranding levels during the March-May time period have been elevated but have not reached the high levels seen in the early 2010's. It should be noted that stranding coverage has increased considerably due to the DWH oil spill event.

Nonetheless, considering that strandings typically represent only a small fraction of actual mortality, these stranding events potentially represent a serious impact to the recovery and survival of the local sea turtle populations. While a definitive cause for these strandings has not been identified, necropsy results indicate a significant number of stranded turtles from these events likely perished due to forced submergence, which is commonly associated with fishery interactions (B. Stacy, NMFS, pers. comm. to M. Barnette, NMFS PRD, March 2012). Yet, available information indicates fishery effort was extremely limited during the stranding events. The fact that 80% or more of all Louisiana, Mississippi, and Alabama stranded sea turtles in the past 5 years were Kemp's ridley sea turtles 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 fisheries beginning in 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fisheries. All but a single sea turtle were identified as Kemp's ridleys (1 sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small juvenile specimens, ranging from 7.6-19.0 in (19.4-48.3 cm) CCL. Subsequent years of observation noted additional captures in the skimmer trawl fisheries, including some mortalities. The small average size of encountered Kemp's ridleys introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum 4-in bar spacing of TEDs currently required in the shrimp fisheries. Due to this issue, a proposed 2012 rule to require 4-in bar spacing TEDs in the skimmer trawl fisheries (77 FR 27411) was not implemented. Following additional gear testing, however, we proposed a new rule in 2016 (81 FR 91097) to require TEDs with 3-in bar spacing for all vessels using skimmer trawls, pusher-head trawls, or wing nets. Ultimately, we published a final rule on December 20, 2019 (84 FR 70048), that requires all skimmer trawl vessels 40 feet and greater in length to use TEDs designed to exclude small sea turtles in their nets effective April 1, 2021. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf 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 4.1.1, specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact stemming from the DWH oil spill event of any sea turtle species. Impacts to Kemp's ridley sea turtles occurred to offshore small juveniles, as well as large juveniles and adults. Loss of hatchling production resulting from injury to adult turtles was also estimated for this species. Injuries to adult turtles of other species, such as loggerheads, certainly would have resulted in unrealized nests and hatchlings to those species as well. Yet, the calculation of unrealized nests and hatchlings was limited to Kemp's ridleys for several reasons. All Kemp's ridleys in the Gulf belong to the same population (NMFS et al. 2011), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf throughout their lives (DWH Trustees 2016).

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

4.1.4 Loggerhead Sea Turtle (Northwest Atlantic DPS)

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a final rule which designated 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) 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 Northwest Atlantic (NWA) DPS is the only one that occurs within the action area, and therefore it is the only one considered in this Opinion.

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

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

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990). For the Northwest Atlantic 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, 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, the Gulf, 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, and 5% in the western Gulf (TEWG 1998).

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

The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula. It also concluded that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the recovery plan uses a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are as follows: (1) the Northern Recovery Unit (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 2008). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the Northwest Atlantic DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the Northwest Atlantic 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: nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 m), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations (Frazer and Ehrhart 1985; NMFS 2001). The annual mating season occurs from late March to

early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008). Loggerhead hatchlings are 1.5-2 in long and weigh about 0.7 oz (20 g).

As post-hatchlings, loggerheads hatched on U.S. beaches enter the “oceanic juvenile” life stage, migrating offshore and becoming associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Conant et al. 2009; 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 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 the Gulf (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. Estuarine waters of the United States, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, as well as numerous embayments fringing the Gulf, comprise important inshore habitat. Along the Atlantic and the Gulf shoreline, essentially all shelf waters are inhabited by loggerheads (Conant et al. 2009).

Like juveniles, non-nesting adult loggerheads also use the neritic zone. However, these adult loggerheads do not use the relatively enclosed shallow-water estuarine habitats with limited ocean access as frequently as juveniles. Areas such as Pamlico Sound, North Carolina, and 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. 2009).

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, The Bahamas, Cuba, and the Gulf. 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) GADNR, unpublished data; SCDNR, 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 of 5 adult female loggerheads in Cuban waters originally flipper-tagged in Quintana Roo, Mexico, which indicates that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

Status and Population Dynamics
A number of stock assessments and similar reviews (Conant et al. 2009; Heppell et al. 2003; NMFS-SEFSC 2009; NMFS 2001; NMFS and USFWS 2008; TEWG 1998; TEWG 2000; TEWG 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

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

Peninsular Florida Recovery Unit (PFRU)
The PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008). The statewide estimated total for 2020 was 105,164 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. FWRI uses the standardized index survey data to analyze the nesting trends (Figure 5) (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Since the beginning of the index program in 1989, 3 distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represented a new record for loggerheads on the core index beaches. While nest numbers subsequently declined from the 2016 high FWRI noted that the 2007-2021 period represents a period of increase. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but non-significant increasing trend. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability between 2012-2016 resulting in widening confidence intervals. Nesting at the core index beaches declined in 2017 to 48,033, and rose again each year through 2020, reaching 53,443 nests, dipping back to 49,100 in 2021, and then in 2022 reaching the second-highest number since the survey began, with 62,396 nests. It is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.) it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani, et al. 2019).

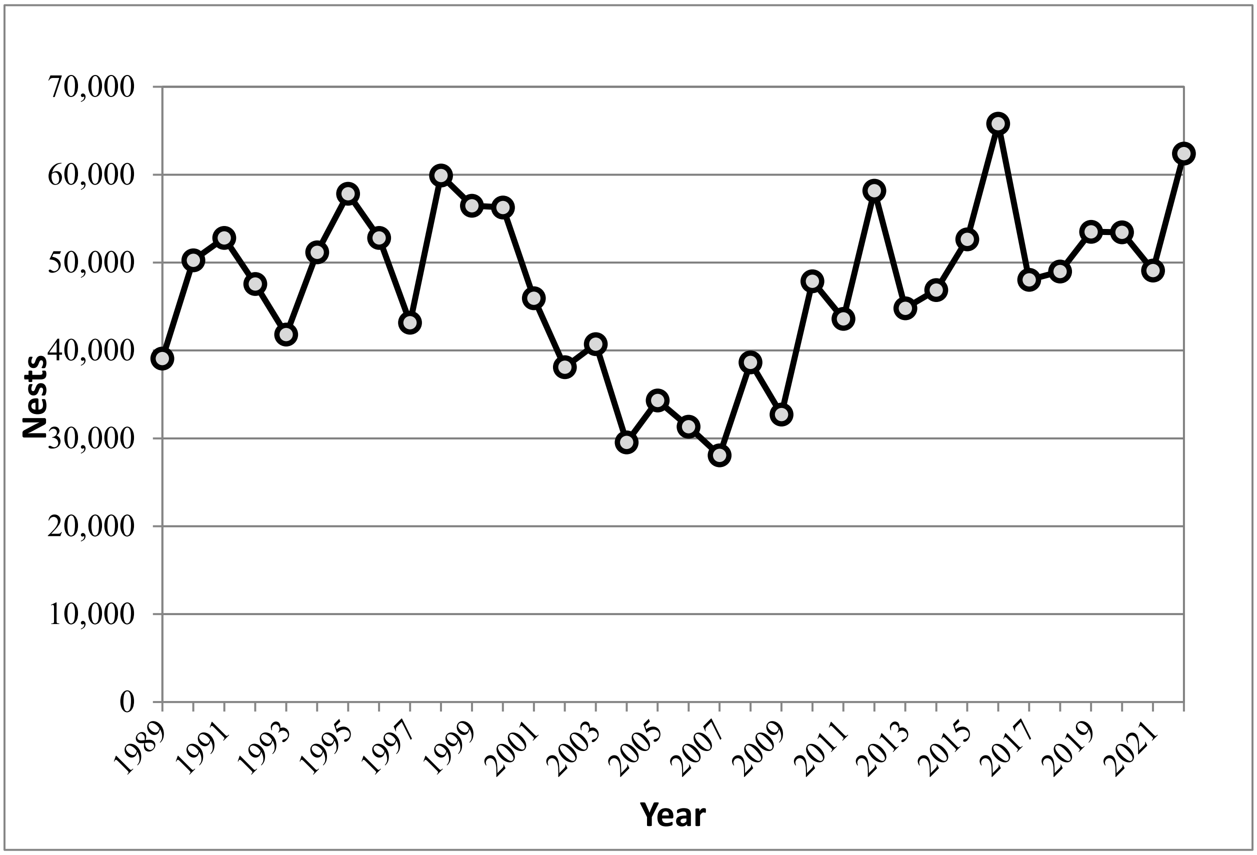


Figure 5. Loggerhead sea turtle nesting at Florida index beaches since 1989

<u>Northern Recovery Unit (NRU)</u>
Annual nest totals from beaches within the NRU averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (GADNR unpublished data, NCWRC unpublished data, 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 4) 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, https://georgiawildlife.com/loggerhead-nest-season-begins-where-monitoring-began). South Carolina and North Carolina nesting have also begun to shift away from the past declining trend. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016. Nesting in 2017 and 2018 declined relative to

2016, back to levels seen in 2013 to 2015, but then bounced back in 2019, breaking records for each of the three states and the overall recovery unit. Nesting in 2020 and 2021 declined from the 2019 records, but still remained high, representing the third and fourth highest total numbers for the NRU since 2008. In 2022 Georgia loggerhead nesting broke the record at 4,071, while South Carolina and North Carolina nesting were both at the second-highest level recorded.

Table 4. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets compiled at Seaturtle.org)

Year	Georgia	South Carolina	North Carolina	Totals
2008	1,649	4,500	841	**6,990**
2009	998	2,182	302	**3,482**
2010	1,760	3,141	856	**5,757**
2011	1,992	4,015	950	**6,957**
2012	2,241	4,615	1,074	**7,930**
2013	2,289	5,193	1,260	**8,742**
2014	1,196	2,083	542	**3,821**
2015	2,319	5,104	1,254	**8,677**
2016	3,265	6,443	1,612	**11,320**
2017	2,155	5,232	1,195	**8,582**
2018	1,735	2,762	765	**5,262**
2019	3,945	8,774	2,291	**15,010**
2020	2,786	5,551	1,335	**9,672**
2021	2,493	5,639	1,448	**9,580**
2022	4,071	7,970	1,906	**13,947**

In addition to the statewide nest counts, South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record. After another drop in 2018, a new record was set for the 2019 season, with a return to 2016 levels in 2020 and 2021 and then a rebound to the second highest level on record in 2022 (Figure 6).

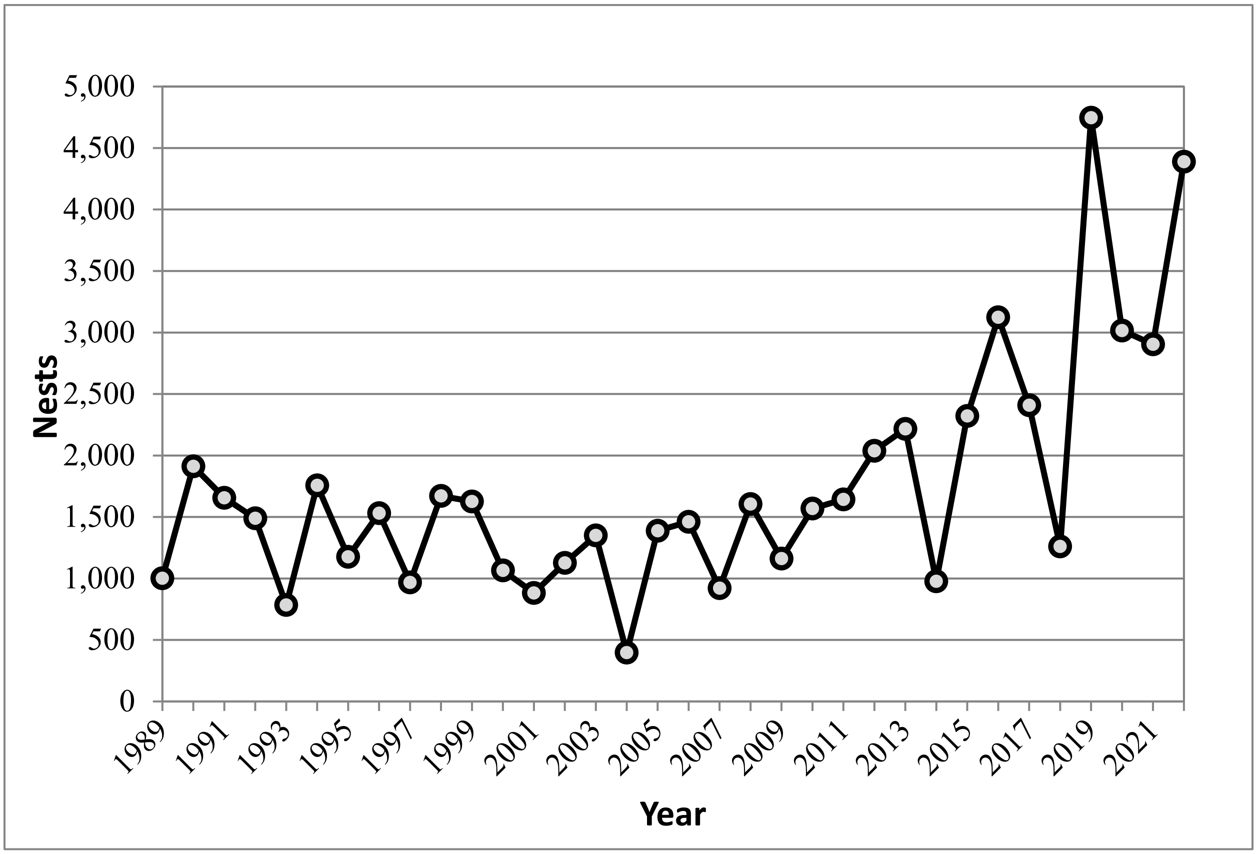


Figure 6. South Carolina index nesting beach counts for loggerhead sea turtles (data provided by SCDNR).

<u>Other Northwest Atlantic DPS Recovery Units</u>

The remaining 3 recovery units – Dry Tortugas (DTRU), Northern Gulf of America (NGARU), 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 2008). Nest counts for the NGARU 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 NGARU 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. From 1989-2018 the average number of NGARU nests annually on index beaches was 169 nests, with an average of 1100 counted in the statewide nesting counts (Ceriani et al. 2019). Nesting survey effort has been inconsistent among the GCRU nesting beaches, and no trend can be determined for this subpopulation (NMFS and USFWS 2008). Zurita et al. (2003) found a statistically significant increase in the number of nests on 7 of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. Nonetheless, nesting has declined since

2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008).

In-water Trends

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

Population Estimate

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

Threats (Specific to Loggerhead Sea Turtles)

The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 4.1.1. 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 Northwest Atlantic DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009).

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. 1991).

While oil spill impacts are discussed generally for all species in Section 4.1.1, specific impacts of the DWH oil spill event on loggerhead sea turtles are considered here. Impacts to loggerhead sea turtles occurred to offshore small juveniles as well as large juveniles and adults. A total of 30,800 small juvenile loggerheads (7.3% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. Of those exposed, 10,700 small juveniles are estimated to have died as a result of the exposure. In contrast to small juveniles, loggerheads represented a large proportion of the adults and large juveniles exposed to and killed by the oil. There were 30,000 exposures (almost 52% of all exposures for those age/size classes) and 3,600 estimated mortalities. A total of 265 nests (27,618 eggs) were also translocated during response efforts, with 14,216 hatchlings released, the fate of which is unknown (DWH Trustees 2016). 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 or dispersants, and loss of foraging resources which could lead to compromised growth and reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

Unlike Kemp’s ridleys, the majority of nesting for the Northwest Atlantic DPS occurs on the Atlantic coast and, thus, loggerheads were impacted to a relatively lesser degree. However, it is likely that impacts to the NGARU of the Northwest Atlantic DPS would be proportionally much greater than the impacts occurring to other recovery units. Impacts to nesting and oiling effects on a large proportion of the NGARU recovery unit, especially mating and nesting adults likely had an impact on the NGARU. Based on the response injury evaluations for Florida Panhandle and Alabama nesting beaches (which fall under the NFMRU), the DWH Trustees (2016) estimated that approximately 20,000 loggerhead hatchlings were lost due to DWH oil spill response activities on nesting beaches. Although the long-term effects remain unknown, the DWH oil spill event impacts to the NGARU may result in some nesting declines in the future due to a large reduction of oceanic age classes during the DWH oil spill event. Although adverse impacts occurred to loggerheads, the proportion of the population that is expected to have been exposed to and directly impacted by the DWH oil spill event is relatively low. Thus we do not believe a population-level impact occurred due to the widespread distribution and nesting location outside of the Gulf for this species.

Specific information regarding potential climate change impacts on loggerheads is also available. Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes 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).

4.1.5 Giant Manta Ray

Physical Description of the Species

The giant manta ray has a diamond-shaped body with wing-like pectoral fins; the distance over this wingspan is termed DW. It may be the largest living ray species, attaining a maximum size of 800 cm DW, with anecdotal reports up to 910 cm DW (Compagno 1999; Alava et al., 2002; Carpenter et al., 2023). Males mature at 350-400 cm DW and females mature at 380–500 cm DW (White et al., 2006; Last et al., 2016; Stewart et al., 2018b). There are two distinct color types: chevron and black (melanistic). Most of the chevron variants have a black dorsal surface and a white ventral surface with distinct patterns on the underside that can be used to identify individuals (Marshall et al., 2008; Kitchen-Wheeler 2010; Deakos et al., 2011). While these markings are assumed to be permanent, there is some evidence that the pigmentation pattern of giant manta ray may actually change over the course of development (based on observation of two individuals in captivity), and thus caution may be warranted when using color markings for identification purposes in the wild (Ari 2015). The black color variants are entirely black on the dorsal side and almost completely black on the ventral side, except for areas between the gill-slits and the abdominal area below the gill-slits (Kitchen-Wheeler 2013).

Habitat

The giant manta ray inhabits tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and near productive coastlines, with water temperatures generally between 20°C and 30°C (Duffy and Abbott 2003; Marshall et al., 2009; Kashiwagi et al., 2011; Freedman and Roy 2012; Graham et al., 2012; Hacohen-Domené et al., 2017; Farmer et al., 2022). Manta rays are commonly seen in surface waters or cleaning in shallow coral reef habitats typically in tropical or subtropical regions (Couturier et al., 2012; Braun et al., 2014). The giant manta ray can exhibit diel patterns in habitat use, moving inshore during the day to clean and socialize in shallow waters (10-20 m), and then moving offshore at night to feed to depths of 1,000 meters (Hearn et al. 2014; Burgess 2017). The coastal vertical movements of giant manta rays may be motivated by a combined foraging and thermal recovery strategy, whereby giant manta rays dived to forage on vertically migrating zooplankton at night and returned to surface waters (<2 m) to rewarm between dives (Andrzejaczek et al., 2021). In coastal areas, giant manta rays have been observed in shallow waters, sometimes less than 3 meters deep, in estuarine waters, near coastal inlets, with use of these shallow waters as potential nursery habitats (Adams and Amesbury 1998; Milessi and Oddone 2003; Medeiros et al., 2015; Pate and Marshall 2020; Farmer et al., 2022).

Diet and Feeding

Giant manta rays primarily feed on planktonic organisms such as euphausiids, copepods, mysids, decapod larvae and shrimp, but some studies have noted their consumption of small and moderate sized fishes (Bertolini 1933; Bigelow and Schroeder 1953; Carpenter and Niem 2001;

Rohner et al., 2017a; Stewart et al., 2017; Medeiros et al., 2022). While there are no studies that compare diet requirements for the different life stages, recent studies suggest that both juveniles and adults may occupy the same habitats within a location and, thus, target the same prey (Stewart et al., 2016b, Stewart et al., 2017, Graham et al., 2012). Manta rays have a complex depth profile of their foraging habitat (Andrzejaczek et al., 2021). Burgess et al., (2016) found that, on average, mesopelagic sources contributed 73% to the giant manta ray's diet, compared to 27% for surface zooplankton suggesting that giant manta rays may be supplementing their diet with opportunistic feeding in near-surface waters (Couturier et al., 2013; Burgess et al., 2016).

The feeding behaviors of manta species have also been studied to provide insight into their cognition and response to sensory stimuli. When feeding, groups of manta rays hold their cephalic fins in an "o" shape and open their mouths wide. They tend to swim at a speed around 30 pectoral fin beats per minute when feeding, which is almost twice as fast as they swim when being cleaned (Kitchen-Wheeler 2013). After collecting water with zooplankton in their mouths, manta rays use a transverse curtain on the roof of the mouth as a valve to hold the water in as the pharynx contracts during swallowing (Bigelow and Schroeder 1953). This movement of the pharynx pulls plankton towards the stomach when the gills are closed (Kitchen-Wheeler 2013). Intestinal eversion has also been observed, likely to clear the intestines of indigestible material and parasites (Clark and Papastamatiou 2008). The positioning of the cephalic fins was found to be a good indicator of feeding motivation, triggered by underwater visual stimuli or olfactory stimuli/sense of smell (Ari and Correia 2008).

Listing History

The giant manta ray is listed as a threatened species under the ESA (83 FR 2916, January 22, 2018). Critical habitat is not designated (84 FR 66652; December 5, 2019).

Life History Information

<u>Reproduction</u>

The giant manta ray is ovoviviparous and is thought to produce a single offspring per pregnancy after a gestation period of 12-13 months (Rambahiniarison et al., 2018; Murakumo et al., 2020). An average female produces 4–7 pups during its lifespan (Marshall et al., 2022). Due to their low fecundity and late age of maturation, manta ray populations are slow to recover from population declines (Dulvy et al. 2014; NMFS 2024).

<u>Age at Maturity</u>

Female giant manta rays mature at 8.6 years of age, although first pregnancy may be delayed by up to 4 years depending on food availability (Rambahiniarison et al., 2018). Maximum age is estimated at 45 years and generation length is estimated to be between 20 years (J. Carlson unpublished) to 29 years (Marshall et al., 2022).

<u>Habitat Use by Different Life Stages</u>

Identifying potential manta ray important habitats, such as nursery, feeding and reproductive areas, especially in data limited regions such as the northwest Atlantic Ocean, is essential to conservation and recovery of this species. A recent study conducted off the Atlantic coast of central Florida provided evidence of reproductive habitat for manta rays (Pate 2024). Each spring manta rays aggregate off the coast of central and northern Florida, between Indian River County, Florida and the Florida/Georgia border. Pate (2024) documented numerous courtship and breaching events indicating that this area is potentially seasonal reproductive habitat for manta rays. This same study suggested that this area maybe important feeding habitat as feeding behaviors and prey species were also documented (Pate 2024). These initial observations warrant future study to determine the importance of this area to manta ray feeding and reproduction, as well as characterization of the environmental influences that affect manta ray presence and behavior.

Documenting juvenile nursery habitats is a priority in manta ray research and conservation (Stewart et al., 2018a), yet few have been described. Worldwide few nursery areas for manta rays have been described; however, two manta ray nursery habitats have been described in the U.S Atlantic and the Gulf. Pate and Marshall (2020) described the nearshore area between St. Lucie Inlet and Boynton Beach Inlet, along southeast Florida as a nursery habitat for manta rays. Observations of juvenile giant manta rays as far south as Miami suggest this nursery habitat may extend farther south (J. Pate, MMF, pers comm. to C. Horn, NMFS, June 4, 2024). Nearly all (98%) of manta rays observed by Pate and Marshall (2020) were juveniles, many showed high site fidelity to the study area, which is characterized by a highly populated coastline (Palm Beach County and Martin County) with intensive vessel traffic. As of December, 2023, 151 juvenile manta rays had been identified, with 52% being re-sighted and 26% re-sighted over multiple years (Pate and Fong 2023). New individuals are being identified regularly along southeastern Florida (J. Pate unpublished data). In addition, the Flower Garden Banks National Marine Sanctuary and the surrounding banks in the northwest Gulf have been described as manta ray nursery habitat (Stewart et al., 2018a). These nursery habitats were described based on frequent observations of immature individuals in these areas, high site fidelity with individuals remaining in the areas, and extended use of these areas by individuals over multiple years (Heupel et al., 2017; Stewart et al 2018a; Pate and Marshall 2020).

<u>Seasonal Distribution Patterns</u>

In the U.S Atlantic, giant manta rays are distributed from Florida to as far north as New York, with a clear expansion to the north during warmer months. The highest nearshore occurrence is predicted to take place off the Atlantic coast of Florida during April, with the distribution extending northward along the shelf-edge as temperatures warm, leading to higher occurrences north of Cape Hatteras, North Carolina from June to October, and then south of Savannah, Georgia from November to March as temperatures cool (Figure 7; Farmer et al., 2022). These findings are consistent with other lines of evidence that demonstrate that large numbers of giant manta rays are known to migrate to the Atlantic coast of Florida during the spring and summer (Levesque 2019; Pate and Fong 2023). Aerial observations of manta ray movements indicate that the Atlantic coast of Florida is potentially an important foraging and reproductive habitat (Pate and Fong 2023; Pate 2024). Each spring manta rays aggregate off the coast of central and northern Florida, between Indian River County, Florida, and the Florida/Georgia border. Typically, individuals are observed during March of each year in coastal waters off Indian River County, then migrate northward, possibly coinciding with rising water temperatures. Anglers reported that when temperatures fall between 68 and 72°F both manta ray and cobia abundance peaked, usually between March and April (Braun et al., 2024), which is consistent with findings in Farmer et al., (2022).

Additionally, several lines of evidence indicate that the Mississippi delta region is an important aggregation. Farmer et al., (2022) predicted that the highest nearshore occurrence of giant manta rays in the Gulf occurs around the Mississippi River Delta from April to June and again from October to November (Figure 7; Farmer et al., 2022). These findings are supported by directed research and survey efforts, public sightings, and fisheries bycatch data that indicate the Mississippi River Delta is likely an important aggregation site (NOAA 2024; NMFS, unpublished data).

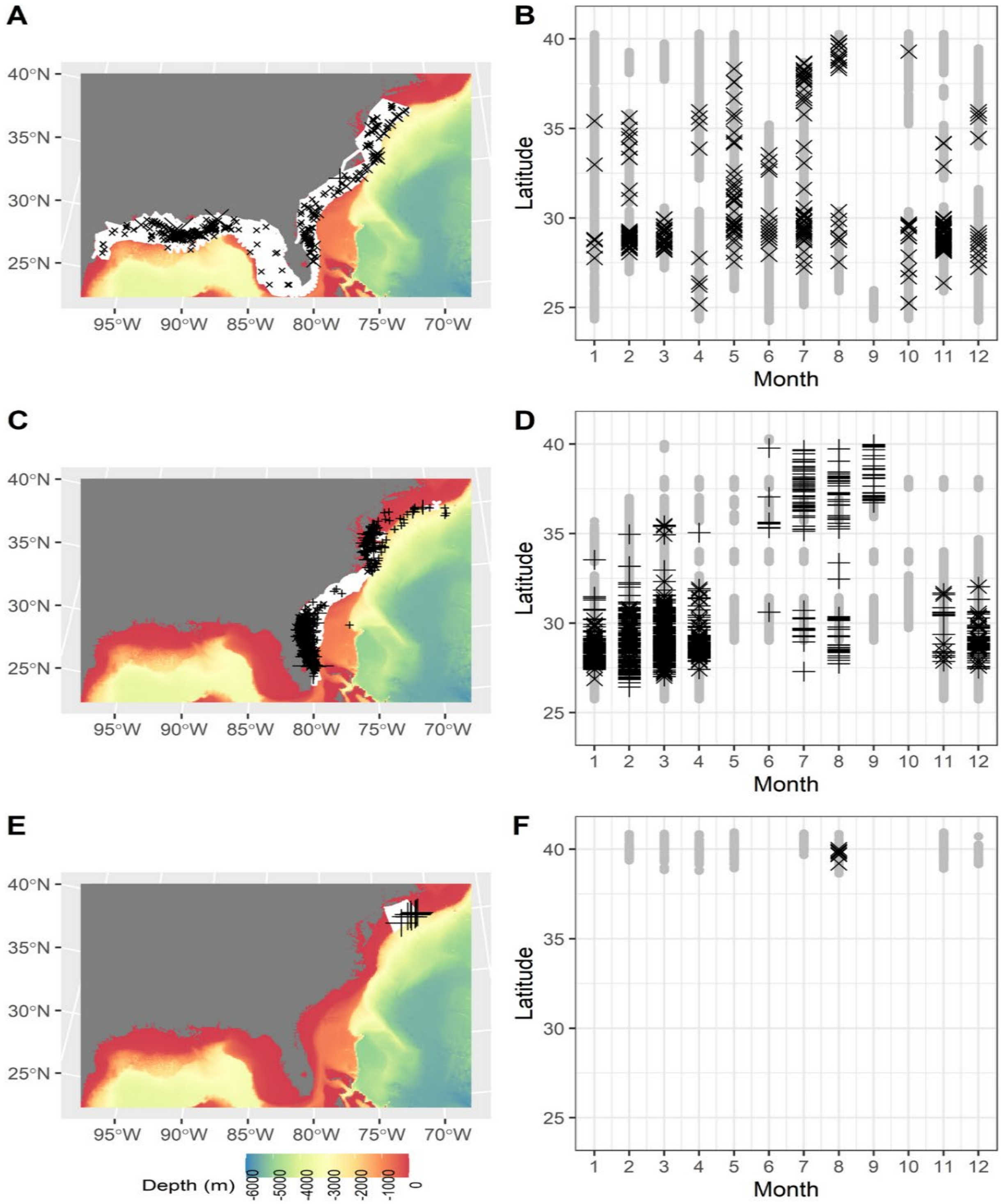


Figure 7: (A) Spatial distribution relative to coarse-scale bathymetry (red = shallow; blue = deep) and survey effort (white lines) and (B) spatio-temporal distribution of survey effort (gray circles) and manta ray sightings (X: on effort, + : off effort; scaled to number reported within survey) by Southeast Fisheries Science Center, (C,D) North Atlantic Right Whale Consortium, and (E,F) Normandeau Associates aerial surveys for New York State Energy Research and Development Authority. Source: Farmer et al., (2022).

Predators and Competitors

Manta rays are frequently sighted with non-fatal injuries consistent with shark attacks, although the prevalence of these sightings varies by location (Homma et al. 1999; Ebert 2003; Mourier 2012). Deakos et al. (2011) reported that scars from shark predation, mostly on the posterior part of the body or the wing tip, were evident in 24% of reef manta ray individuals (n=70 individuals with injuries) observed at a manta ray aggregation site off Maui, Hawaii. Off eastern Australia, Couturier et al. (2014) observed 23% of reef manta rays had shark scars. Approximately 76% of reef manta rays bear bite wounds of predatory sharks in southern Mozambique (Marshall & Bennett 2010a). Because the damage from a shark bite usually occurs in the posterior region of the manta ray, there may be disfigurement leading to difficult clasper insertion during mating or inhibited waste excretion (Clark and Papastamatiou 2008).

Population Dynamics

Population Size

Although the global population size is not known, regional populations have been estimated in Ecuador, Indonesia, Mexico, and Mozambique. Ecuador's Machalilla National Park and the Galapagos Marine Reserve is thought to be home to the largest identified population of giant manta ray in the world, with the estimated population size of 11,022 (95% CI: 9,095-13,357) for females and 11,294 (9,456-13,490) for males (Hearn et al., 2014; Harty et al., 2022). The next largest population has been noted in Raja Ampat, Indonesia, but is much smaller, estimated at around 1,875 individuals (Beale et al., 2019). The other estimated populations are similar in size, with 1,172 individuals the Revillagigedo Archipelago, Mexico (Cabral et al., 2023), more than 400 individuals in Banderas Bay, Mexico (Domínguez-Sánchez et al., 2023), and 600 individuals Mozambique (Marshall 2008). Preliminary (uncorrected for availability bias) relative abundance estimates for giant manta rays in the northwest Atlantic Ocean and the Gulf, U.S., suggest an abundance ranging from approximately 5,000–14,000 individuals with a coefficient of variation between 14–20%, depending on the month (N. Farmer unpubl. data 2023). Preliminary satellite tagging returns from nine individuals suggest manta rays in the southeast spend a median of 14% of their time within depths visible to aerial observers; adjusted estimates for this availability bias suggest 47,802±121,032 (mean ± SD; range 8,206–161,804) individuals in the northwest Atlantic off the eastern U.S. (N. Farmer unpubl. data 2023). Locally, abundance varies substantially and may be based on food availability and the degree that they were, or are currently, being fished. In most regions throughout their range, the number of giant manta rays observed over the years appear to be small (fewer than 1,000 individuals) (NMFS 2024).

Population Variability

The trend of the number of individuals within populations varies widely across the species range, but trends appear stable where they are protected and declining rapidly where fishing pressure is greater (Marshall et al., 2022). For example, sighting trends appear stable where they receive some level of protections, such as Hawaii (Ward-Paige et al., 2013) and Ecuador (Holmberg and Marshall 2018), although individuals sighted in Ecuador seasonally migrate to Peru (A. Marshall unpubl. data 2019) where directed fishing occurs (Heinrichs et al., 2011). Elsewhere, the number of individuals is likely to be declining in places where the species is targeted or caught regularly as bycatch. For example, in southern Mozambique, a 94% decline in diver sighting records occurred over a 15-year period in a well-studied population (Rohner et al., 2017). Similarly, at Cocos Island, Costa Rica, there has been an 89% decline in diver sighting records of giant manta rays over a 21-year period (White et al., 2015). These steep declines have occurred in less than one-generation length (29 years) (Marshall et al., 2022). Although sparse, the available data suggest that target fisheries in some regions have rapidly depleted localized populations of the giant manta ray; local extinction is suspected to have occurred in many parts of their historical range. Globally, the suspected population reduction is 50–79% over three generation lengths, with a further population reduction suspected over the next several generations based on current and ongoing threats and exploitation levels, steep declines in monitored populations, and a reduction in area of occupancy (Marshall et al., 2022).

Range and Distribution
Within the Northern hemisphere, the giant manta ray has been documented as far north as the following locations: New York, U.S. and the Azores Islands in the Atlantic Ocean region; the Sinai Peninsula, Egypt in the Indian Ocean region; and Mutsu Bay, Aomori, Japan and southern California, U.S. in the Pacific Ocean region (Figure 8; Lawson et al., 2017; Kashiwagi et al., 2010; Moore 2012; CITES 2013; Sobral and Alfonso 2014; Knochel et al., 2022; Farmer et al., 2022). In the Southern Hemisphere, the species has been observed as far south as Peru in the eastern Pacific Ocean, Uruguay and St. Helena Island in the Atlantic Ocean, South Africa and Australia in the Indian Ocean, and off Tasmania, New Zealand, and French Polynesia in the western and central Pacific Ocean (Figure 8; Lawson et al., 2017; Mourier 2012; CITES 2013, Couturier et al., 2015; Carpentier et al., 2019, Beard et al., 2021).

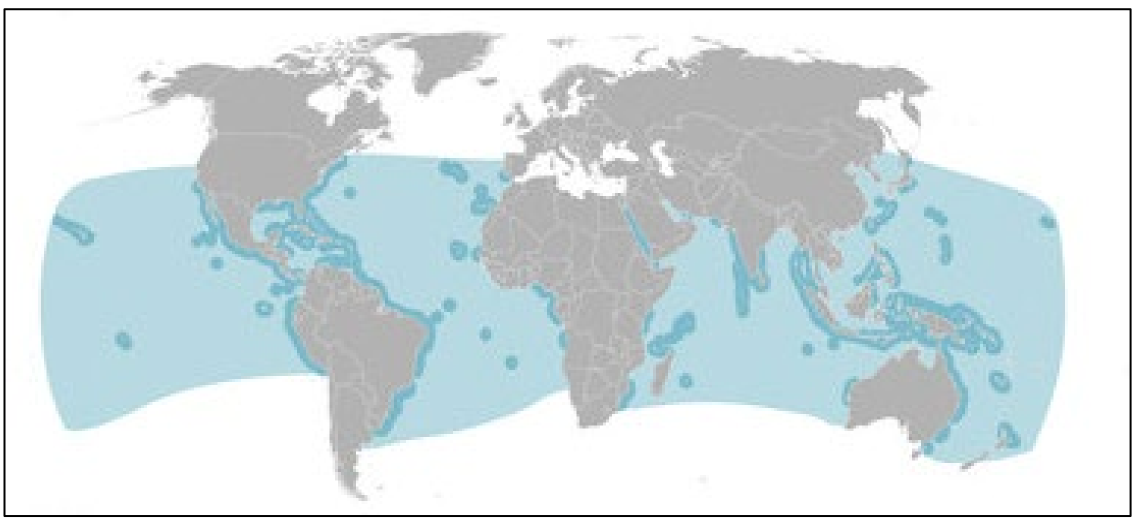


Figure 8: Geographic range of giant manta ray showing confirmed locations (extend in dark blue) as well as presumed range (possibly extant in light blue) (Lawson et al., 2017).

<u>Biotic and Abiotic Factors Dictating Range / Distribution</u>
Giant manta rays are commonly sighted in aggregations at many locations throughout their range, including: Similan Islands (Thailand); Raja Ampat (Indonesia); Sharm el-Sheikh (Egypt); Fuvahmulah and Addu Atolls (Maldives); northeast North Island (New Zealand), Kona, Hawaii (U.S.); U.S. Atlantic and the Gulf, Brazil; Cabo Verde; Isla de la Plata (Ecuador); Ogasawara Islands (Japan); Isla Margarita and Puerto la Cruz (Venezuela); northern coast of the Yucatan Peninsula; Isla Holbox; Revillagigedo Islands; and Bahia de Banderas (Mexico) (Notarbartolo-di-Sciara and Hillyer 1989; Homma et al., 1999; Duffy and Abbott 2003; Luiz et al., 2009; Clark 2010; Kashiwagi et al., 2010; Marshall et al., 2011a; Stewart et al., 2016a; Hacohen-Domené et

al., 2017; Hilbourne and Stevens 2019; Pate 2024; Farmer et al., 2022; Knochel et al., 2022; Domínguez-Sánchez et al., 2023; Garzon et al., 2023). The timing of these aggregations varies by region and seem to correspond with the movement of zooplankton, climatic fluctuations (e.g., El Niño Southern Oscillation), current circulation and tidal patterns, seasonal upwelling, seawater temperature, and possibly mating behavior (Couturier et al., 2012; De Boer et al., 2015; Armstrong et al., 2016; Hacohen-Domené et al., 2017; Beale et al., 2019; Nicholson-Jack et al., 2021; Domínguez-Sánchez et al., 2023, Garzon et al., 2023). For example, in the U.S. Atlantic and the Gulf, the distribution of manta rays was found to be influenced primarily by sea surface temperature, with a clear expansion to the north during warmer months (Farmer et al., 2022). Additionally, within the preferred thermal range (approximately 68–86°F), manta rays occurred most frequently either nearshore or along the continental shelf-edge, at locations best predicted by proxies for productivity such as thermal fronts, bathymetric slope, and high chlorophyll-a concentration (Farmer et al., 2022).

Threats

Past and Current Threats Resulting in Population Declines

The largest cause of direct mortality of giant manta rays globally is targeted fishing and capture as bycatch (Croll et al., 2016; NMFS 2024), though they face a range of other threats including marine pollution, vessel strikes, and entanglement (NMFS 2024). In addition, while there is no direct evidence, there is concern for this species as a result of impacts associated with climate change (Essumang 2010, Ooi et al., 2015, Stewart et al., 2018).

Fisheries (Foreign)

Giant mana rays are both targeted and caught incidentally in industrial and artisanal fisheries (Couturier et al., 2012; Croll et al., 2016; Stewart et al., 2018). These rays are captured in a wide range of gear types including harpoons, drift nets, purse seine nets, gill nets, traps, trawls, and longlines. Manta rays are also caught in bather protection nets (Cliff and Dudley 2011, Department of Agriculture and Fisheries 2018). Their coastal and offshore distribution, and tendency to aggregate, makes giant manta rays particularly susceptible to bycatch in purse seine and longline fisheries and targeted capture in artisanal fisheries (Croll et al. 2016; Duffy and Griffiths 2017). In particular, giant manta rays are easy to target because of their large size, slow cruising speed, tendency to aggregate, predictable habitat use, and lack of human avoidance (Couturier et al., 2012).

Manta ray catches have been recorded in at least 30 large and small-scale fisheries covering 25 countries (Lawson et al., 2016). The largest documented target fisheries are Indonesia, the Philippines, and India (NMFS 2024). While many artisanal fisheries have grown to meet international trade demand for gill plates as discussed below, some still target these manta rays mainly for food and local products (White et al., 2006, Essumang 2010, Rohner et al., 2017).

Global landings of mobulid species, including giant manta rays, have been increasing steadily due in large part to the recent rise (from the 1990s onwards) in demand for gill plates (Croll et al., 2016; O'Malley et al., 2017). Many former bycatch fisheries have become directed commercial export fisheries (Dewar 2002; White et al., 2006; Heinrichs et al., 2011; Fernando and Stevens 2011). Between 2000 and 2007, total landings of 'Mantas, devil rays nei' ('nei' refers to 'not landed elsewhere') increased from 900 tons to over 3,300 tons according to the FAO

Fishstat Capture Production database (Lack and Sant 2009). This equates to an average of 1,593 metric tons being landed annually, with this average increasing to 4,462 metric tons annually from 2008 to 2017 (Oakes and Sant 2019). These reported landings likely underestimate total fishing-related mortality (Ward-Paige et al. 2013; Marshall et al. 2022).

In the markets of Guangzhou, China, where 99% of mobulid products are routed, mobulid products are sourced from over 20 countries and regions (O'Malley et al. 2017). The source locations for the largest amounts of product are Indonesia, Sri Lanka, India, China, and Vietnam (O'Malley et al., 2017). Demand for products has driven up the price and traded volume of these products in recent decades. Between 2011 and 2013, there was an increase from 60 to 120 tons of mobulid product moved through shops in Guangzhou (O'Malley et al. 2017).

In the Western Indian Ocean, Romanov (2002) estimated that between 253 and 539 manta rays and devil rays were being caught per year as bycatch in purse seine fisheries, and between 2003 and 2007, 35 manta rays were observed in purse seine bycatch, most of which were likely giant manta rays (Amandè et al. 2012). In the Western and Central Pacific Ocean, from 1998 to 2015, approximately 4,646 individuals were caught by purse seine fisheries and 454 individuals caught by longline fisheries (Tremblay-Boyer and Brouwer, 2016). While a few individuals were released in good condition, post-release mortality which may occur after an individual has been released alive but later dies as a result of the stress and injury accrued during capture is likely to be high as most were released alive but injured (Tremblay-Boyer and Brouwer, 2016; Francis and Jones 2017). The Eastern Pacific purse seine fisheries show a substantial increase in the bycatch of mobulid rays, including giant manta rays, from 20 tons per year before 2005 to 150 tons per year by 2006, which then reduced to 10 tons per year by 2009 (Hall and Roman 2013; Marshall et al., 2022). The Inter-American Tropical Tuna Commission purse seine vessels operating from 1993 to 2015 reported an average catch of approximately 135 giant manta rays per year (Miller and Klimovich 2017). A susceptibility analysis indicated that negative interactions with fishing gear and unintended mortality will continue to be an issue with this species as these fisheries coincide with high productivity areas where giant manta rays are likely to aggregate for feeding (Duffy and Griffiths 2017; Duffy et al., 2019; Marshall et al., 2022).

Federal Fisheries (Southeast U.S.)

The giant manta ray is caught as bycatch in a number of U.S. commercial fisheries operating in the Atlantic Ocean and the Gulf. Much of the data comes from fisheries observer programs in the Southeast U.S. Fisheries observers are the only independent bycatch data collection source for commercial fishing. It is important to note that the new bycatch information is the result of the observer program efforts to expand data collection and species identification following the listing of the giant manta ray under the ESA. Federal fisheries observer programs in the Southeast began identifying and recording bycatch for the giant manta ray in 2019 providing a better understanding of U.S. commercial fisheries interactions with giant manta rays.

Based on the observer data, the Southeast U.S. commercial fisheries that use trawls, pelagic and bottom longlines, gillnet, and hook and line gears incidentally capture giant manta rays. Of these fisheries, shrimp trawl and pelagic longline gears appear to be interacting with giant manta rays the most, followed by bottom longline, and gillnet. Dispositions of the giant manta rays are recorded at the vessel (i.e., released alive, discarded dead, or disposition unknown). In addition, it is important to note that numerous records exist within the bycatch data where species identification was not determinable and thus generically recorded as “ray” or “mobulid”. This information does not include potential post-release mortality.

The Southeast Shrimp Trawl Fishery

The Southeast U.S. shrimp fishery operates within the EEZ in the Gulf and U.S. Atlantic. Based on data collected by the observer program, between 2019 and April 2024, approximately 37 giant manta rays were incidentally captured (NMFS unpublished data), with 26 released alive, 4 dead, and 7 discarded with an “unknown” disposition (NMFS unpublished data, 2024). It is likely that total giant manta ray bycatch is higher because the observer coverage in this fishery is less than 2%, meaning that bycatch data is only recorded for a very small percentage of the shrimp trawl fishery. The majority of interactions have been recorded off the coast of Louisiana, followed by coastal areas near the Florida/Georgia border. Yet, the lack of interactions observed in the U.S Atlantic may be due to very low observer coverage, as several recent studies indicate that north and central Florida is likely an important habitat for migration, foraging and reproduction (Farmer et al., 2022; Pate and Fong 2023; 84 FR 66652). The majority of interactions have occurred in Federal waters, although there are records in State waters as well (NMFS unpublished data, 2024).

On April 26, 2021, the NMFS SERO issued a Biological Opinion on the implementation of the sea turtle conservation regulations under the ESA and the authorization of the southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act (NMFS 2021b). As part of the Opinion, an incidental take statement was issued that anticipated the non-lethal capture of 16,780 giant manta rays over 10 years (averaging 1,678 giant manta rays per year) in the shrimp trawl fishery. No giant manta ray mortalities were anticipated because there were no records of lethal interactions at that time. The incidental take estimate was based on 1 year of data, which included 12 interactions documented during that time, and was highly uncertain (Carlson 2020). In 2023, the Opinion was reinitiated because there were giant manta ray mortalities documented by the observer program.

The Pelagic Longline Fishery

The Pelagic Longline Fishery for Atlantic Highly Migratory Species incidentally captures giant manta rays during fishing operations. This fishery comprises relatively distinct segments including: Caribbean, the Gulf, Florida east coast, South Atlantic bight, mid-Atlantic bight, northeast coastal Atlantic, northeast distant waters, Sargasso Sea, and Offshore waters. Observer coverage is maintained at a minimum of 8%, but some years have higher coverage (NMFS 2020a). From 2020 through 2023, observers (9.9% coverage) recorded 9 giant manta rays captured in pelagic longline gear, with 3 documented at-vessel mortalities (NMFS unpublished data). These captures occurred in the mid-Atlantic bight, northeast coastal Atlantic, and the Gulf fishing zones. Giant manta rays were not recorded as bycatch at the species level until 2019 (following listing late 2018); however, a review of photographs from observers confirmed at least four giant manta rays were caught in the Gulf in 2008, 2013, and 2014, respectively (C. Jones, NMFS, pers. comm. to C. Horn, NMFS, December 20, 2018). Of note, the majority (approximately 71%) of mobulid bycatch records from 2019–2023 lacked identification to the species level; it is unclear what percentage of these records were comprised of giant manta ray.

On May 15, 2020, NMFS SERO issued an Opinion on the operation of the Pelagic Longline Fishery for Atlantic Highly Migratory Species in federal waters under the Magnuson-Stevens Act (NMFS 2020a). As part of the Opinion, an incidental take statement was issued that anticipated the non-lethal capture of 366 giant manta rays and 6 mortalities over 3 years in the Pelagic Longline Fishery. At that time, the incidental take estimate was uncertain as there was limited incidental capture data of giant manta rays, including mortality data. In addition, uncertainty surrounded species identifications made by the observers as most records pre-dated the ESA listing of giant manta rays and subsequent observer training. In 2022, the Opinion was reinitiated because the number of mortalities documented by the observers have exceeded what was authorized in the 2020 Opinion.

The Shark and Reef Fish Bottom Longline Fisheries
The shark and commercial reef fish bottom longline fisheries are active in the Atlantic Ocean from about the Mid-Atlantic Bight to south Florida and throughout the Gulf. Observer data coverage is 3.9% of total fishing effort (Decossas and Mathers, 2023). NMFS has documented four observations of giant manta ray captures in both the shark and reef fish bottom longline fisheries (NMFS unpublished data, 2023). These captures occurred in the Southeast Atlantic and the Gulf. All individuals were released alive.

The Coastal Migratory Pelagic Fishery
The CMP Fishery operates in the Atlantic Ocean and the Gulf. The fishery primarily targets king mackerel, Spanish mackerel, and the Gulf Migratory Group of cobia. The main gear types used in the CMP fishery are hook-and-line (including trolling), cast net, and gillnet. Diver-held spear guns are also a main gear type specific to cobia. On May 1, 2023, NMFS SERO issued a Biological Opinion on the operation of the CMP Fishery in federal waters under the Magnuson-Stevens Act (NMFS 2023c). As part of the Opinion, an incidental take statement was issued that anticipated the non-lethal capture of 714 giant manta rays and 63 mortalities (including post-release mortality) over 3 years in the CMP Fishery. The incidental take is highly uncertain and is based on discard logbook and observer program data from 2010 to 2020. The discards have percent standard error values over 100 indicating a high level of uncertainty (NMFS 2023c).

Consolidated Atlantic HMS Fishery
The Consolidated Atlantic HMS Fishery (excluding pelagic longline) operates within Federal waters of the U.S. EEZ. The gear types authorized include bandit gear, bottom longline, buoy gear, gillnets, green-stick, handline, harpoon, purse seine, rod and reel, and speargun. Giant manta rays have been recorded as catch in shark bottom longline gear, in the research fishery. Giant manta rays have not been reported as catch from other federal HMS bottom longline fisheries. Between 2008 and 2016, there were 2 giant manta rays reported caught in the shark bottom longline research fishery (SEFSC unpublished data). The shark bottom longline research fishery has 100 percent observer coverage. Between 2008 and 2016, one giant manta ray was observed caught in shark gillnet gear, including smoothhound gillnet gear, in 2012 (NMFS 2020). All were released alive. As part of the Opinion, an incidental take statement was issued that anticipated the non-lethal capture of 9 giant manta rays over 3 years in the Consolidated Atlantic HMS Fishery.

The U.S. Southeast Gillnet Fisheries
The U.S. Southeast gillnet fishery is active year round from North Carolina to the Gulf. Many states have banned gillnet fishing in state waters over the last decade and most gillnet fishing is

restricted to Federal waters. The shark gillnet fishery, includes drift, strike, and sink gillnets, operates in Federal waters and is a component of the Consolidated Atlantic Highly Migratory Species Fisheries Management Plan (NMFS 2020). In addition, sink gillnets and strike gillnets, are also a component of the CMP Fishery (discussed above, NMFS 2023c) to target primarily King and Spanish mackerel, and the Gulf migratory group of cobia in Federal waters. Observer coverage in the Southeast gillnet fishery has ranged from 5-15% depending on the year and available funding (Kroetz et al., 2020). Between 2001 and 2023, observers recorded eight giant manta ray captures, including one mortality (NMFS unpublished data). Giant manta rays were captured in drift (n=7) and strike (n=1) nets primarily targeting sharks and mackerel. All these interactions occurred in the U.S. Atlantic, with the majority occurring along Florida's east coast, followed by nearshore North Carolina (Kroetz et al., 2020).

State Fisheries

Various fishing methods used in state commercial and recreational fisheries, including gillnets, trawling, pot fisheries, and vertical line are all known to incidentally take giant manta rays, but information on these fisheries is sparse (NMFS 2024). Most of the state data are based on extremely low observer coverage, or giant manta rays were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem.

Commercial and Recreational Cobia Fishery

Two cobia stocks are found off the US Atlantic coast: Atlantic cobia and the Gulf Migratory Group (Gulf cobia). Gulf cobia occur throughout the Gulf and extend to Florida's east coast, while Atlantic cobia occur from Georgia north (84 FR 4733; February 19, 2019). The Gulf migratory cobia group is federally managed under the CMP FMP (discussed above, NMFS 2024c). The Atlantic States Marine Fisheries Commission and each state maintains management of the Atlantic migratory cobia group. While relatively small by the standards of the major recreational fisheries in Florida, the recreational cobia fishery in Florida has the highest recreational cobia landings among Atlantic or Gulf Coast states (84 FR 4733; February 19, 2019; ASMFC 2020).

On the Atlantic coast of central and north Florida there is a locally well-known and historically active cobia fishery in which anglers track giant manta ray migrations for the purpose of targeting cobia (Pate 2023; Braun et al., 2024). This is a fishing practice where anglers will seek out giant manta rays casting at or near them to target the cobia that are associated with the manta rays (Bishop, 1999; McNally, 2012; Roberts, 2022). In Florida giant manta rays are often seen trailing fishing gear (Pate and Marshall, 2020) which is not necessarily or immediately fatal, but may impair feeding and swimming behaviors or cause serious bodily injury and direct mortality as a result of entanglement and subsequent drowning (Deakos et al., 2011; Gallagher et al., 2014; Perryman et al., 2021). Recently, Braun et al., (2024) conducted a study that gathered data on angler knowledge, perceptions, and behavior in relation to the cobia fishery in central and north Florida and its relationship with resident and migrating giant manta ray. This study found that 60% of anglers reported actively tracking temperature changes in coastal waters to predict migration trends of both giant manta rays and cobia. Over 86% of anglers interviewed in this study reported they or their clients (charters) had incidentally hooked giant manta rays while casting at manta rays when fishing for cobia. In addition, 93% of anglers reported having observed giant manta rays with hooks and training lines or evidence of vessel strike injuries. In Braun at el. (2024), anglers described the hooked and entangled manta rays as looking “like a Christmas tree” or “like Mardis Gras”, suggesting individual manta rays are having a multitude of interactions with anglers in this fishery. Overcrowding and increased vessel activity is also a vessel strike concern as anglers have reported seeing an average maximum of 22 boats (range: 1–50) surrounding a single ray or group of rays at the same time (Braun et al., 2024). The available information indicates that this fishing practice results in a potentially significant amount of incidental hooking and an increased risk of vessel strike to the species in this area. Furthermore, it is likely that vessel overcrowding and incidental hooking are disrupting giant manta rays use of this area; including migration, feeding, and potentially reproduction as this area appears to be important habitat for this species (Pate 2023; 84 FR 66652; December 5, 2019).

Menhaden Purse Seine Fishery

The Gulf Menhaden Purse Seine Fishery occurs in state waters (e.g., bays, sounds, and nearshore coastal waters), primarily off Louisiana and Mississippi, with limited effort off Texas, Alabama, and Florida prohibits the use of purse seine gear (SEDAR 2018). This fishery is managed by the individual States under the Gulf States Marine Fisheries Commission Interstate Gulf Menhaden Fishery Management Plan (SEDAR 2018). The fishing season runs from the 3rd week of April through November 1st, approximately 140 days and the median number of sets per day is 4-5 (SEDAR 2018; Mroch 2018). The Mid-Atlantic Menhaden Purse Seine Fishery also occurs in state waters – this management unit is defined as the range of Atlantic menhaden within U.S. Atlantic, from the estuaries eastward to the offshore boundary of the EEZ (SEDAR 2020). The fishery is managed by the Atlantic States Marine Fisheries Commission under the Interstate Fishery Management Plan for Atlantic Menhaden (SEDAR 2020). Most sets occur within 3 miles of shore, with the majority of the effort occurring off North Carolina from November to January, and moving northward during warmer months to southern New England. Fishing effort is year-round with concentrated migratory peaks from May to September from Virginia northward, and November to January in North Carolina (MMPA LOF).

The gear and fishing methods used by the tuna purse-seine fisheries are similar to those used in the menhaden purse-seine fisheries in the Gulf and Mid-Atlantic. The tuna purse-seine fisheries operating in the Atlantic Ocean and Indo-Pacific Ocean are a significant source of mortality for giant manta rays. While the menhaden purse-seine fisheries deploy shorter nets (i.e., 100-400 ft) (SEDAR 2018) compared to the tuna purse-seine fisheries (4900-6500 ft) (Hall and Roman, 2013), the menhaden purse-seine fisheries operate similarly, by dropping a large cylindrical net and cinching it together at the bottom, like a drawstring purse, so that everything above is caught. The timing and location of the menhaden purse-seine fisheries overlap with the highest occurrences of giant manta rays, particularly in the Gulf, suggesting that interactions may be occurring. The Gulf Menhaden Purse Seine Fishery fishes primarily within Louisiana and Mississippi from the third week of April through the first week of November (SEDAR 2018). A species distribution model developed by Farmer et al., (2022), predicted the highest nearshore occurrence of giant manta rays within the Mississippi delta region from April to June and again from October to November. In addition, researchers conducting giant manta rays surveys (May and September, 2023) in coastal Louisiana have documented giant manta rays within close proximity of purse-seine fishing operations (C. Horn personal observations 2023; J. Pate unpublished 2023). Thus, multiple lines of evidence suggest the Gulf menhaden purse-seine fishing effort heavily overlaps with the peak nearshore occurrence of giant manta rays in the region. Along the U.S. Atlantic, Farmer et al., (2022) predicted the highest nearshore occurrence of giant mantas off northeast Florida during April, with the distribution extending northward along the shelf-edge as temperatures warm, leading to higher occurrences north of Cape Hatteras, North Carolina from June to October, and then south of Savannah, Georgia from November to March as temperatures cool. This suggests potential for spatiotemporal overlap between giant manta rays in the Atlantic and the Mid-Atlantic Purse Seine Fishery.

There is no direct evidence (i.e., bycatch data) showing that these fisheries are interacting with giant manta rays; however, the Gulf and Mid-Atlantic Purse Seine fisheries have inconsistent observer coverage and no requirements for reporting giant manta ray bycatch. Yet, it is widely understood that purse seine fisheries are a significant threat to giant manta rays (NMFS, 2024); considering this in combination with the spatiotemporal overlap between areas of high abundance and fishing effort, it is likely that interactions are occurring but being unobserved or unreported. To fully understand this potential threat, as well as potential management measures for minimizing any impacts to the species, more information is needed.

Recreational Fishing

Recreational fishing from private vessels and fishing piers may interact with giant manta rays. For example, giant manta rays have been observed and reported foul-hooked from boats, fishing piers, jetties, and by recreational anglers fishing for sharks during tournaments. Pate and Marshall (2020) found that 27% of the observed giant manta rays in southeast Florida were foul-hooked or entangled in fishing line, and, of those, 38% interacted with fishing gear more than once. More recent data found that of 152 individual manta rays recorded in southeast Florida, 23.7% had interactions with recreational fishing gear and, of those, 61% had multiple interactions (C. Horn., NMFS, pers comm to J. Pate, 2023). These manta rays were commonly seen in the vicinity of fishing piers and inlet jetties (Pate and Marshall, 2020) and anglers have been observed casting at juvenile manta rays (J.H. Pate unpublished data). NMFS has also documented several manta ray captures by anglers targeting sharks from the shore and also from vessels (C. Horn unpubl. data). While some fishing interactions may result in minimal permanent injury to the manta ray, they likely cause considerable stress and possible sub-lethal effects. When fishermen have accidentally hooked manta rays, fight times have been over one hour (J. Pate unpubl. data cited in Pate and Marshall, 2020). Fight time is correlated with physiological stress (i.e., lactate production) in elasmobranchs, with smaller sharks producing more lactate than larger sharks (Gallagher et al. 2014). Fishing line entanglement can have non-lethal effects, including truncated cephalic fins (Deakos et al., 2011), deep lacerations to the body (Pate and Marshall 2020), stress (Gallagher et al., 2014), and impaired feeding or swimming. In addition, amputations and disfigurements, specifically those of the cephalic fin, may reduce feeding efficiency, and the absence of this fin may negatively affect size, growth rate and reproductive success (Marshall and Bennett 2010, Deakos et al., 2011, Couturier et al., 2012, Stewart et al., 2018a). While no manta ray deaths have been directly attributed to recreational fishing, mortality may be cryptic as manta rays are negatively buoyant, reducing the likelihood of dead animals washing ashore.

Vessel Strike

Vessel strikes are evident in every monitored manta ray population across the globe (Stewart et al., 2018a). Spending considerable time at the surface (e.g., while feeding and basking; Braun et al., 2014; Braun et al., 2015) manta rays are especially susceptible to vessel strikes (McGregor et al., 2019; Stevens and Froman 2019; Armstrong et al., 2020; Augliere, 2020). Occurrence of vessel strikes are spatially variable and are more likely to occur where vessel density and manta ray aggregation along surface waters is high. For example, off the Ningaloo Coast, vessel strikes were highest during the seasonal aggregation of manta rays, which was attributed to an abundance of zooplankton around the area (McGregor et al., 2019). In French Polynesia, manta rays near inhabited islands are more likely to be observed with sub-lethal injuries caused by fishing gear or boat strikes than manta rays near uninhabited islands (Carpentier et al., 2019). In southeast Florida where human activity is heavily concentrated, vessel strike injuries were one of the most common sources of injuries for juvenile giant manta rays in the region, (Pate and Marshall 2020). In addition, in some parts of their range, such as the northwest Atlantic, it is likely that the seasonal contraction of suitable manta ray habitat during the warmer months increases their proximity to busy ports and could pose a serious threat to the species (Garzon et al., 2020). For example, Garzon et al. (2020) found that the Southeast U.S. followed by Venezuela and The Bahamas had the largest areas of overlap between predicted core manta ray habitat areas and intense commercial vessel traffic (Figure 9).

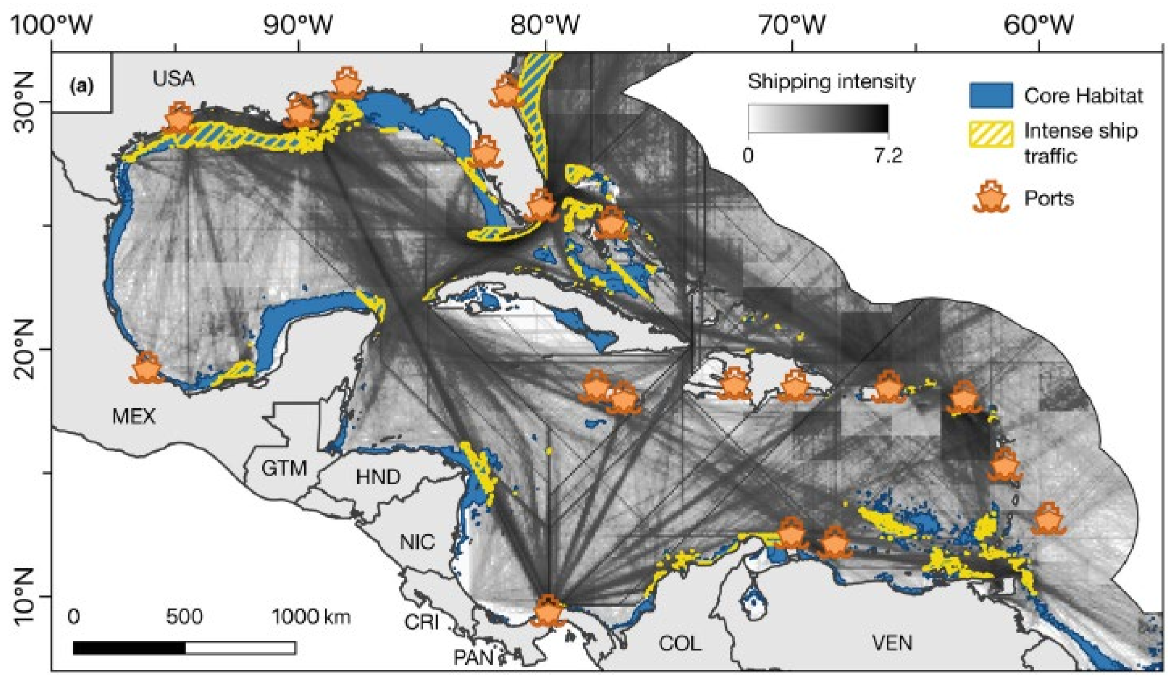


Figure 9: Core manta ray habitat predicted through ensemble ecological niche models with ship traffic, shipping routes and major ports displayed across the western central Atlantic. Source: Garzon et al. (2020)

The risk of vessel strike for giant manta rays is temporally and spatially variable (i.e., vessel strikes are more likely to occur where vessel density and manta ray density is high). In addition, when comparing the likelihood of vessel strikes on juveniles versus adults, the observed habitat use of juveniles may make them more prone to this threat (Strikes et al., 2022). For example, human activity and vessel traffic is extremely high in the giant manta ray nursery habitat along Florida's Atlantic coast and vessel strikes are one of the most common sources of injuries to juvenile giant manta rays that frequent the coastal waters there (Pate and Marshall, 2020). Of the known individual giant manta rays (n=179) occurring in southeast Florida, 15 individuals (8.4%) have been recorded with apparently non-lethal vessel strike injuries between June 2016 and December 2023 (J. Pate, pers. comm. to C. Horn, NMFS SERO PRD, January 12, 2024). However, interpreting reported vessel strike data can be difficult due to the fact that many vessel strikes are not detected or go unreported and there are reporting biases related to spatial coverage of reports (Pate and Marshall 2022; Garzon et al., 2020; McGregor et al., 2019). One source of underreporting for manta ray vessel strikes is the rapid wound healing characteristic of the species; McGregor et al. (2019) found that manta ray wound healing follows a negative exponential curve, with 37% of the wound closed after 33 days and 95% of the wound closed after 295 days. This suggests that for approximately 19% (295/365 days) of the year, surveys might not record a vessel strike due to rapid wound healing. Further, researchers note that identifying vessel strike injuries beyond the 95% healing is exceedingly difficult, especially when most photographs are poor quality making it difficult to observe the injury (C. Horn, NMFS pers comm. to J. Pate, MMF, July 18, 2024).

No information is currently available to estimate mortality rates to giant manta rays from vessel strikes. However, for sea turtles, greater than 75% of vessel strikes result in mortality with only 10-20% of vessel strikes being observed (Foley et al., 2019). The mortality rate for giant manta rays is likely higher because the giant manta ray's head and body cavity, which includes all major organs, is large, making up about approximately half of their body's surface area. While surface feeding and basking their body cavity and head are at the surface, unlike sea turtles, the giant manta ray has no hard shell to protect their vital organs, thus, making it more likely that injuries sustained to the head and body will be fatal. It is notable that all the vessel strike injuries documented within the southeast Florida survey domain have occurred on the individual's pectoral fins, not the head or body. Lethal vessel strikes are unlikely to be observed because giant manta rays sink once they die due to their lack of a swim bladder. For these reasons, the giant manta ray mortality rate and unobserved vessel strike death rate may be higher than sea turtles.

<u>Entanglement</u>

The giant manta ray is an obligate ram ventilator and mooring line entanglement can significantly restrict their ability to swim, rapidly leading to asphyxiation and death (Manta Trust 2019). Entanglement in mooring, anchor line, and buoy lines can also cause disfigurements and amputations (i.e., missing cephalic lobes) (Braun et al., 2015; Convention on Migratory Species 2014; Couturier et al., 2012; Deakos et al., 2011; Germanov and Marshall 2014; Heinrichs et al., 2011). Giant manta rays cannot swim backwards and often cannot see a thin mooring line directly in front of them as they swim forward. It is likely that giant manta rays become entangled because when the line makes contact with the front of the head between the cephalic lobes, the animal's reflex response is to close the cephalic lobes, thereby trapping the rope between the cephalic lobes, and entangling the animal as it begins to roll in an attempt to free itself (A. Marshall pers comm to C. Horn, NMFS, 2019). In 2017, a giant manta ray was documented as dead, entangled in a vessel exclusion line (steel cable) near Pompano Beach, Florida. The female measured 2.48 m in disc width and had no other signs of injury or fishing line entanglement. It is likely that the manta ray became entangled in the line and drowned (Pate et al., 2020). In Hawaii, numerous manta rays have been reported to have dead or have evidence (i.e., amputations or disfigurements) as a result of entanglement in mooring lines (Deakos, 2011). Mooring line entanglement have resulted in the death of numerous manta rays in the Maldives (Manta Trust, 2019). There have been several reported incidences of giant manta ray entanglements on vertical lines deployed during oil and gas activities. Oil and gas activities can deploy numerous vertical lines during operation including diver downlines, acoustic buoy release lines, acoustic pinger lanyards, nodal tether cables, and nodal lanyards etc. Similar to mooring line entanglements discussed above, the giant manta ray cannot see a vertical line directly in front of them and they become entangled once the line makes contact with their head, between the cephalic lobes, causing the animal to roll in an effort to free itself, thereby further entangling itself. There have been several confirmed reports of giant manta rays becoming entangled in vertical lines that deployed by commercial oil and gas divers in the Gulf in recent years (C. Horn and N. Famer unpubl. data 2022). For example, in 2013, 2021, and 2022, giant manta rays were reported and documented as entangled in a vertical downlines deployed by oil and gas divers. In addition, commercial oil and gas divers have reported numerous incidences of large rays, possibly giant manta rays in close proximity to underwater operations. It is thought that zooplankton is attracted to the underwater lights deployed by commercial divers. The amassing of zooplankton may be attracting giant manta rays to underwater operation sites where vertical lines are deployed, thereby increasing the risk of entanglement (C. Horn, NMFS, personal observation).

<u>Marine Pollution</u>

In locations with high densities of floating microplastics, giant manta rays may directly ingest microplastics (Stewart et al., 2018). Additionally, zooplankton can be contaminated with pollutants and toxins (Fossi et al., 2014) as well as ingest microplastics and nanoplastics (Cole et al., 2013; Setälä et al., 2014). This suggests that giant manta rays may be secondary consumers of microplastics and associated pollutants even if they are foraging in locations (or at depths) that do not have high densities of floating microplastics. Previous studies found elevated levels of some heavy metals in mobulid tissues (Essumang, 2009, 2010; Ooi et al., 2015), but low levels of POPs (Germanov et al., 2019). Phthalates and POPs have been recorded in tissue samples of baleen whales, basking sharks and whale sharks in areas with high levels of microplastic pollution (Fossi et al., 2014, 2016, 2017), indicating that filter feeding organisms are likely bioaccumulating these pollutants as a result of plastic ingestion. In addition, a number of studies have demonstrated that microplastics, POPs and heavy metals impact regular cellular and system functioning, including endocrine disruption, leading to knock-on negative impacts on reproductive output with the potential to alter populations and ecological assemblages of marine species (Jakimska et al., 2011; Rochman, 2013; Rochman et al., 2014; Galloway and Lewis, 2016; Sussarellu et al., 2016; Germanov et al., 2018). Yet, the implications of exposure to pollution and contaminants on the giant manta ray, remain speculative, especially at the level of individual fitness and population viability (Stewart et al., 2018).

<u>Oil and Gas Activities</u>

A recent ecological vulnerability assessment of elasmobranchs and other large pelagic fish found that giant manta rays have the highest ecological vulnerability (compared to other elasmobranch species) to oil spills within the Gulf (Romo-Curiel et al., 2022). Giant manta rays are highly susceptible to the negative health effects associated with oil exposure as they are filter feeders that form seasonal aggregations near oil and gas infrastructure in the Gulf (Carpenter, 2002; De la Parra Venegas et al., 2011; Couturier et al., 2012; Hueter et al., 2013; Worm et al., 2017; Germanov et al., 2018; Stewart et al., 2018; Kahane-Rabbort et al., 2022).

Giant manta rays can also come into contact with oil while swimming, resting, basking, and feeding in their habitats impacted by oil spills. Because giant manta rays are negatively buoyant, carcasses will sink, suggesting a low probability of observing lethal oil impacts to the species. Direct contact with oil can result in significant health effects and jeopardize the giant manta ray's survival. The effects of ingesting indigestible particles such as oil include blocking adequate nutrient absorption and causing mechanical damage to the digestive tract. The giant manta ray may also ingest toxins through their prey since zooplankton can be contaminated with oil and other toxins (Fossi et al., 2014; Cole et al., 2013; Setälä et al., 2014; Goswami et al., 2023) causing significant health implications. While studies have suggested that highly mobile fish, like the giant manta ray, may actively shift habitat to avoid oil, thereby reducing or minimizing exposure, this active avoidance may alter important behavior (i.e., foraging and reproduction) and migration patterns having detrimental effects on populations (Pulster et al., 2020; Dornberger et al., 2020; Romo-Curiel et al., 2022).

Climate Change

Warming oceans cause changes in ocean acidity, oxygen content, oceanic circulation, and primary productivity dynamics, ultimately affecting food web structure and the distribution and availability of mobulid prey (Moloney et al., 2011). The major impact of climate change on manta rays is likely to be the projected decline in zooplankton biomass in tropical waters (Stewart et al., 2018a). Biogeochemical models project a decline in zooplankton biomass in the future of about 10% globally (Chust et al., 2014; Stock et al., 2014; Woodworth-Jefcoats et al., 2017), but some regions, particularly those in the tropics, could experience >50% decline in zooplankton biomass (Stock et al., 2014). While it is unknown how this broad-scale decline in zooplankton biomass at the tropics could impact local areas where giant manta rays feed, the most likely outcome is that there will be lower zooplankton biomass available for manta rays. In addition, changes in climate and oceanographic conditions, such as acidification, are also known to affect zooplankton structure (size, composition, and diversity), phenology, and distribution (Guinder and Molinero 2013). As such, the migration paths and locations of both resident and seasonal aggregations of manta rays, which depend on these animals for food, may similarly be altered (Australian Government 2012; Couturier et al., 2012). To date, warming in northern latitudes off the US East Coast appears to have resulted in a significant northerly shift of manta ray distribution (Farmer et al., 2022). Resulting changes in zooplankton availability could affect the behavior and health of giant manta ray populations. For example, shifts in seasonal migration patterns to feeding grounds and nursery areas could have profound impacts on the species' survival. Additionally, some giant manta rays use coral reefs as cleaning stations where small fish remove parasites and dead or diseased skin from their bodies. As sensitive reef habitats degrade due to climate-driven changes, the abundance of cleaning stations and cleaner fish may be reduced (Jones et al., 2004; Graham et al., 2008). The loss of cleaning opportunities can hinder the giant manta ray's ability to reduce parasitic loads and dead tissue, leading to increased disease and reduced survival.

Aquarium Trade

The giant manta ray is traded internationally for display in public aquariums around the globe. Yet, there is limited information available on the number of animals taken from wild populations for the aquarium trade. There are several known aquariums that display manta rays harvested from wild populations for public display. These aquariums include the Georgia Aquarium (United States), Okinawa Churaumi Aquarium (Japan), Nausicaá National Sea Center (France), Atlantis Resort (The Bahamas), S.E.A Aquarium (Singapore), and uShaka Marine World (Durban, South Africa). The available information indicates that while some manta rays have died in captivity, others are transferred among aquariums. For example, the manta ray at UShaka Marine World outgrew its tank, and was eventually transferred to the Georgia Aquarium (Banks 2008). While most wild harvested individuals remain in captivity, the Atlantis Resort is one facility that has successfully returned 13 individuals to the wild populations (Rutger 2018). There is limited information available on the total number of individuals harvested for exhibition/aquarium purposes and whether those individuals are giant manta rays or reef manta rays. The only international trade data available comes from the CITES Trade Database. Since the giant manta ray was listed under Appendix II in 2016, the CITES Trade Database (https://trade.cites.org/) reports that two giant manta ray export permits were issued, both in 2018, for France to receive two giant manta rays from the United States for exhibition purposes.

With respect to domestic trade, Florida is the only state within the U.S. that authorizes giant manta ray harvest for aquarium and exhibition purposes. While giant manta rays are prohibited from harvest in Florida, the FWC authorizes harvest under a SAL for exhibition purposes. In 2009 and 2010, three giant manta rays were harvested from Florida's waters for exhibition purposes for the Georgia Aquarium. More recently, from 2019 to 2022, the FWC has issued 17 SALs for harvest for exhibition purposes. These SALs were issued to a number of aquarium facilities that were not previously known to exhibit/display manta rays, including: Nausicaá National Sea Center (France), Hainan Ocean Paradise (Hainan, China), Rizhao Ocean Park (Shandog, China), Changxing Taihu Longzhimeng Sea World (Shanghai, China), Chongqing Andover Ocean Park (Chongqing, China), SeaWorld Abu Dhabi (United Arab Emirates), and The National Aquarium LLC (Maryland, United States) (L. Gregg pers comm to C.Horn July 18, 2023). Yet, despite the SALs being issued, the facilities were not successful in harvesting any individuals from Florida waters. In addition, no CITES export permits were issued for the harvest licensed by the FWC. The FWC sets its annual harvest quota based on the traditional level of harvest request that the state has received for exhibition purposes (L. Gregg pers com to C. Horn, July 18, 2023).

Other Threats

While the overwhelming cause of species decline is fishing mortality, other non-lethal effects occur from numerous lesser threats, such as coastal development, anthropogenic noise, toxic blooms from algae and other microorganisms, military detonations and training exercises, in-water construction activities, aquaculture, and tourism. Coastal shoreline and lagoon habitats, which may serve as important nursery areas, are especially sensitive to habitat degradation, pollution, and sedimentation (McCauley et al., 2012, 2014; Stewart et al., 2018b; Pate and Marshall 2020). While these threats are known, the extent to which these impacts may affect individual health and overall population fitness is unclear (Couturier et al., 2012; Croll et al., 2016; Stewart et al., 2018).

5 ENVIRONMENTAL BASELINE

5.1 Overview

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the species, their habitats, and ecosystem 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 ecosystem. The environmental baseline describes the species' health based on information available at the time of the consultation.

By regulation, the environmental baseline for an Opinion refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal facilities that are not within the agency's discretion to modify are part of the environmental baseline (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 that occur in an action area, that will be exposed to effects from the action under consultation. This focus is important because, in some states or life history stages, or areas of their ranges, listed individuals will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other states, stages, or areas within their distributions. These localized stress responses or stressed baseline conditions may increase the severity of the adverse effects expected from the proposed action.

5.2 Baseline Status of ESA-Listed Species Considered for Further Analysis

Sea turtles and giant manta ray found in the immediate project area may travel widely throughout the Atlantic, the Gulf, and Caribbean Sea, and individuals found in the action area can potentially be affected by activities anywhere within this wide range. The status of these species in the action area, as well as the threats to these species, are supported by the species accounts in Section 4 (Status of the Species).

As stated in Section 2.2 (Action Area), the proposed action occurs in the Gulf, and includes the Sabine Banks Offshore Borrow Areas 1 and 2, the Eastern and Western Temporary Mooring Areas, the pipeline corridors, the vessel transit routes, the sand fill placement area in Texas NWR, and the areal extent of turbidity plumes generated during construction in the waters of the Gulf and Sabine Pass, Jefferson County, Texas.

5.3 Additional Factors Affecting the Baseline Status of ESA-Listed Species Considered for Further Analysis

5.3.1 Federal Actions

In recent years, NMFS has undertaken numerous ESA section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species or giant manta ray. Each of those consultations sought to develop ways of reducing the probability of adverse effects of an action on sea turtles or giant manta ray. Similarly, recovery actions NMFS has undertaken under the ESA are addressing the problem of take of sea turtles or giant manta ray in the fishing and shipping industries and other activities such as USACE dredging operations. The summary below of anticipated sources of incidental take of sea turtle species or giant manta ray from federal actions includes only those actions which have already concluded or are currently undergoing formal section 7 consultation.

Fisheries

Adverse effects on threatened and endangered sea turtles species or giant manta ray from several types of fishing gear occur in the action area. These gears, including gillnet, hook-and-line (i.e., vertical line), and trawl gear; have all been documented as interacting with sea turtles. For all fisheries for which there is a FMP or for which any federal action is taken to manage that fishery, the impacts have been evaluated via section 7 consultation. Formal section 7 consultations have been conducted on the southeast shrimp trawl fishery, which is the only federally-managed fishery operating in the action area.

The southeast shrimp trawl fishery affects more sea turtles than all other activities combined (NRC 1990). On April 26, 2021, NMFS completed reinitiation of the opinion for shrimp trawling in the southeastern United States analyzing the effects of this fishery on species listed since the listing of several new species under the ESA and after finalizing the rule requiring TEDs for a portion of the skimmer trawl fisheries. This opinion determined that the shrimp trawl fishery would not jeopardize the continued existence of any sea turtle species or of giant manta ray. An Incidental Take Statement has been issued for the take of sea turtles in this fishery. More detailed information can be found in the opinion (NMFS 2021).

Formal section 7 consultations have also been conducted for the issuance of several EFPs. These opinions have concluded the proposed activities may adversely affect but were not likely to jeopardize the continued existence of any sea turtles. Incidental Take Statements for each EFP issued were provided.

Federal Vessel Activity

Watercraft are the greatest contributors to overall noise in the sea and have the potential to interact with sea turtles through direct impacts or propellers. Sound levels and tones produced are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and vessels underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. Vessels operating at high speeds have the potential to strike sea turtles. Potential sources of adverse effects from federal vessel operations in the action area include operations authorized or conducted by BOEM, FERC, USCG, NOAA, and USACE. For example, vessels associated with projects funded, authorized, or permitted by federal agencies can have effects in the action area. Commercial fishing vessels operating in federally managed fisheries likely traverse through the area on their way to federal waters.

NMFS has also conducted ESA Section 7 consultations related to energy projects in the Gulf (BOEM and FERC) to implement conservation measures for vessel operations. Through the ESA Section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these vessel operations to avoid or minimize adverse effects to listed species. At the present time, they present the potential for some level of adverse effects.

Other potential sources of adverse effects from federal vessel activity and operations in the action area include operations of the USN and USCG. Through the ESA Section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. Refer to the Biological Opinions for the USCG (NMFS 1995; NMFS 1996) and the USN (NMFS 1996; NMFS 1997a; NMFS 2013) for details on the scope of vessel operations for these agencies and conservation measures implemented as standard operating procedures.

Dredging

The construction and maintenance of federal navigation channels and sand mining ("borrow") areas has also been identified as a source of sea turtle mortality. Hopper dredges move relatively rapidly (compared to sea turtle swimming speeds) and can entrain and kill sea turtles as the drag arm of the moving dredge overtakes the slower moving sea turtle. We originally completed a regional Opinion on the impacts of USACE's maintenance dredging and sand mining operations in the Gulf in 2003 (i.e., GRBO). We revised the GRBO in 2007 (NMFS 2007c), and concluded that: 1) Gulf hopper dredging would adversely affect Gulf sturgeon and 4 sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads), but would not jeopardize their continued existence; and, 2) dredging in the Gulf would not adversely affect leatherback sea turtles, smalltooth sawfish, or ESA-listed large whales. An Incidental Take Statement for adversely affected species was issued in this revised Opinion.

On March 5, 2024, NMFS issued an Opinion for USACE's proposal to widen and deepen the Sabine-Neches Waterway Channel in Texas and Louisiana. The Opinion issued an ITS for 2 species of ESA-listed sea turtles and for giant manta ray. NMFS concluded that the proposed action is not likely to adversely affect green sea turtle (North Atlantic DPS), leatherback and hawksbill sea turtle. NMFS also concluded that the proposed action is likely to adversely affect, but is not likely to jeopardize the continued existence of, Kemp's ridley sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), and giant manta ray.

Oil and Gas Exploration and Extraction

Federal and state oil and gas exploration, production, and development are expected to result in some sublethal effects to protected species, including impacts associated with the explosive removal of offshore structures, seismic exploration, marine debris, oil spills, and vessel operation. Many Section 7 consultations have been completed on BOEM oil and gas lease activities. Until 2002, these Opinions concluded only one sea turtle take may occur annually due to vessel strikes. Opinions issued on July 11, 2002 (NMFS 2002d), November 29, 2002 (NMFS

2002a), August 30, 2003 (Lease Sales 189 and 197 (NMFS 2003b), and June 29, 2007 (2007-2012 Five-Year Lease Plan (NMFS 2007a) have concluded that sea turtle takes may also result from vessel strikes, marine debris, and oil spills. Oil drilling may affect the action area and species in the action area, for example, if tar balls wash ashore or if there was a spill offshore. The effects of the DWH oil spill on sea turtles is discussed above and in the following subsection.

Impact of DWH Oil Spill on Status of Sea Turtles
The April 20, 2010, explosion of the DWH oil rig affected sea turtles in the Gulf. An assessment has been completed on the injury to Gulf marine life, including sea turtles, resulting from the spill (DWH Trustees 2015a). 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 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 (Section 4) sections for each species.

ESA Permits and Cooperative Agreements
The ESA allows the issuance of permits to take ESA-listed species for the purposes of scientific research (section 10(a)(1)(a)). In addition, the ESA allows for the NMFS to enter into cooperative agreements with states developed under section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with section 7 of the ESA.

Per a search of the NOAA Fisheries Authorizations and Permits for Protected Species (https://apps.nmfs.noaa.gov/) database by the consulting biologist on October 31, 2024, there were 5 active Section 10(a)(1)(A) scientific research permits applicable to ESA-listed sea turtle species within the action area. These permits allow the capture, handling, sampling, and release of these turtle species (all life stages except hatchlings).

Conservation and Recovery Actions Shaping the Baseline
Manta rays were included on Appendix II of CITES at the 16 Conference of the CITES Parties in March 2013, with the listing going into effect on September 14, 2014. Export of manta rays and manta ray products, such as gill plates, require CITES permits that ensure the products were legally acquired and that the Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species (after taking into account factors such as its population status and trends, distribution, harvest, and other biological and ecological elements). Although this CITES protection was not considered to be an action that decreased the current listing status of the threatened giant manta ray (due to its uncertain effects at reducing the threats of foreign domestic overutilization and inadequate regulations, and unknown post-release mortality rates from bycatch in industrial fisheries), it may help address the threat of foreign overutilization for the gill plate trade by ensuring that international trade of this threatened species is sustainable. Regardless, because the United States does not have a significant (or potentially any) presence in the international gill plate trade, we have concluded that any

restrictions on U.S. trade of the giant manta ray that are in addition to the CITES requirements are not necessary and advisable for the conservation of the species.

5.3.2 State and Private Actions

A number of activities in state waters that may directly or indirectly affect listed species include recreational and commercial fishing, construction, discharges from wastewater systems, dredging, ocean pumping and disposal, and aquaculture facilities. The impacts from some of these activities are difficult to measure. However, where possible, conservation actions through the ESA Section 7 process, ESA Section 10 permitting, and state permitting programs are being implemented to monitor or study impacts from these sources. Increasing coastal development and ongoing beach erosion will result in increased demands by coastal communities, especially beach resort towns, for periodic privately funded or federally sponsored beach nourishment projects. Some of these activities may affect listed species (e.g., sea turtles) and their critical habitat by burying nearshore habitats that serve as foraging areas. Additional discussion on some of these activities follows.

State Fisheries
Various fishing methods used in state commercial and recreational fisheries, including trawling, pot fisheries, gillnets, and vertical line are all known to incidentally take sea turtles, but information on these fisheries is sparse (NMFS 2001a). Most state data are based on extremely low observer coverage or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall problem.

To address data gaps, several state agencies have initiated observer programs to collect information on interactions between listed species and certain gear types. Other states have closed nearshore waters to gear-types known to have high encounter rates with listed species. Depending on the fishery in question, many state permit holders also hold federal permits; therefore, existing section 7 consultations on federal fisheries may address some of the state fishery impacts.

Additional information on impact of take (i.e., associated mortality) is also needed for analysis of impacts to sea turtles from these fisheries. Certain gear types may have high levels of sea turtle takes, but very low rates of serious injury or mortality. For example, hook-and-line takes rarely are dead upon retrieval of gear, but trawls and gillnets frequently result in immediate mortality. Hardshell turtles, particularly loggerhead sea turtles, seem to appear in data from almost all state fisheries. Texas and Louisiana have placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting takes place.

Observations of state recreational fisheries have shown that loggerhead, leatherback, and green sea turtles are known to bite baited hooks, and loggerhead sea turtles frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial fishermen fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001b). A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the TEWG reports (1998; 2000).

Vessel Traffic
Commercial traffic and recreational boating pursuits can have adverse effects on sea turtles and giant manta ray in particular via propeller and boat strike damage. The STSSN includes many records of vessel interactions (propeller injury) with sea turtles, and giant manta ray are also frequently observed with prop scars on their dorsal surface. Data show that vessel traffic is one cause of sea turtle mortality (Hazel and Gyuris 2006; Lutcavage et al. 1997). Stranding data show that vessel-related injuries are noted in stranded sea turtles. Data indicate that live- and dead-stranded sea turtles showing signs of vessel-related injuries continue in a high percentage of stranded sea turtles in coastal regions of the southeastern United States.

Coastal Development
Beachfront development, lighting, and beach erosion control all are ongoing activities throughout the action area. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. Still, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

5.3.3 Marine Debris, Pollution, and Environmental Contamination

Marine debris is a continuing problem for sea turtles and giant manta ray. Sea turtles living in the pelagic environment and giant manta ray 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). The number of oil drilling rigs operating in the Gulf make the prevalence of tar balls on beaches in the action area an ongoing problem. Adult and juvenile sea turtles may consume tar balls while they are foraging in the water and hatchlings on the beach may become entangled and trapped in the tar balls as the tar balls soften and melt in the sun.

Sources of pollutants along the action area include atmospheric loading of pollutants such as PCB, stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean, and groundwater and other discharges. Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of many other man-made toxins have not been investigated.

Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles (Colburn et al. 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. The species of turtles analyzed in this Opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

5.3.4 Acoustic Impacts

Acoustic effects are a known impact to ESA-listed sea turtles and giant manta ray and they are difficult to measure. Where possible, conservation actions are being implemented to monitor or study the effects to these species from these sources.

5.3.5 Stochastic Events

Stochastic events, such as hurricanes or cold snaps, occur in the action area and can affect ESA-listed sea turtles and giant manta ray in the action area. These events are unpredictable and their effect on the recovery of these ESA-listed sea turtles and giant manta ray is unknown; yet, they have the potential to impede recovery if animals die as a result or indirectly if important habitats are damaged.

5.3.6 Climate Change

As discussed earlier in this Opinion, there is a large and growing body of literature on past, present, and future impacts of global climate change. Potential effects commonly mentioned include changes in sea temperatures and salinity (due to melting ice and increased rainfall), ocean currents, storm frequency and weather patterns, and ocean acidification. These changes have the potential to affect species behavior and ecology including migration, foraging, reproduction (e.g., success), and distribution.

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 2007a). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007a). 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 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, etc.) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish, etc.) which could ultimately affect the primary foraging areas of sea turtles.

Warming in northern latitudes off the U.S. East Coast appears to have resulted in a significant northerly shift of manta ray distribution (Farmer et al. 2022). Similarly, climate change is expected to cause shifts in productivity of the Humboldt Current System (Bertrand et al. 2018), and increased ocean temperatures, deepening stratification, and changes in wind patterns may lead to variable effects on primary production and upwelling strength (Mogollón and Calil 2018, Oyarzún and Brierley 2018). Even though some protection measures are in place, changes to food web dynamics may impact foraging opportunities for manta rays, potentially causing shifts in their distribution and movement patterns that may influence their susceptibility to incidental capture, especially in regional fisheries (Harty et al. 2022; Stewart et al. 2018).

6 EFFECTS OF THE ACTION

6.1 Overview

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if the effect would not occur but for the proposed action and the effect is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

In this section of our Opinion, we assess the effects of the action on listed species that are likely to be adversely affected. The analysis in this section forms the foundation for our jeopardy analysis and destruction in Section 8. The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the action. We believe the data from hopper dredging and relocation trawling activities in the Sabine-Neches Waterway and covered by the March 5, 2024, Opinion is the best available data for estimating the adverse effects to sea turtle species and giant manta ray likely to be present in the action area for the proposed project. Below, the approach to our analysis is explained, including how uncertainty, causation, and the choice among a range of values are evaluated and addressed.

6.2 Effects of the Proposed Action on ESA-Listed Species Considered for Further Analysis

6.2.1 Routes of Effect That Are Not Likely to Adversely Affect ESA-Listed Species

Effects that are not likely to adversely affect green, Kemp's ridley, and loggerhead sea turtles and giant manta ray are discussed in Section 3.1.2, above.

6.2.2 Routes of Effect That Are Likely to Adversely Affect ESA-Listed Species

NMFS believes that the hopper dredging and relocation trawling components of the proposed action are likely to adversely affect the North Atlantic DPS of green sea turtles, Kemp's ridley sea turtle, the Northwest Atlantic DPS of loggerhead sea turtles, and giant manta ray.

Giant manta rays are likely to be captured by relocation trawling that will occur in connection with hopper dredging, though we lack records of captures of this species to accurately estimate the number that may be captured. The lack of data is a result of the recent listing of this species under the ESA in 2018 (83 FR 2916, January 22, 2018), and that prior reports of captures of rays were not accurately identified to know if they were giant manta rays. The best documentation that we have at the time of completion of this Opinion is from the northeast Atlantic, which is outside of the action area. The reports from the northeast Atlantic are reports of mantas caught as bycatch in fisheries where NMFS' observers document each interaction with a Mobulid ray by species when possible. Observations historically included giant manta ray, Atlantic devil ray, unidentified ray, unidentified manta, and *Mobulidae* (any manta and devil ray species that could not be confirmed to species). Because of the unique form and cephalic lobes adjacent to the mouth of manta and devil rays, it is unlikely that these records would have been listed more generally as an unidentified stingray or an unidentified ray; however, we do consider misidentification in these reports possible. Historically, many *Mobulidae* species may have been identified as giant manta rays because observers were provided with the Peterson's guide *Atlantic Coast Fishes* as a main source for identification, and the giant manta ray was the only large *Mobulidae* species shown. In 2015, NMFS NEFSC re-evaluated photo records of *Mobulidae* species and found that numerous historic records that were originally identified as giant manta rays were actually other *Mobulidae* species. Thus, historic records that did not include photos, or where photos were not detailed enough to determine a species, were then classified as an unidentified manta ray.

6.2.3 Hopper Dredging – Effects on Sea Turtles

A typical hopper dredge vessel operates with 2 trailing, suction dragheads simultaneously, 1 on each side of the vessel. Sand will be dredged from the borrow area and transported to the nearshore waters adjacent to the beach. There it will be dispersed via pump and pipeline from the hopper dredge.

Effects of Hopper Dredging
It has been previously documented in NMFS Biological Opinions that hopper dredges have captured, injured, and killed sea turtles. Available data indicates that within the Gulf Region for USACE (Texas, Louisiana, Mississippi, Alabama, and Florida), the following sea turtle take totals have been documented for civil and regulatory works projects occurring between 1995 to October 31, 2024 (ODESS database search October 31, 2024): 90 green sea turtles, 86 Kemp's ridley sea turtles, 168 loggerhead sea turtles, and 1 leatherback sea turtle. Hopper dredges are equipped with large centrifugal pumps similar to those employed by other hydraulic dredges. Dredged material is raised by dredge pumps through suction pipes (dragarms) connected to the intake (drag) in contact with the channel bottom and discharged into hoppers built in the vessel. Dragarms are hinged on each side of the vessel with the drag extending downward toward the stern of the vessel. The dragarm is moved along the bottom as the vessel moves forward at speeds up to 3-5 mph. The dredged material is sucked up the pipe and deposited and stored in the hoppers of the vessel.

Most sea turtles are able to escape from the oncoming draghead. However, hopper dredges can entrain and kill sea turtles if the drag arm(s) of the moving dredge overtakes a slower moving or stationary sea turtle. Entrainment refers to the animal being sucked through the draghead into the hopper. Turtles can also be entrained if suction is created in the draghead by current flow while the device is being placed or removed, or if the dredge is operating on an uneven or rocky substrate and rises off the bottom. Reports based on dredge take during USACE navigation channel maintenance projects suggest that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "cleanup" operations at the end of a dredge cycle when the bottom is trenched and the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand, thus sea turtles near the bottom may be more vulnerable to entrainment. In addition to entrainment, interactions with a hopper dredge result from crushing when the draghead is placed on the bottom or when an animal is unable to escape from the suction of the dredge and becomes stuck on the draghead (impingement). Mortality most often occurs when animals are sucked into the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper.

Interactions with the draghead can also occur if the suction is turned on while the draghead is in the water column (i.e., not seated on the bottom). USACE implements procedures to minimize the operation of suction when the draghead is not properly seated on the bottom sediments, which reduce the risk of these types of interactions. In addition, during dredging operations, protected species observers will live aboard the dredge, monitoring every load, 24 hours a day, for evidence of dredge-related impacts to protected species, particularly sea turtles and giant manta ray. When the dredge is transiting, observers will maintain a bridge watch for protected species and keep a logbook noting the date, time, location, species, number of animals, distance and bearing from dredge, direction of travel, and other information, for all sightings.

Because entrainment is believed to occur primarily while the draghead is operating on the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Within the action area, we expect effects to sea turtles from hopper dredge operations as these species are likely to be feeding on or near the bottom of the water column and thus are vulnerable to entrainment in the suction draghead of the hopper dredge.

Estimated Mortality from Hopper Dredging Impingement and Entrainment
To estimate take of green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic) sea turtles as a result of the proposed action, we analyzed the number of sea turtles killed by hopper dredging during previous hopper dredge projects within the Sabine-Neches Waterway Channel. The Sabine-Neches Waterway Channel is a subset of the entire Gulf Region (Texas, Louisiana, Mississippi, Alabama, and Florida) that we discussed in the previous section. Further, a portion of the Sabine-Neches Waterway Channel is included as part of the action area. Subsequently, we believe the data from hopper dredging and relocation trawling activities in the Sabine-Neches Waterway is the best available data for estimating the adverse effects to sea turtle species likely to be present in the action area for the proposed project.

Table 5 below shows the total number of lethal takes of sea turtle species in the Sabine-Neches Waterway Channel. Between February 1995 and March 2007, a total of 2 Kemp's ridley and 1 loggerhead sea turtle takes occurred within the Sabine-Neches Waterway Channel during O&M hopper dredging that removed 35,464,724 cy of material. Between April 2007 to May 2022, a total of 1 Kemp's ridley sea turtle and 2 loggerhead sea turtle takes occurred during O&M hopper dredging events within the Sabine-Neches Waterway Channel that removed 35,311,915 cy of material (USACE 2023). In 2024, one green sea turtle take occurred during O&M hopper dredging events within the Sabine-Neches Waterway Channel that removed 3,153,666 cy of material (USACE 2024)

Table 5. Total reported incidental lethal takes for sea turtles during O&M dredging by the USACE Galveston District in Sabine-Neches Waterway Channel between 1995 and 2024.

Time Period	Kemp's ridley sea turtle	Loggerhead sea turtle	Green sea turtle	Total Lethal Take	Total CY
1995-2007	2	1	0	3	35,464,724
2007-2022	1	2	0	3	35,311,915
2024	0	0	1	1	3,153,666
TOTAL	**3**	**3**	**1**	**7**	**73,930,305**

According to data provided by USACE, between 1995 and 2024, the USACE recorded 7 lethal takes of sea turtles during O&M dredging events within the Sabine-Neches Waterway Channel (i.e., 1 green, 3 Kemp's ridley, and 3 loggerhead sea turtles). Of those O&M dredging projects, none documented any lethal take of hawksbill or leatherback sea turtles during hopper dredging activities. Based on this information, we do not anticipate any lethal take of hawksbill or leatherback sea turtles from hopper dredging associated with the proposed project.

To estimate the number of green (North Atlantic DPS), Kemp's ridley, and loggerhead sea turtles (Northwest Atlantic DPS) that may be killed by the proposed action, we examined the ratio of documented green (North Atlantic DPS), Kemp's ridley, and loggerhead sea turtles (Northwest Atlantic DPS) killed to the total volume of material removed by the previous hopper dredging projects within the Sabine-Neches Waterway Channel. The cumulative volume of material dredged using a hopper dredge within the Sabine-Neches Waterway Channel is approximately 73,930,305 cy. When we divide the total cubic yards of material dredged by the total number of number green (North Atlantic DPS), Kemp's ridley, and loggerhead sea turtles (Northwest Atlantic DPS) observed as killed by a hopper dredge, we can calculate the expected observed mortality of each species per volume of dredged material for the proposed project.

Expected Observed Mortality of Sea Turtles by Species per Volume of Dredged Material
= (total yards dredged by hopper dredge) ÷ (number of reported takes by hopper dredge for each species)

Green Sea Turtle (North Atlantic DPS)
= 73,930,305 cy ÷ 1
= 1 expected green sea turtle mortality per 73,930,305 cy

Kemp's ridley Sea Turtle

= 73,930,305 cy ÷ 3
= 1 expected Kemp's ridley sea turtle mortality per 24,643,435 cy

Loggerhead Sea Turtle
= 73,930,305 cy ÷ 3
= 1 expected loggerhead sea turtle mortality per 24,643,435 cy

The proposed project estimates that a total of approximately 4,200,000 cy of material will be dredged from 2 offshore borrow areas located in the Sabine Banks using a hopper dredge.

Expected Observed Sea Turtle Mortalities by Species
= [(proposed volume of material to be dredged) ÷ (per volume total)] × (expected number of mortalities for each species)

Green Sea Turtle
= [(4,200,000 cy) ÷ (73,930,305 cy)] × (1 green sea turtle)
= 0.057 observed green sea turtle mortalities

Kemp's ridley Sea Turtles
= [(4,200,000 cy) ÷ (24,643,435 cy)] × (1 Kemp's ridley sea turtle)
= 0.170 observed Kemp's ridley sea turtle mortalities

Loggerhead Sea Turtles
= [(4,200,000 cy) ÷ (24,643,435 cy)] × (1 loggerhead sea turtle)
= 0.170 observed loggerhead sea turtle mortalities

Because the calculated number of observed mortalities is a fraction, we round this estimate to the nearest whole number for a total estimate listed in the table below.

Table 6. Estimated Number of Observed Sea Turtle Mortalities by Species.

Species	**Expected Number of Observed Mortalities Per Volume of Dredged Material**	**Expected Number of Observed Mortalities**
Green sea turtle	73,930,305 cy	1
Kemp's ridley sea turtle	24,643,435 cy	1
Loggerhead sea turtle	24,643,435 cy	1

As discussed above, dredged material screening by observers on hopper dredges is only partially effective, and observed interactions are expected to document only 50% of sea turtles entrained and killed by a hopper dredge. Thus, the anticipated observed and unobserved lethal take of sea turtles by the proposed action is show in Table 5 below.

Table 7. Expected number of Observed and Unobserved Sea Turtle Mortalities by Species

Species	Expected Number of Observed + Unobserved Mortalities
Green sea turtle	1 + 1 = 2
Kemp's ridley sea turtle	1 + 1 = 2
Loggerhead sea turtle	1 + 1 = 2

In addition to the sea turtle interactions by hopper dredge, project-required relocation trawling is reported. This information is discussed below, in our analysis of the effect of relocation trawling. It also helps us anticipate which species are likely to be within the action area, in the absence of specific population data (e.g., nesting, migration), and their relative abundances.

6.2.4 Relocation Trawling

Relocation trawling is a proven method of reducing the density of ESA-listed species in front of an advancing hopper dredge and very likely results in reduced lethal take from hopper dredging (NMFS 2007). Relocation trawling is conducted only when it can be done safely. Nets are pulled along the sea bottom for 30 minutes or less before each retrieval and re-setting. During relocation trawling, PSOs live aboard the trawlers, monitor all tows for endangered and threatened species, and record water temperatures, bycatch information, and any sightings of protected species in the area. Any sea turtle or giant manta ray captured during relocation trawling are photographed, measured, biopsied for genetics, tagged, and relocated at least 3 nm away. Giant manta ray captured by relocation trawling will be handled by qualified, third-party PSOs aboard the vessel who will be responsible for collecting measurements, recording and reporting data, tagging, and taking genetic samples of the captured species. Species-specific handling guidelines are provided in the NMFS Safe Handling and Release Guidelines in Appendix A that detail how the PSO will perform these tasks such as how to take a genetic sample on a specific species, when species should be brought on board or released directly into the water, and how to handle animals in distress, among others. During all phases of relocation trawling, the applicant is required to abide by established harm avoidance and minimization measures.

Effects of Relocation Trawling

The effects of relocation trawling and subsequent handling are expected to be non-lethal to captured sea turtles and giant manta ray. All sea turtles captured via relocation trawling are released unharmed in a nearby area that contains the same habitat as the areas where the trawling occurs; therefore, any habitat displacement effects associated with the relocation trawling capture are considered to be insignificant. Capturing the species and relocating it, however, is an effect to the species, which is evaluated below.

All giant manta rays will be released directly from the trawling net according to the NMFS Safe Handling and Release Guidelines in Appendix A. Giant mantra rays are large animals that are difficult to carry and maneuver; thus, releasing them directly from the net will reduce the risk of harm to this species when captured. Due to the size and maneuverability of this species, we do not expect that they will be taken by hopper dredging and therefore releasing them back into the dredging area from relocation trawling is the safest option for this species.

Estimated Take of Sea Turtles from Relocation Trawling
We consulted USACE's ODESS and existing take reports for the 2024 biological opinion for widening and deepening the Sabine-Neches Waterway Channel in Texas and Louisiana (SERO-2024-00049) for information on the number of sea turtles captured during previous relocation trawling that occurred within the Sabine-Neches Waterway Channel. Using that information, we were able to calculate the number of sea turtles relocated per cubic yard of dredged material. Looking at the volume of dredge material instead of the number of dredge events allows us to better understand and estimate the potential for interactions for a project of this size. Between 1995 and 2024, the USACE recorded dredging a total of 73,930,305 cy of material during hopper dredging events within the Sabine-Neches Waterway Channel.

Estimated Number of Sea Turtles Relocated per Cubic Yard of Dredged Material
= (total number of sea turtles relocated) ÷ (total volume dredged)
= 30 ÷ 73,930,305 cy
= 0.00000041 sea turtles per cubic yard dredged

The proposed project estimates that a total of approximately 4,200,000 cy of material will be dredged from the Sabine-Neches Waterway Channel using a hopper dredge. We multiply this volume by the ratio calculated above to determine the estimated total of sea turtles to be relocated for the remainder of the proposed project.

Estimated Total Number of Sea Turtles Relocated (All Species)
= (proposed volume of material to be hopper dredged) × (estimated number of sea turtles relocated per cubic yard of dredged material)
= (4,200,000 cy) × (0.00000041 sea turtles relocated)
= 1.72 sea turtles relocated (all species)

Because the calculated estimate is a fraction, and it is not possible to incidentally take just a portion of an animal, we round this estimate up to the nearest whole number. This gives us a total estimate of 2 sea turtles to be relocated for the 4,200,000 cy of material to be dredged using a hopper dredge.

To estimate the number of green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles to be potentially relocated for the proposed project, we looked at the breakdown of sea turtles captured and identified by species during previous relocation trawling that occurred within the action area. Table 8 shows the number of each sea turtle species captured during relocation trawling as well as the percentage of the total number of sea turtles captured represented by each species.

Table 8. Hopper Dredging Sea Turtle Relocation Trawling Data for the Sabine-Neches Waterway Channel, 2002-2024 (USACE data) [Note: Relocation trawling occurred only during the years listed for hopper dredging conducted within the Sabine-Neches Waterway Channel.]

Year	Green Sea Turtle Relocations	Kemp's ridley Sea Turtle Relocations	Loggerhead Sea Turtle Relocations	Hawksbill Sea Turtle Relocations	Unknown Species Relocations	Total Relocations (All species)
2002	0	3	5	0	0	8
2003	0	2	1	0	0	3
2006	0	2	3	0	0	5
2022	0	3	4	0	0	7
2024	0	7	0	0	0	7
TOTAL	**0**	**17**	**13**	**0**	**0**	**30**
Percentage	**0**	**56.67%**	**43.33%**	**0**	**0**	**100%**

Using the calculated species percentages for relocated sea turtles in Table 8, we can estimate the potential species composition for future captures of sea turtles during relocation trawling within the action area for the remainder of the proposed project.

Table 9. Estimated Non-Lethal Take by Sea Turtle Species for Relocation Trawling

Species	Non-lethal Capture Estimate	Rounded Non-Lethal Total
Green sea turtle (North Atlantic DPS)	1.72 × 0 = 0	0
Kemp's ridley sea turtle	1.72 × 0.5667 = 0.975	1
Loggerhead sea turtle (Northwest Atlantic DPS)	1.72 × 0.4333 = 0.745	1

The effects of capture and handling during relocation trawling can result in raised levels of stressor hormones and can cause some discomfort during tagging procedures. Based on past observations obtained during similar research trawling for sea turtles (i.e., small-scale trawling, not the type associated with large-scale maintenance dredging), these effects are expected to dissipate within a day (Stabenau and Vietti 2003). Since sea turtle recaptures are not common, and recaptures that do occur typically happen several days to weeks after initial capture, cumulative adverse effects of recapture are not expected. The reasoning behind this is sea turtles that are non-lethally taken by a closed-net trawl, which is observing trawl speed and tow-time limits, will be safely relocated to an area outside of the trawl area (typically 3-5 mi). If the sea turtle is captured again, the sea turtle will have had ample time to recover from the stress of the experience of the trawl net. This project differs from larger maintenance dredging projects, which would likely use larger relocation vessels with larger nets that can accommodate heavier catches and could potentially result in internal and external injuries to sea turtles, leading to the potential for post-release mortalities. Because of the smaller scale of this project, including the smaller relocation vessels and nets, and for the other reasons stated here, we do not anticipate any mortalities of healthy sea turtles associated with relocation trawling. Relocation trawling could injure or kill sea turtles with impaired health, but we do not anticipate this to occur.

Estimated Take of Giant Manta Ray from Relocation Trawling
Giant manta ray is likely to be captured by relocation trawling that will occur in connection with hopper dredging, though we currently lack records of captures of this species to accurately estimate the number that may be captured. The best available information we have at the time of completion of this Opinion is from the northeast Atlantic, which is outside of the action area. The reports from the northeast Atlantic are reports of mantas caught as bycatch in fisheries where NMFS' observers document each interaction with a Mobulid ray by species when possible. Based on the available unpublished NEFOP data from 2001-2015 of giant manta rays and unknown ray species captured in gear types used in the Northeast fisheries, we were able to estimate a CPUE based on the number of reported ray captures and the tow effort. The rays counted included those that were identified as giant manta rays through photo identification and others reported *Mobulidae* (any manta and devil ray species that could not be confirmed to species), assuming that they may have been giant manta ray. Table 10 shows the take that may occur under this Opinion using the calculated CPUE and multiplying it by the estimated number of tows under this Opinion. We used the maximum number of tows estimated to occur annually under this Opinion (i.e., 2,200 tows) to account for the likelihood of encountering more giant manta ray in the action area than the reported captures in a fishery in the northeast. Giant manta rays are year round residents in the action area for this Opinion, including some that migrate out of the action area.

Table 10. Estimated Relocation Trawling Captures of Giant Manta Ray (NEFOP data, 2001-2015)

	2001-2015
Total tows	57,829.12
Total Captures	11
CPUE	0.000190
Maximum annual estimated take (CPUE x 2,200 tows)	0.418

Because the calculated estimate is a fraction, we round this estimate up to the nearest whole number. This gives us a total estimate of 1 giant manta ray to be relocated for the material to be dredged from the borrow areas using a hopper dredge.

7 CUMULATIVE EFFECTS

ESA section 7 regulations require NMFS to consider cumulative effects in formulating its Opinions (50 CFR 402.14). Cumulative effects include the effects of future state or private actions, not involving federal activities, that are reasonably certain to occur within the action area considered in this Opinion (50 CFR 402.02). NMFS is not aware of any future projects that may contribute to cumulative effects. Within the action area, the ongoing activities and processes described in the environmental baseline are expected to continue and NMFS did not identify any additional sources of potential cumulative effect.

8 JEOPARDY ANALYSIS

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

The NMFS and USFWS's ESA Section 7 Handbook (USFWS and NMFS 1998) defines survival and recovery, as these terms apply to the ESA's jeopardy standard. Survival means "the species' persistence…beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment." The Handbook further explains that survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. Per the Handbook and the ESA regulations at 50 CFR 402.02, recovery means "improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Recovery is the process by which species' ecosystems are restored or threats to the species are removed or both so that self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities.

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of green (North Atlantic DPS), Kemp's ridley, or loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray. In Section 6.0, we outlined how the proposed action can adversely affect these species. Now we turn to an assessment of the species response to these impacts, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the Status of the Species (Section 4.0), the Environmental Baseline (Section 5.0), and the Cumulative Effects (Section 7.0), will jeopardize the continued existence of the affected species. For any species listed globally, our jeopardy determination must evaluate whether the proposed action will appreciably reduce the likelihood of survival and recovery at the species' global range. For any species listed as DPSs, a jeopardy determination must evaluate whether the proposed action will appreciably reduce the likelihood of survival and recovery of that DPS.

8.1 Sea Turtles

8.1.1 Green Sea Turtle (North Atlantic DPS)

Survival

The proposed action is expected to result in take of up to 2 green sea turtles (2 lethal, 0 non-lethal) from the North Atlantic DPS during the proposed project. The potential lethal take of up to 2 green sea turtles (1 observed, 1 not observed) during the project would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Potential lethal capture would also result in a reduction in future reproduction, assuming the individual was female and would have survived otherwise to reproduce. For example, as discussed in this Opinion, an adult green sea turtle can lay up to 7 clutches (usually 3-4) of eggs every 2-4 years, with a mean clutch size of 110-115 eggs per nest, of which a small percentage is expected to survive to sexual maturity. The potential lethal captures are expected to occur in a small, discrete area and green sea turtles in the North Atlantic DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce the species likelihood of survival depends on the probable effect that the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species (Section 4.1.2), we presented the status of the North Atlantic DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline (Section 5), we outlined the past and present impacts of all state, federal, or private actions and other human activities in or having effects in the action area that have affected and continue to affect the North Atlantic DPS.

In Section 4.1.2, we summarized the available information on a number of green sea turtle nesters and nesting trends at North Atlantic DPS beaches. In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Eight nesting sites have high levels of abundance (i.e., < 1000 nesters), located in Costa Rica, Cuba, Mexico, and Florida. Tortuguero, Costa Rica is by far the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff et al. 2015). A recent long-term study spanning over 50 years of nesting at Tortuguero found that while nest numbers increased steadily over 37 years from 1971-2008, the rate of increase slowed gradually from 2000-2008. After 2008 the nesting trend has been downwards, with current nesting levels having reverted to that of the mid 1990's and the overall long-term trend has now become negative (Restrepo, et al. 2023).

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (Meylan et al. 1994; Weishampel et al. 2003). Florida accounts for approximately 5% of nesting for this DPS (Seminoff et al. 2015). While nesting in Florida has shown dramatic increases over the past decade, individuals from the Tortuguero, the Florida, and the other Caribbean and Gulf populations in the North Atlantic DPS intermix and share developmental habitat. Therefore, threats that have affected the Tortuguero population as described previously, may ultimately influence the other population trajectories, including Florida. Given the large size of the Tortuguero nesting population, which is currently in decline, its status and trend largely drives the status of North Atlantic DPS.

Aside from the long-term increasing nesting trend observed in Florida, the declining trend in nesting observed in Tortuguero indicates a species in decline. However, since the proposed project is anticipated to result in the lethal take of up to 2 green sea turtles from the North Atlantic DPS, which is only a small fraction of the reduced but still large overall nesting population, and we have no reason to believe nesting females will be disproportionately affected, we believe the potential mortality associated with the proposed action will have no detectable effect on current nesting trends.

After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the species discussed in this Opinion, we believe the proposed project is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle (North Atlantic DPS) in the wild.

Recovery

The North Atlantic DPS of green sea turtles does not have a separate recovery plan at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991) does exist. Since the animals within the North Atlantic 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 North Atlantic DPS, is developed. The Atlantic Recovery Plan lists the following relevant recovery objectives over a period of 25 continuous years:

- *The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.*
- *A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.*

According to data collected from Florida's index nesting beach survey from 1989-2021, green sea turtle nest counts across Florida have increased dramatically, from a low of 267 in the early 1990s to a high of 40,911 in 2019. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011. The pattern departed from the low lows and high peaks in 2020 and 2021 as well, when 2020 nesting only dropped by half from the 2019 high, while 2021 nesting increased over the 2020 nesting, with another increase in 2022 still well below the 2019 high. This indicates that the first recovery objective is currently being met. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting, however, it is likely that numbers on foraging grounds have also increased, consistent with the criteria of the second listed recovery objective.

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

Conclusion
The potential lethal captures of up to 2 green sea turtles from the North Atlantic DPS associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the North Atlantic DPS of green sea turtle in the wild.

8.1.2 Kemp's ridley Sea Turtle

Survival
The proposed action is expected to result in take of up to 3 Kemp's sea turtles (2 lethal, 1 non-lethal) during the proposed project. Any potential non-lethal take is not expected to have a measurable impact on the reproduction, numbers, or distribution of this species. The individuals suffering non-lethal injuries are expected to fully recover such that no reductions in reproduction or numbers of Kemp's ridley sea turtles are anticipated. All non-lethal take will occur in the action area, which encompass a small portion of the overall range or distribution of Kemp's ridley sea turtles. Any captured animals would be released within the general area where caught and no change in the distribution of Kemp's ridley sea turtles would be anticipated.

The potential lethal take of up to 2 Kemp's ridley sea turtles (1 observed, 1 not observed) during the project would reduce the number of Kemp's ridley sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Potential lethal capture would also result in a reduction in future reproduction, assuming the individual was female and would have survived otherwise to reproduce. For example, females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs. The loss of 2 adult female Kemp's ridley sea turtles could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. The potential lethal take, however, is expected to occur in a small, discrete area and Kemp's ridley sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species (Section 4.1.3), we presented the status of Kemp's ridley sea turtle, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we considered the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area that have affected and continue to affect this sea turtle species.

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population trend. In Section 4.1.3, we summarized available information on the number of Kemp's ridley sea turtle nesters and nesting trends. At this time, it is unclear whether the increases and declines in Kemp's ridley sea turtle nesting seen over the past decade-and-a-half represents a population oscillating around an equilibrium point, if the recent three years (2020-2022) of relatively steady nesting indicates that equilibrium point, or if nesting will decline or increase in the future. Nonetheless, the full data set from 1990 to present continues to support the conclusion that Kemp's ridley sea turtles are increasing in population size. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the nesting trend information is increasing, we believe the potential lethal captures will not have any measurable effect on that trend.

After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the species discussed in this Opinion, we believe the proposed project is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the Kemp's ridley sea turtle in the wild.

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

- *A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.*

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. Recent data indicates an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017), but nesting for 2018 declined to 17,945, with another steep drop to 11,090 nests in 2019 (Gladys Porter Zoo data, 2019). Nesting numbers rebounded in 2020 (18,068 nests), 2021 (17,671 nests), and 2022 (17,418) (CONAMP data, 2022). At this time, it is unclear whether the increases and declines in nesting seen over the past decade-and-a-half represents a population oscillating around an equilibrium point, if the recent three years (2020-2022) of relatively steady numbers of nests indicates that equilibrium point, or if nesting will decline or increase in the future. Currently, we can conclude only that the population has dramatically rebounded from the lows seen in the 1980's and 1990's, and we cannot ascertain a current population trend or trajectory.

The potential lethal captures during the proposed action will result in a reduction in numbers and reproduction; however, it is unlikely to have any detectable influence on the nesting trends. Given annual nesting numbers are in the thousands, the projected loss is not expected to have any discernable impact to the species. Any non-lethal capture would not affect the adult female nesting population. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of recovery of Kemp's ridley sea turtles in the wild.

Conclusion
The combined lethal and non-lethal captures of up to 3 Kemp's ridley sea turtles associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the Kemp's ridley sea turtle in the wild.

8.1.3 Loggerhead Sea Turtle (Northwest Atlantic DPS)

The proposed action is expected to result in take of up to 3 loggerhead sea turtles (2 lethal, 1 non-lethal) from the Northwest Atlantic DPS during the proposed project. Any potential non-lethal take is not expected to have a measurable impact on the reproduction, numbers, or distribution of this species. The individuals suffering non-lethal injuries are expected to fully recover such that no reductions in reproduction or numbers of loggerhead sea turtles are anticipated. All non-lethal take will occur in the action area, which encompass a small portion of the overall range or distribution of loggerhead sea turtles within the Northwest Atlantic DPS. Any captured animals would be released within the general area where caught and no change in the distribution of Northwest Atlantic DPS of loggerhead sea turtles would be anticipated.

The potential lethal take of up to 2 loggerhead sea turtles (1 observed, 1 not observed) during the project would reduce the number of Northwest Atlantic DPS loggerhead sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Potential lethal capture would also result in a reduction in future reproduction, assuming the individual was female and would have survived otherwise to reproduce. For example, an adult female loggerhead sea turtle can lay approximately 4 clutches of eggs every 3-4 years, with 100-126 eggs per clutch. Thus, the loss of 2 adult female loggerhead sea turtles could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. The potential lethal take, however, is expected to occur in a small, discrete area and loggerhead sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species (Section 4.1.4), we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, we considered the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area that have affected and continue to affect this DPS.

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Abundance estimates in the western North Atlantic indicate the population is large (i.e., several hundred thousand individuals). In Section 4.1.4, we summarized available information on number of loggerhead sea turtle nesters and nesting trends. Nesting trends across all of the recovery units have been steady or increasing over several years against the background of the past and ongoing human and natural factors that have contributed to the current status of the species. Additionally, in-water research suggests the abundance of neritic juvenile loggerheads is steady or increasing.

While the potential lethal capture of up to 2 loggerhead sea turtles during the proposed project will affect the population, in the context of the overall population's size and current trend, we do not expect this loss to result in a detectable change to the population numbers or increasing trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed project is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the Northwest Atlantic DPS of loggerhead sea turtle in the wild.

Recovery

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

- *Objective: 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*
- *Objective: Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes*

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

In Section 4.1.4, we summarized available information on number of loggerhead sea turtle nesters and nesting trends. Nesting trends across all of the recovery units have been steady or increasing over several years against the background of the past and ongoing human and natural factors that have contributed to the current status of the species. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability in 2012-2016, resulting in widening confidence intervals. Nesting at the core index beaches declined in 2017 to 48,033, and rose again each year through 2020, reaching 53,443 nests, dipping back to 49,100 in 2021, and then in 2022 reaching the second-highest number since the survey began, with 62,396 nests. It is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.) it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani, et al. 2019). In-water research suggests the abundance of neritic juvenile loggerheads is also steady or increasing.

The potential non-lethal capture of loggerhead sea turtles from the Northwest Atlantic DPS would not affect the adult female nesting population, number of nests per nesting season, or juvenile in-water populations. Thus, the proposed project will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of Northwest Atlantic DPS of loggerhead sea turtles' recovery in the wild.

Conclusion
The combined lethal and non-lethal captures of up to 3 loggerhead sea turtles associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the Northwest Atlantic DPS of the loggerhead sea turtle in the wild.

8.2 Giant Manta Ray

The proposed action is expected to result in the capture of 1 giant manta ray during relocation trawling associated with the proposed project. We expect this capture to be non-lethal.

Survival
The non-lethal capture of giant manta ray is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals captured are expected to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since this capture may occur in the small, discrete action area and would be released within the general area where caught, no change in the distribution of giant manta ray is anticipated.

Recovery
A recovery plan for giant manta ray has not yet been developed; however, NMFS published a recovery outline for the giant manta ray (NMFS 2019). The recovery outline serves as an interim guidance to direct recovery efforts for giant manta ray. The recovery outline identifies two primary interim goals:

- *Stabilize population trends through reduction of threats, such that the species is no longer declining throughout a significant portion of its range; and*
- *Gather additional information through research and monitoring on the species' current distribution and abundance, movement and habitat use of adult and juveniles, mortality rates in commercial fisheries (including at-vessel and PRM), and other potential threats that may contribute to the species' decline.*

The major threats affecting the giant manta ray were summarized in the final listing rule (83 FR 2619, Publication Date January 22, 2018). The most significant threats to the giant manta ray are overutilization by foreign commercial and artisanal fisheries in the Indo-Pacific and Eastern Pacific and inadequate regulatory mechanisms in foreign nations to protect this species from the heavy fishing pressure and related mortality in these waters outside of U.S. jurisdiction. Other threats that potentially contribute to long-term risk of the species include: (micro) plastic ingestion rates, increased parasitic loads as a result of climate change effects, and potential disruption of important life history functions as a result of increased tourism. However, due to the significant data gaps, the likelihood and impact of these threats on the status of the species is highly uncertain. Relocation trawling not considered a major threat to this species and we do not believe the proposed action will appreciably reduce the recovery of giant manta ray, by significantly exacerbating effects of any of the major threats identified in the final listing rule.

The individuals suffering non-lethal capture are expected to fully recover such that no reductions in reproduction or numbers of giant manta rays are anticipated. The non-lethal capture will occur in a discrete location and the action area encompasses only a portion of the overall range or distribution of giant manta rays. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of giant manta rays would be anticipated. Therefore, the non-lethal capture of giant manta ray associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of recovery of the giant manta ray in the wild.

Conclusion

The potential non-lethal capture associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of giant manta ray in the wild. Mortalities are not expected and the proposed project will not result in an appreciable reduction in the likelihood of giant manta ray recovery in the wild.

9 CONCLUSION

We reviewed the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects using the best available data.

The proposed action will result in the take of green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray. Given the nature of the proposed action and the information provided above, we conclude that the action, as proposed, is not likely to jeopardize the continued existence of green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray.

10 INCIDENTAL TAKE STATEMENT

10.1 Overview

Section 9 of the ESA and protective regulations issued pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. *Take* is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct (ESA Section 2(19)). *Incidental take* refers to takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant. Under the terms of section 7(b)(4) and section 7(o)(2), taking that would otherwise be considered prohibited under section 9 or section 4(d) but which is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the Reasonable and Prudent Measures and the Terms and Conditions of the Incidental Take Statement of the Opinion.

The take of the giant manta ray by the proposed action is not prohibited under ESA section 9, as no section 4(d) Rules for the species have been promulgated. However, a circuit court case held that non-prohibited incidental take must be included in the Incidental Take Statement (*CBD v. Salazar*, 695 F.3d 893 [9th Circuit 2012]). Though the *Salazar* case is not a binding precedent for this action, which occurs outside of the 9th Circuit, NMFS finds the reasoning persuasive and is following the case out of an abundance of caution and because we anticipate that the ruling will be more broadly followed in future cases. Providing an exemption from Section 9 liability is not the only important purpose of specifying take in an Incidental Take Statement. Specifying incidental take ensures we have a metric against which we can measure whether or not reinitiation of consultation is required. Including these species in the Incidental Take Statement also ensures that we identify Reasonable and Prudent Measures that we believe are necessary or appropriate to minimize the impact of the incidental take on the species.

Section 7(b)(4)(c) of the ESA specifies that to provide an Incidental Take Statement for an endangered or threatened species of marine mammal, the taking must be authorized under Section 101(a)(5) of the MMPA. Since no incidental take of listed marine mammals is anticipated as a result of the proposed action, no statement on incidental take of protected marine mammals is provided and no take is authorized. Nevertheless, the USFWS must immediately notify (within 24 hours, if communication is possible) our Office of Protected Resources if a take of a listed marine mammal occurs.

As soon as the USFWS becomes aware of any take of an ESA-listed species under NMFS's purview that occurs during the proposed action, the USFWS shall report the take to NMFS SERO PRD via the NMFS SERO Endangered Species Take Report Form (https://forms.gle/85fP2da4Ds9jEL829). This form shall be completed for each individual known reported capture, entanglement, stranding, or other take incident. Information provided via this form shall include the title, Texas Point NWR Nourishment, the issuance date, and ECO tracking number, SERO-2024-02130, for this Opinion; the species name; the date and time of the incident; the general location and activity resulting in capture; condition of the species (i.e., alive, dead, sent to rehabilitation); size of the individual, behavior, identifying features (i.e., presence of tags, scars, or distinguishing marks), and any photos that may have been taken. At that time, consultation may need to be reinitiated.

The USFWS has a continuing duty to ensure compliance with the reasonable and prudent measures and terms and conditions included in this Incidental Take Statement. If the USFWS (1) fails to assume and implement the terms and conditions or (2) fails to require the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document or other similar document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the USFWS must report the progress of the action and its impact on the species to NMFS as specified in the Incidental Take Statement (50 CFR 402.14(i)(4)).

10.2 Amount of Extent of Anticipated Incidental Take

Based on the above information and analyses, NMFS believes that the proposed action is likely to adversely affect green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles, and giant manta ray. These effects will result from hopper dredging and relocation trawling operations in relation to the proposed action. NMFS anticipates the following incidental take may occur as a result of the proposed action over the duration of the project timeline (Table 11).

Table 11. Anticipated Lethal and Non-Lethal Take of Sea Turtles by Species

Species	Lethal (Hopper Dredging)	Non-Lethal (Relocation Trawling)
Green sea turtle	2	0
Kemp's ridley sea turtle	2	1
Loggerhead sea turtle	2	1

We do not anticipate, nor do we authorize, any lethal take of hawksbill or leatherback sea turtle from hopper dredging associated with the proposed project.

Giant Manta Ray
We anticipate that the remaining hopper dredging and relocation trawling for the proposed project will incidentally take 1 giant manta ray from relocation trawling only. We expect all interactions with giant manta ray to be non-lethal.

10.3 Effect of Take

NMFS has determined that the anticipated incidental take specified in Section 10.2 is not likely to jeopardize the continued existence of green (North Atlantic DPS), Kemp's ridley, and loggerhead (Northwest Atlantic DPS) sea turtles and giant manta ray if the project is developed as proposed.

10.4 Reasonable and Prudent Measures

Section 7(b)(4) of the ESA requires NMFS to issue to any federal agency whose proposed action is found to comply with section 7(a)(2) of the ESA, but may incidentally take individuals of listed species, a statement specifying the impact of that taking. The Incidental Take Statement must specify the Reasonable and Prudent Measures necessary or appropriate to minimize the impacts of the incidental taking from the proposed action on the species, and Terms and Conditions to implement those measures. "Reasonable and prudent measures" refer to those actions the Director considers necessary or appropriate to minimize the impact of the incidental take on the species" (50 CFR 402.02). Per section 7(o)(2) of the ESA, any incidental taking that complies with the specified terms and conditions is not considered to be a prohibited taking of the species concerned.

The Reasonable and Prudent Measures and terms and conditions are required to document the incidental take by the proposed action and to minimize the impact of that take on ESA-listed species (50 CFR 402.14(i)(1)(ii) and (iv)). These measures and terms and conditions must be implemented by the USFWS for the protection of section 7(o)(2) to apply. The USFWS has a continuing duty to ensure compliance with the reasonable and prudent measures and terms and conditions included in this Incidental Take Statement. If USFWS fails to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms, or fails 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, the USFWS must report the progress of the action and its impact on the species to SERO PRD as specified in the Incidental Take Statement [50 CFR 402.14(i)(4)].

NMFS has determined that the following Reasonable and Prudent Measures are necessary or appropriate to minimize impacts of the incidental take of ESA-listed species related to the proposed action. The following Reasonable and Prudent Measures and associated terms and conditions are established to implement these measures, and to document incidental takes. Only incidental takes that occur while these measures are in full implementation are not considered to be a prohibited taking of the species. These restrictions remain valid until reinitiation and conclusion of any subsequent Section 7 consultation.

1. USFWS must provide take reports regarding all interactions with ESA-listed species that occur during the proposed project.

2. USFWS must minimize the likelihood of injury or mortality to ESA-listed species resulting from relocation trawling and subsequent handling of animals.

10.5 Terms and Conditions

In order to be exempt from the prohibitions established by section 9 of the ESA, the USFWS must comply (or must ensure that any applicant complies) with the following Terms and Conditions.

The following Terms and Conditions implement Reasonable and Prudent Measure #1:

- USFWS must report all known captures of ESA-listed species and any other takes of ESA-listed species to the NMFS SERO PRD.
    - If and when the USACE becomes aware of any known reported capture, entanglement, stranding, or other take of ESA-listed species, the applicant must report it to NMFS SERO PRD via the NMFS SERO Endangered Species Take Report Form (https://forms.gle/85fP2da4Ds9jEL829).
        - Emails must reference this Opinion by the NMFS tracking number (SERO-2024-02130 Texas Point NWR Nourishment) and date of issuance.
        - This form shall be completed for each individual known reported capture, entanglement, stranding, or other take incident for ESA-listed species.
        - The form must include the species name, state the date and time of the incident, general location and activity resulting in capture, condition of the species (i.e., alive, dead, sent to rehabilitation), size of the individual, behavior, identifying features (i.e., presence of tags, scars, or distinguishing marks), and any photos that may have been taken.

- For the activities covered by this Opinion, the USFWS must submit an annual summary report of capture, entanglement, stranding, or other take of ESA-listed species to NMFS SERO PRD by email: nmfs.ser.esa.consultations@noaa.gov.
    - All emails and summary reports must reference this Opinion by the NMFS tracking number (SERO-2024-02130 Texas Point NWR Nourishment) and date of issuance.
    - The summary report will contain the following information: the total number of ESA-listed species captures, entanglements, strandings, or other take that was reported during activities covered by this Opinion.
    - The summary report will contain all information for any sea turtles taken to a rehabilitation facility holding an appropriate USFWS Native Endangered and Threatened Species Recovery permit. This information can be obtained from the appropriate State Coordinator for the STSSN (https://www.fisheries.noaa.gov/state-coordinators-sea-turtle-stranding-and-salvage-network)
    - The annual summary report shall be submitted even when there have been no reported take of ESA-listed species.
    - The first annual summary report will be submitted by January 31 in the calendar year following commencement of the activities covered by this Opinion. Thereafter, reports will be prepared every year during which the activities covered by the Opinion occur, and will be submitted to NMFS via email no later than January 31 of any year.

The following Terms and Conditions implement Reasonable and Prudent Measure #2:

- The USFWS, and their designated agents, will:
  - Comply with NMFS SERO *Protected Species Construction Conditions*, revised May 2021.
  - Comply with the NMFS SERO *Vessel Strike Avoidance Measures*, revised May 2021.
  - Comply with the NMFS Safe Handling and Release Guidelines (Appendix A).
  - Implement the general PDCs in in Appendix B on the use of in-water lines (see Appendix B).
- After the final relocation trawling event, the USFWS must submit a summary report of capture, entanglement, stranding, or other take of ESA-listed species to NMFS SERO PRD by email: nmfs.ser.esa.consultations@noaa.gov.
  - Emails and reports must reference this Opinion by the NMFS tracking number (SERO-2024-02130 Texas Point NWR Nourishment) and date of issuance.
  - The report will contain the following information: the total number of ESA-listed species captures, entanglements, strandings, or other take that was reported during the relocation trawling.

11 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation Recommendations identified in Opinions can assist action agencies in implementing their responsibilities under section 7(a)(1). Conservation recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans, or to develop information. The following conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the federal action agency:

Dredge Equipment and Species Interactions

- NMFS recommends that the USFWS evaluate the feasibility of installing video or other remote-sensing equipment (e.g., GoPro) on the dragarm or draghead to determine whether visibility is sufficient to monitor for interactions with species. If installing such equipment is feasible, and visibility is sufficient to observe and identify species encounters, the USFWS should design a study to test species reactions to the dredge or the disturbance radius from the hopper dredge draghead.
- NMFS recommends that the USFWS conduct or support research to observe listed species' reactions to dredging to understand how the species react to the oncoming draghead (e.g., disturbance radius, behavioral response) in different conditions (e.g., bottom topography, temperature).
- NMFS recommends that the USFWS support the development of standard procedures to remove marine debris excavated during dredging operations. Marine debris creates an entanglement risk and pose risk to listed species when consumed. Standard procedures should be developed and implemented by action agencies to necessitate surface marine debris removal during dredging operations.
- NMFS recommends that the USFWS conduct or support research that evaluates known, commonly used biomarkers for physiological stress (e.g., stress hormone levels) or other sublethal impacts of listed species taken during relocation activities. This information could help us better determine the condition of listed species post release and more accurately assess post-release mortality that will inform future consultations.
- NMFS recommends that the USFWS consider testing the feasibility of innovative techniques (e.g., side scan sonar) to improve observing or identify if giant manta ray, sea turtles, or other ESA-listed species are present in the path of dredging or trawling activities. If effective, results could identify times and locations when dredging or relocation trawling should or should not be used. This could reduce take if dredging in high density locations can be delayed to another time or reduce cost of relocation trawlers if the area has a low risk of species interaction.

Sea turtles

- NMFS recommends that the USFWS conduct or support directed research to understand sea turtle use of and movement in, the water column in the summer. Warmer water temperatures, and breeding and nesting activities, likely result in different sea turtle behavior and movements within the water column compared to other times of year when hopper dredging occurs. Information on water column use during that time is important to understand the likelihood of sea turtle interactions with hopper dredges, and to inform hopper-dredging practices during the summer months.

Giant manta ray

- NMFS recommends the USFWS conduct studies or support directed research to satellite (SPOT 6; Mini PAT) or acoustic tag giant manta rays in the action area. Data collected from tagging would be used evaluate residency and diel movement patterns, and purported nearshore nursery habitat along Florida east coast, which will inform future consultation and authorizations.
- NMFS recommends the USFWS require all personnel to report giant manta ray sightings to the giant manta ray recovery coordinator at NMFS SERO PRD. Giant manta ray observations should be photographed and include the latitude/longitude, date, and environmental conditions at the time of the sighting.

12 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed action. As provided in 50 CFR 402.16, reinitiation of formal consultation is required and shall be requested by USFWS, where discretionary federal action agency involvement or control over the action has been retained, or is authorized by law, and if: (a) the amount or extent of incidental take specified in the Incidental Take Statement is exceeded, (b) new information reveals effects of the action on listed species or critical habitat in a manner or to an extent not considered in this Opinion, (c) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion, or (d) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the USFWS must immediately request reinitiation of formal consultation and project activities may only resume if the USWFWS establishes that such continuation will not violate sections 7(a)(2) and 7(d) of the ESA.

13 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.

Abele, L. G., and W. Kim. 1986. An illustrated guide to the marine decapod crustaceans of Florida, volume 8. State of Florida, Department of Environmental Regulation, Tallahassee, FL.

Acebes, J.M.V. and Tull, M. 2016. The history and characteristics of the mobulid ray fishery in the Bohol Sea, Philippines. PLOS ONE 11(8): e016144.

Adams, D. H., and E. Amesbury. 1998. Occurrence of the manta ray, Manta birostris, in the Indian River Lagoon, Florida. Florida Scientist 61(1):7-9.

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

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

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.

Alava, M.N.R., Dolumbaló, E.R.Z., Yaptinchay, A.A. and Trono, R.B. 2002. Fishery and trade of whale sharks and manta rays in the Bohol Sea, Philippines. Pp. 132-148. In: S.L. Fowler, T.M. Reed and F.A. Dipper (eds), Elasmobranch Biodiversity, Conservation and Management: Proceedings of the International Seminar and Workshop. Sabah, Malaysia, July 1997. Occasional paper of the IUCN Species Survival Commission No. 25.

Amos, A. F. 1989. The occurrence of Hawksbill sea turtles (*Eretmochelys imbricata*) along the Texas Coast. Pages 9-11 *in* S. A. Eckert, K. L. Eckert, and T. H. Richardson, editors. Ninth Annual Workshop on Sea Turtle Conservation and Biology.

Andrzejaczek, S., Schallert, R.J., Forsberg, K., Arnoldi, N.S., Cabanillas-Torpoco, M., Purizaca, W. and Block, B.A., 2021. Reverse diel vertical movements of oceanic manta rays off the northern coast of Peru and implications for conservation. Ecological Solutions and Evidence, 2(1), p.e12051.

Arendt, M., J. Byrd, A. Segars, P. Maier, J. Schwenter, J. B. D. Burgess, J. D. Whitaker, L. Liguori, 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, Marine Resources Division.

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.

Barnes, R.H. 2005. Indigenous use and management of Whales and other Marine Resources in East Flores and Lembata, Indonesia. Indigenous Use and Management of Marine Resources

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.

Bass, A. L., D. A. Good, K. A. Bjorndal, J. I. Richardson, Z.-M. Hillis, J. A. Horrocks, and B. W. Bowen. 1996. Testing models of female reproductive migratory behaviour and population structure in the Caribbean hawksbill turtle, *Eretmochelys imbricata*, with mtDNA sequences. Molecular Ecology 5:321-328.

Beale, C., Stewart, J., Setyawan, E., Sianipar, A., Erdmann, M.V. 2019. Population dynamics of oceanic manta rays (Mobula birostris) in the Raja Ampat Archipelago, West Papua, Indonesia, and the impacts of the El Niño–Southern Oscillation on their movement ecology. Diversity and Distributions. 25. 10.1111/ddi.12962.

Bertrand A, Vögler Santos R, Defeo O. 2018.Climate change impacts, vulnerabilities and adaptations: Southwest Atlantic and Southeast Pacific marine fisheries. In: Barange M, Bahri T, Beveridge MCM, Cochrane KL, Funge-Smith S, Poulain F (eds) Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options. FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO:325–346.

Bianchi, G. 1985. Field guide to the commercial marine and brackish water species of Tanzania. FAO Species Identification Sheets for Fishery Purposes. Project No. TCP/URT/4406. FAO, Rome.

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. 1997. Foraging ecology and nutrition of sea turtles. Pages 199–231 *in* The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Bjorndal, K. A., and A. B. Bolten. 2002. Proceedings of a workshop on assessing abundance and trends for in-water sea turtle populations. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, NMFS-SEFSC-445.

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.

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.

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

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):1-7.

Booda, L. 1984. Manta ray wings, shark meat posing as scallops. Sea Technology 25(11): 7.

Boulan, R. H., Jr. 1983. Some notes on the population biology of green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) turtles in the northern U.S. Virgin Islands: 1981-1983. Report to the National Marine Fisheries Service, Grant No. NA82-GA-A-00044.

Boulon Jr., R. H. 1994. Growth rates of wild juvenile hawksbill turtles, *Eretmochelys imbricata*, in St. Thomas, United States Virgin Islands. Copeia 1994(3):811-814.

Bowen, B. W., and W. N. Witzell. 1996. Proceedings of the International Symposium on Sea Turtle Conservation Genetics. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, NMFS-SEFSC-396.

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.

Brainard, R. E., and coauthors. 2011. Status review report of 82 candidate coral species petitioned under the U.S. Endangered Species Act. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Pacific Islands Fisheries Science Center, NOAA Technical Memorandum NMFS-PIFSC-27, Honolulu, HI.

Braun, C. D., G. B. Skomal, S. R. Thorrold, and M. L. Berumen. 2015. Movements of the reef manta ray (Manta alfredi) in the Red Sea using satellite and acoustic telemetry. Marine Biology 162(12):2351-2362.

Brautigam, A., and K. L. Eckert. 2006. Turning the tide: Exploitation, trade and management of marine turtles in the Lesser Antilles, Central America, Columbia and Venezuela. TRAFFIC International, Cambridge, United Kingdom.

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.

Burgess, K. B., and coauthors. 2016. Manta birostris, predator of the deep? Insight into the diet of the giant manta ray through stable isotope analysis. Royal Society Open Science 3(11).

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.

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.

Carillo, E., G. J. W. Webb, and S. C. Manolis. 1999. Hawksbill turtles (*Eretmochelys imbricata*) in Cuba: an assessment of the historical harvest and its impacts. Chelonian Conservation and Biology 3(2):264-280.

Carpentier, A.S., Berthe, C., Ender, I., Jaine, F.R., Mourier, J., Stevens, G., De Rosemont, M. and Clua, E., 2019. Preliminary insights into the population characteristics and distribution of reef (Mobula alfredi) and oceanic (M. birostris) manta rays in French Polynesia. Coral Reefs, 38(6), pp.1197-1210.

Carr, A. 1983. All the way down upon the Suwannee River. Audubon 85:78-101.

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

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

Chaloupka, M. Y., and C. J. Limpus. 1997. Robust statistical modelling of hawksbill sea turtle growth rates (southern Great Barrier Reef). Marine Ecology Progress Series 146(1-3):1-8.

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. Y., and J. A. Musick. 1997. 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., C. Limpus, and J. Miller. 2004. Green turtle somatic growth dynamics in a spatially disjunct Great Barrier Reef metapopulation. Coral Reefs 23(3):325-335.

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. 1997. 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.

Chassot, E., M. Amandè, C. Pierre, R. Pianet, and R. Dédo. 2008. Some preliminary results on tuna discards and bycatch in the French purse seine fishery of the eastern Atlantic Ocean. Collective Volume Of Scientific Papers 64.

Chin, A., P. Kyne, T. Walker, and R. McAuley. 2010. An integrated risk assessment for climate change: Analysing the vulnerability of sharks and rays on Australia's Great Barrier Reef. Global Change Biology 16:1936-1953.

CITES. 2013. Consideration of proposals for amendment of Appendices I and II: Manta Rays. Convention on International Trace in Endangered Species of Wild Fauna and Flora (CITES), Sixteenth Meeting of the Conference of the Parties, CoP16 Prop. 46 (Rev. 2), Bangkok, Thailand.

Clark, T. B. 2010. Abundance, home range, and movement patterns of manta rays (Manta alfredi, M. birostris) in Hawai'i. Dissertation. Univeristy of Hawai'i at Mānoa, Honolulu, HI.

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moger, J., et al. (2013). Microplastic ingestion by zooplankton. Environ. Sci. Technol. 47, 6646–6655. doi: 10.1021/es400663f

Coles, R. J. 1916. Natural history notes on the devil-fish, Manta birostris (Walbaum) and Mobula olfersi (Muller). Bulletin of the American Museum of Natural History 35(33):649-657.

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

Convention on Migratory Species. 2014. Proposal for the inclusion of the reef manta ray (Manta alfredi) in CMS Appendix I and II. Convention on Migratory Species (CMS), 18th Meeting of the Scientic Council, UNEP/CMS/ScC18/Doc.7.2.9, Bonn, Germany.

Couturier, L. I. E., and coauthors. 2012. Biology, ecology and conservation of the Mobulidae. Journal of Fish Biology 80(5):1075-1119.

Couturier, L. I. E., and coauthors. 2013. Stable isotope and signature fatty acid analyses suggest reef manta rays feed on demersal zooplankton. PLOS ONE 8(10):e77152.

Crabbe, M. J. 2008. Climate change, global warming and coral reefs: modelling the effects of temperature. Computational Biology and Chemistry 32(5):311-4.

Deakos, M. H. 2010. Ecology and social behavior of a resident manta ray (Manta alfredi) population of Maui, Hawai'i. Dissertation. Univeristy of Hawai'i at Mānoa, Honolulu, HI.

Deakos, M. H., J. D. Baker, and L. Bejder. 2011. Characteristics of a manta ray Manta alfredi population off Maui, Hawaii, and implications for management. Marine Ecology Progress Series 429:245-260.

Dewar, H., and coauthors. 2008. Movements and site fidelity of the giant manta ray, Manta birostris, in the Komodo Marine Park, Indonesia. Marine Biology 155(2):121-133.

Diez, C. E., and R. P. Van Dam. 2002. Habitat effect on hawksbill turtle growth rates on feeding grounds at Mona and Monito Islands, Puerto Rico. Marine Ecology Progress Series 234:301-309.

Diez, C. E., and R. P. Van Dam. 2007. In-water surveys for marine turtles at foraging grounds of Culebra Archipelago, Puerto Rico

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.

Dodd Jr., C. K. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service, 88(14).

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/.

DWH Trustees. 2016. 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/.

Duffy, L. and Griffiths, S. 2017. Resolving potential redundancy of productivity attributes to improve ecological risk assessments. SAC-08-07c. Inter-American Tropical Tuna Commission. Scientific Advisory Committee Eight Meeting, La Jolla, California (USA), 8-12 May 2017.

Dulvy, N. K., S. A. Pardo, C. A. Simpfendorfer, and J. K. Carlson. 2014. Diagnosing the dangerous demography of manta rays using life history theory. PeerJ Preprints 2.

EA Engineering, Science, and Technology, Inc. 2012. *Post-Oil Spill Surface Sediment Evaluation: Panama City Borrow Areas, Panama City, Florida. Draft.* Prepared for USACE Mobile District. February.

Eckert, K. L. 1995. Hawksbill sea turtle (*Eretmochelys imbricata*). Pages 76-108 *in* National Marine Fisheries Service and U.S. Fish and Wildlife Service Status Reviews for Sea Turtles Listed under the Endangered Species Act of 1973. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Springs, Maryland.

Eckert, K. L., J. A. Overing, and B. B. Lettsome. 1992. Sea turtle recovery action plan for the British Virgin Islands. UNEP Caribbean Environment Programme, Wider Caribbean Sea Turtle Recovery Team and Conservation Network, Kingston, Jamaica.

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. A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon System, Florida. Florida Scientist 70(4):415-434.

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

Epperly, S. P., J. Braun-McNeill, and P. M. Richards. 2007. Trends in catch rates of sea turtles in North Carolina, USA. Endangered Species Research 3(3):283-293.

Essumang, D.K. 2010. First determination of the levels of platinum group metals in Manta birostris (manta ray) caught along the Ghanaian coastline. Bulletin of Environmental Contamination and Toxicology 84: 720-725.

Farmer, N.A., Garrison, L.P., Horn, C. et al. (2022) The distribution of manta rays in the western North Atlantic Ocean off the eastern United States. Sci Rep 12, 6544. https://doi.org/10.1038/s41598-022-10482-8

Fernando, D. and Stevens, G. 2011. A study of Sri Lanka's Manta & Mobula Ray Fishery. Manta Trust.

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.

Fleming, E. H. 2001. Swimming Against the Tide: Recent Surveys of Exploitation, Trade, And Management of Marine Turtles In the Northern Caribbean. TRAFFIC North America, Washington, D.C., USA.

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.

Foley, A. M., B. A. Schroeder, and S. L. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerheads (Caretta caretta). Pages 75-76 *in* H. J. Kalb, A. S. Rhode, K. Gayheart, and K. Shanker, editors. Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Savannah, Georgia.

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

Fossi, M. C., Baini, M., Panti, C., Galli, M., Jiménez, B., Muñoz-Arnanz, J., et al. (2017). Are whale sharks exposed to persistent organic pollutants and plastic pollution in the Gulf of California (Mexico)? first ecotoxicological investigation using skin biopsies. Comp. Biochem. Physiol. C Toxicol. Pharmacol. 199, 48–58. doi: 10.1016/j.cbpc.2017.03.002

Fossi, M. C., Marsili, L., Baini, M., Giannetti, M., Coppola, D., Guerranti, C., et al. (2016). Fin whales and microplastics: the Mediterranean Sea and the Sea of Cortez scenarios. Environ. Pollut. 209, 68–78. doi: 10.1016/j.envpol.2015.11.02

Fossi, M. C., Coppola, D., Baini, M., Giannetti, M., Guerranti, C., Marsili, L., et al. (2014). Large filter feeding marine organisms as indicators of microplastic in the pelagic environment: the case studies of the Mediterranean basking shark *(Cetorhinus maximus)* and fin whale *(Balaenoptera physalus)*. Mar. Environ. Res. 100, 17–24. doi: 10.1016/j.marenvres.2014.02.002

Francis, M.P. and Jones, E.G. 2017. Movement, depth distribution and survival of spinetail devilrays (Mobula japanica) tagged and released from purse-seine catches in New Zealand. Aquatic Conservation: Marine and Freshwater Ecosystems 27(1): 219-236.

Frankham, R., Bradshaw, C. J., & Brook, B. W. 2014. Genetics in conservation management: revised recommendations for the 50/500 rules, Red List criteria and population viability analyses. Biological Conservation, 170, 56-63.

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

Fretey, J. 2001. Biogeography and conservation of marine turtles of the Atlantic Coast of Africa, UNebraskaP/CMississippi Secretariat.

Galloway, T. S., and Lewis, C. N. (2016). Marine microplastics spell big problems for future generations. Proc. Nat. Acad. Sci. U.S.A. 113, 2331–2333. doi: 10.1073/pnas.1600715113

Garduño-Andrade, M., V. Guzmán, E. Miranda, R. Briseño-Dueñas, and F. A. Abreu-Grobois. 1999. Increases in hawksbill turtle (*Eretmochelys imbricata*) nestings in the Yucatán Peninsula, Mexico, 1977-1996: Data in support of successful conservation? Chelonian Conservation and Biology 3(2):286-295.

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, Santo Domingo, Dominican Republic.

Germanov, E. S., Marshall, A. D., Bejder, L., Fossi, M. C., and Loneragan, N. R. (2018). Microplastics: no small problem for filter-feeding megafauna. Trends Ecol Evol. 33, 227–232. doi: 10.1016/j.tree.2018.01.005

Germanov, E. S., and A. D. Marshall. 2014. Running the gauntlet: regional movement patterns of Manta alfredi through a complex of parks and fisheries. PLOS ONE 9(10):e110071.

Germanov, E. S., and coauthors. 2019. Microplastics on the menu: Plastics pollute Indonesian manta ray and whale shark feeding grounds. Frontiers in Marine Science 6(679).

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.

Girondot, M., and coauthors. 2015. Spatio-temporal distribution of Manta birostris in French Guiana waters. Journal of the Marine Biological Association of the United Kingdom 95(1):153-160.

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

Gonzalez Carman, V., K. Alvarez, L. Prosdocimi, M. C. Inchaurraga, 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.

Graham, N. A. J., and coauthors. 2008. Climate Warming, Marine Protected Areas and the Ocean-Scale Integrity of Coral Reef Ecosystems. PLOS ONE 3(8):e3039.

Graham, R. T., and coauthors. 2012. Satellite tracking of manta rays highlights challenges to their conservation. PLOS ONE 7(5).

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.

Groombridge, B., and R. Luxmoore. 1989. The Green Turtle and Hawksbill (Reptilia: Cheloniidae): World Status, Exploitation and Trade. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Lausanne, Switzerland.

Gudger, E. W. 1922. The most northerly record of the capture in Atlantic waters of the United States of the giant ray, Manta birostris. Science 55(1422):338-340.

Guinder, V. A., and J. C. Molinero. 2013. Climate change effects on marine phytoplankton. Pages 68-90 in A. H. Arias, and M. C. Menendez, editors. Marine Ecology in a Changing World. CRC Press, Boca Raton, FL.

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.

Handwerk, B. 2010, October 16. Little-known Gulf Rays Affected by Oil Spill?. National Geographic News. https://www.nationalgeographic.com/animals/article/101015-new-manta-rays-gulf-bp-oil-spill-science-animals.

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 145:185-194.

Harty K, Guerrero M, Knochel AM, Stevens GMW, Marshall A, Burgess K, Stewart JD. 2022. Demographics and dynamics of the world’s largest known population of oceanic manta rays Mobula birostris in coastal Ecuador. Mar Ecol Prog Ser 700:145-159. https://doi.org/10.3354/meps14189

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 13:1-10.

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 internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. Journal of Thermal Biology 27(5):429-432.

Hearn, A. R., and coauthors. 2014. Elasmobranchs of the Galapagos Marine Reserve. Pages 23-59 in J. Denkinger, and L. Vinueza, editors. Social and Ecological Interactions in the Galapagos Island, The Galapagos Marine Reserve: A dynamic social-ecological system. Springer, New York, NY.

Heinrichs, S., M. O'Malley, H. Medd, and P. Hilton. 2011. Global Threat to Manta and Mobula Rays. Manta Ray of Hope, 2011 Report.

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. Bolten, and B. Witherington, editors. Loggerhead Sea Turtles. Smithsonian Books, Washington, D. C.

Heppell, S. S., D. T. Crouse, L. B. Crowder, S. P. Epperly, W. Gabriel, T. Henwood, R. Márquez, and N. B. Thompson. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. Chelonian Conservation and Biology 4(4):767-773.

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.

Heron, S. F., C. M. Eakin, J. A. Maynard, and R. van Hooidonk. 2016. Impacts and effects of ocean warming on coral reefs. Pages 177-197 in D. Laffoley, and J. M. Baxter, editors. Explaining Ocean Warming: Causes, scale, effects and consequences. IUCN, Gland, Switzerland.

Hilbourne S, Stevens G. 2019. Maldivian Manta Ray Project oceanic manta ray summary report 2019. The Manta Trust. https: //static1.squarespace.com/static/ 5a196500914e6b09132e911f/t/5d1090a94951180001880 a1d/1561366735894/MT_MMRP_Oceanic+Manta+ Summary+Report_2019_FINAL.pdf

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

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

Hillis, Z.-M., and A. L. Mackay. 1989. Research report on nesting and tagging of hawksbill sea turtles *Eretmocheys imbricata* at Buck Island Reef National Monument, U.S. Virgin Islands, 1987-88.

Hinojosa-Alvarez S., Walter R.P., Diaz-Jaimes P., Galván-Magaña F. and Paig-Tran E.M. 2016. A potential third Manta Ray species near the Yucatán Peninsula? Evidence for a recently diverged and novel genetic Manta group from the Gulf of Mexico. PeerJ 4: e2586.

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.

Hirth, H. F., and E. M. A. Latif. 1980. A nesting colony of the hawksbill turtle (*Eretmochelys imbricata*) on Seil Ada Kebir Island, Suakin Archipelago, Sudan. Biological Conservation 17:125-130.

Holmberg Pierce, S.J. and Marshall, A.D., 2018. Photographic identification of sharks. Shark research: emerging technologies and applications for the field and laboratory, pp.219-234.

Hosegood, P.J., Nimmo-Smith, W.A.M., Proud, R., Adams, K. and Brierley, A.S., 2019. Internal lee waves and baroclinic bores over a tropical seamount shark ‘hot-spot’. Progress in Oceanography, 172, pp.34-50.

Intergovernmental Panel on Climate Change. 2013. Climate Change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Intergovernmental Panel on Climate Change, Cambridge, United Kingdom; New York, NY.

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.

Jakimska, A., Konieczka, P., Skóra, K., and Namieśnik, J. 2011. Bioaccumulation of metals in tissues of marine animals, part I: the role and impact of heavy metals on organism. Pol. J. Enviro. Studies 20, 1127–1146.

Jambeck, J. R., and coauthors. 2015. Plastic waste inputs from land into the ocean. Science 347(6223):768-771.

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.

Jones, G. P., M. I. McCormick, M. Srinivasan, and J. V. Eagle. 2004. Coral decline threatens fish biodiversity in marine reserves. Proc Natl Acad Sci U S A 101(21):8251-8253.

Kashiwagi, T., T. Ito, and F. Sato. 2010. Occurences of reef manta ray, Manta alfredi, and giant manta ray, M. birostris, in Japan, examined by photographic records. Japanese Society for Elasmobranch Studies 46:20-27.

Kashiwagi, T., A. D. Marshall, M. B. Bennett, and J. R. Ovenden. 2011. Habitat segregation and mosaic sympatry of the two species of manta ray in the Indian and Pacific Oceans: Manta alfredi and M. birostris. Marine Biodiversity Records 4:1-8.

Knochel, A.M., Cochran, J.E., Kattan, A., Stevens, G.M., Bojanowksi, E. and Berumen, M.L., 2022. Crowdsourced data reveal multinational connectivity, population demographics, and possible nursery ground of endangered oceanic manta rays in the Red Sea. Aquatic Conservation: Marine and Freshwater Ecosystems, 32(11), pp.1774-1786.

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.

Laurent, L., P. Casale, M. N. Bradai, B. J. Godley, G. Gerosa, A. C. Broderick, W. Schroth, B. Schierwater, A. M. Levy, D. Freggi, E. M. A. El-Mawla, D. A. Hadoud, H. E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraky, F. Demirayak, and C. H. Gautier. 1998. Molecular resolution of marine turtle stock composition in fishery by-catch: A case study in the Mediterranean. Molecular Ecology 7:1529-1542.

Law, R. J., C. F. Fileman, A. D. Hopkins, J. R. Baker, J. Harwood, D. B. Jackson, S. Kennedy, A. R. Martin, and R. J. Morris. 1991. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. Marine Pollution Bulletin 22(4):183-191.

Lawson, J. M., and coauthors. 2017. Sympathy for the devil: a conservation strategy for devil and manta rays. PeerJ 5:e3027.

Lawson, J. M., and coauthors. 2016. Sympathy for the devil: A conservation strategy for devil and manta rays. PeerJ 5:e3027.

León, Y. M., and C. E. Diez. 1999. Population structure of hawksbill turtles on a foraging ground in the Dominican Republic. Chelonian Conservation and Biology 3(2):230-236.

León, Y. M., and C. E. Diez. 2000. Ecology and population biology of hawksbill turtles at a Caribbean feeding ground. Pages 32-33 *in* F. A. Abreu-Grobois, R. Briseño-Dueñas, R. Márquez-Millán, and L. Sarti-Martinez, editors. Eighteenth International Sea Turtle Symposium. U.S. Department of Commerce, Mazatlán, Sinaloa, México.

Lewis, S.A., Setiasih, N., Dharmadi, Fahmi, O'Malley, M.P., Campbell, S.J., Yusuf, M. and Sianipar, A. 2015. Assessing Indonesian Manta and Devil Ray Populations Through Historical Landings and Fishing Community Interviews. PeerJ Preprints: available online at https://peerj.com/preprints/1334

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.

Limpus, C. J. 1992. The hawksbill turtle, *Eretmochelys imbricata*, in Queensland: Population struture within a southern Great Barrier Reef feeding ground. Australian Wildlife Research 19:489-506.

Limpus, C. J., and J. D. Miller. 2000. Final report for Australian hawksbill turtle population dynamics project. Queensland Parks and Wildlife Service.

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 yetología de las tortugas marinas en la zona costera uru-guaya, Montevideo, Uruguay: Vida Silvestre, Uruguay.

Lund, F. P. 1985. Hawksbill turtle (*Eretmochelys imbricata*) nesting on the East Coast of Florida. Journal of Herpetology 19(1):166-168.

Mackay, A. L. 2006. 2005 sea turtle monitoring program the East End beaches (Jack's, Isaac's, and East End Bay) St. Croix, U.S. Virgin Islands. Nature Conservancy.

Manta Trust. 2019a. Mooring Line Entanglement Mitigation. Manta Trust. Available online at: https://static1.squarespace.com/static/5a196500914e6b09132e911f/t/5dfe1e20b02a616945eb5772/1576934948296/MT_MMRP_Entanglement+Mitigation_2019_FINAL.pdf (accessed January 20, 2021).

Manta Trust. 2019b. Manta Ray Entanglement Protocol. Manta Trust. Available online at: https://static1.squarespace.com/static/5a196500914e6b09132e911f/

t/5dfe2e70229b17607ddeb2c9/1576939123128/MT_MMRP_Entanglement+Protocol_2019_FINAL.pdf (accessed March 2, 2021).

MantaMatcher. 2016. Manta Matcher - The Wildbook for Manta Rays.

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, 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.

Marshall, A., Barreto, R., Carlson, J., Fernando, D., Fordham, S., Francis, M.P., Derrick, D., Herman, K., Jabado, R.W., Liu, K.M., Rigby, C.L. & Romanov, E. 2022. Mobula birostris (amended version of 2020 assessment). The IUCN Red List of Threatened Species 2022: e.T198921A214397182. https://dx.doi.org/10.2305/IUCN.UK.2022-1.RLTS.T198921A214397182.en

Marshall, A. D., L. J. V. Compagno, and M. B. Bennett. 2009. Redescription of the genus Manta with resurrection of Manta alfredi (Krefft, 1868) (Chondrichthyes; Myliobatoidei; Mobulidae). Zootaxa 2301:1-28.

Mayor, P. A., B. Phillips, and Z.-M. Hillis-Starr. 1998. Results of the stomach content analysis on the juvenile hawksbill turtles of Buck Island Reef National Monument, U.S.V.I. Pages 230-233 *in* S. P. Epperly, and J. Braun, editors. Seventeenth Annual Sea Turtle Symposium.

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.

Medeiros, A. M., O. J. Luiz, and C. Domit. 2015. Occurrence and use of an estuarine habitat by giant manta ray Manta birostris. Journal of Fish Biology 86(6):1830-1838.

Menzel, R. W. 1971. Checklist of the marine fauna and flora of the Apalachee Bay and the St. George Sound area. Third Edition. Department of Oceanography, Florida State University, Tallahassee, FL.

Meylan, A. 1988. Spongivory in hawksbill turtles: A diet of glass. Science 239(4838):393-395.

Meylan, A. B. 1999a. International movements of immature and adult hawksbill turtles (*Eretmochelys imbricata*) in the Caribbean region. Chelonian Conservation and Biology 3(2):189-194.

Meylan, A. B. 1999b. Status of the hawksbill turtle (*Eretmochelys imbricata*) in the Caribbean region. Chelonian Conservation and Biology 3(2):177-184.

Meylan, A., and M. Donnelly. 1999. Status justification for listing the hawksbill turtle (*Eretmochelys imbricata*) as critically endangered on the 1996 IUCN Red List of threatened animals. Chelonian Conservation and Biology 3(2):200-224.

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.

Milessi, A. C., and M. C. Oddone. 2003. Primer registro de Manta birostris (Donndorff 1798) (Batoidea: Mobulidae) en el Rio de La Plata, Uruguay. Gayana 67(1):126-129.

Milliken, T., and H. Tokunaga. 1987. The Japanese sea turtle trade 1970-1986. TRAFFIC (JAPAN), Center for Environmental Education, Washington, D. C.

Miller, M. H., and C. Klimovich. 2017. Endangered Species Act status review report: Giant manta ray (Manta birostris) and reef manta ray (Manta alfredi). U.S. Department of Commerce, National Oceanic and Atmoshperic Administration, National Marine Fisheries Servcie, Office of Protected Resources, Silver Spring, MD.

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., E. Carrillo, A. Saenz, and G. Nodarse. 1999. Reproduction and nesting of the hawksbill turtle, *Eretmochelys imbricata*, in the Cuban Archipelago. Chelonian Conservation and Biology 3(2):257-263.

Moncada, F., A. Abreu-Grobois, D. Bagley, K. A. Bjorndal, A. B. Bolten, J. A. Caminas, L. 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.

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.

Moazzam, M. 2018. Unprecedented decline in the catches of mobulids: an important component of tuna gillnet fisheries in the Northern Arabian Sea. IOTC-2018-WPEB14-30. Indian Ocean Tuna Commission Report.

Mogollón R, Calil PHR. 2018.Counterintuitive effects of global warming-induced wind patterns on primary production in the Northern Humboldt Current System. Glob Change Biol 24: 3187−3198.

Moore, A. B. M. 2012. Records of poorly known batoid fishes from the north-western Indian Ocean (Chondrichthyes: Rhynchobatidae, Rhinobatidae, Dasyatidae, Mobulidae). African Journal of Marine Science 34(2):297-301.

Mortimer, J. A., J. Collie, T. Jupiter, R. Chapman, A. Liljevik, and B. Betsy. 2003. Growth rates of immature hawksbill sea turtles (*Eretmochelys imbricata*) at Aldabra Atoll, Seychelles (Western Indian Ocean). Pages 247-248 *in* J. A. Seminoff, editor Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation.

Mortimer, J. A., M. Day, and D. Broderick. 2002. Sea turtle populations of the Chagos Archipelago, British Indian Ocean Territory. Pages 47-49 *in* A. Mosier, A. Foley, and B. Brost, editors. Twentieth Annual Symposium on Sea Turtle Biology and Conservation.

Mortimer, J. A., and M. Donnelly. 2008. Hawksbill turtle (*Eretmochelys imbricata*) International Union for Conservation of Nature and Natural Resources.

Mourier, J. 2012. Manta rays in the Marquesas Islands: First records of Manta birostris in French Polynesia and most easterly location of Manta alfredi in the Pacific Ocean, with notes on their distribution. Journal of Fish Biology 81(6):2053-2058.

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

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.

Nair, R.J., Zacharia, P.U., Kishor, T.G., Dinesh, K.S., Dhaneesh, K.V., Suraj, K.S., Siva, G.K. and Seetha, P.K. 2013. Heavy landings of mobulids reported at Cochin Fisheries Harbour, Kerala. Marine Fisheries Information Services, T&E Series 21: 19-20.

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.

Nawaz, R. and Khan, M.M. 2015. Developing conservation strategy for Mobulids found in waters of Pakistan, 2013-2015. Final Project Report 2013-2015. WWF Pakistan and Save Our Seas Foundation, Pakistan.

Nelson, W.G. 1989. An overview of the effects of beach nourishment on the sand beach fauna. Pp. 295-310 *In:* L.S. Tait (ed.), Beach Preservation Technology >88: Problems and Advancements in Beach Nourishment. Tallahassee, Florida Shore and Beach Preservation Association.

Nelson, W.G. 1993. Beach restoration in the southeastern US: environmental effects and biological monitoring. Ocean & Coastal Management 19: 157-182.

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

NMFS. 2002. Endangered Species Act section 7 consultation on shrimp trawling in the southeastern United States under the sea turtle conservation regulations and as managed by the fishery management plans for shrimp in the South Atlantic and the Gulf of Mexico. Biological Opinion, December 2, 2002.

NMFS. 2003. National Marine Fisheries Service (NMFS) November 19, 2003, Gulf of Mexico regional biological opinion (GRBO) to the U.S. Army Corps of Engineers (COE) on hopper dredging of navigation channels and borrow areas in the U.S. Gulf of Mexico

NMFS. 2005. Revision no. 1 to the National Marine Fisheries Service (NMFS) November 19, 2003, Gulf of Mexico regional biological opinion (GRBO) to the U.S. Army Corps of Engineers (COE) on hopper dredging of navigation channels and borrow areas in the U.S. Gulf of Mexico

NMFS. 2007. Revision 2 to the National Marine Fisheries Service (NMFS) November 19, 2003, Gulf of Mexico regional biological opinion (GRBO) to the U.S. Army Corps of Engineers (COE) on hopper dredging of navigation channels and borrow areas in the U.S. Gulf of Mexico

NMFS. 2019. Giant manta ray recovery outline. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD.

NMFS. 2020. *South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States (2020 SARBO);* NMFS Tracking Number SERO-2019-03111, issued March 27, 2020 and revised July 30, 2020.

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. 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality on population dynamics. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, PRD-08/09-14.

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. 1998. Recovery plan for U. S. Pacific populations of the hawksbill turtle (*Eretmochelys imbricata*). National Marine Fisheires Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

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

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

NMFS, and USFWS. 2008. 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. 2011. 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.

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

Notarbartolo di Sciara, G., and E. V. Hillyer. 1989. Mobulid rays off eastern Venezuela (Chondrichthyes, Mobulidae). Copeia (3):607-614.

Ogren, L. H. 1989. 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.

O’Malley, M. P., K. Lee-Brooks, and H. B. Medd. 2013. The global economic impact of manta ray watching tourism. PLOS ONE 8(5):e65051.

Oliver, S., M. Braccini, S. J. Newman, and E. S. Harvey. 2015. Global patterns in the bycatch of sharks and rays. Marine Policy 54:86-97.

Ooi, M.S.M., Townsend, K.A., Bennett, M.B., Richardson, A.J., Fernando, D., Villa, C.A. and Gaus, C. 2015. Levels of arsenic, cadmium, lead and mercury in the branchial plate and muscle tissue of mobulid rays. Marine Pollution Bulletin 94(1): 251-259.

Oyarzún D, Brierley CM.2018. The future of coastal up - welling in the Humboldt Current from model projections. Clim Dyn 52: 599−615.

Parsons, J. J. 1972. The hawksbill turtle and the tortoise shell trade. Pages 45-60 *in* Études de Géographie Tropicale Offertes a Pierre Gourou. Mouton, Paris, France.

Pate, J. H., and Marshall, A. D. 2020. Urban manta rays: potential manta ray nursery habitat along a highly developed Florida coastline. Endanger. Species Res. 43, 51–64. doi: 10.3354/esr01054

Pate J.H, Macdonald C., Wester J. 2020. Surveys of recreational anglers reveal knowledge gaps and positive attitudes towards manta ray conservation in Florida. Aquatic Conservation Marine and Freshwater Ecosystems. 31. 10.1002/aqc.3508.

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.

Plotkin, P., and A. F. Amos. 1990. Effects of anthropogenic debris on sea turtles in the northwestern Gulf of Mexico. Pages 736-743 *in* R. S. Shoumura, and M. L. Godfrey, editors. Proceedings of the Second Internntional Conference on Marine Debris. NOAA Technical Memorandum NMFS SWFSC-154. U.S. Department of Commerce, Honolulu, Hawaii.

Plotkin, P. T. 2003. Adult migrations and habitat use. Pages 225-241 *in* P. L. Lutz, J. A. Musick, and J. Wyneken, editors. The Biology of Sea Turtles, volume 2. CRC Press.

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.

Raje, S.G., Sivakami, S., Mohanraj, G., Manojkumar, P.P., Raju, A. and Joshi, K.K. 2007. An atlas on the Elasmobranch fishery resources of India. CMFRI Special Publication, 95. 1-253.

Rakocinski, C.F., R.W. Heard, S.E. LeCroy, J.A. McLelland, and T. Simons. 1996. Responses by macrobenthic assemblages to extensive beach restoration at Perdido Key, Florida, U.S.A. Journal of Coastal Research 12: 326-353.

Rambahiniarison, J. M., and coauthors. 2018. Life history, growth, and reproductive biology of four mobulid species in the Bohol Sea, Philippines. Frontiers in Marine Science 5:269.

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.

Richardson, J. I., R. Bell, and T. H. Richardson. 1999. Population ecology and demographic implications drawn from an 11-year study of nesting hawksbill turtles, *Eretmochelys imbricata*, at Jumby Bay, Long Island, Antigua, West Indies. Chelonian Conservation and Biology 3(2):244-250.

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

Roberts, B. 2022. Catch Cobia on migrating manta rays: cobia can't resist hanging around these giant rays on the move this month. Florida Sportsman. First published Florida Sportsman April 2015. https://www.floridasportsman.com/editorial/cobia-rays/400722

Rochman, C. M., Kurobe, T., Flores, I., and Teh, S. J. (2014). Early warning signs of endocrine disruption in adult fish from the ingestion of polyethylene with and without sorbed chemical pollutants from the marine environment. Sci. Total Environ. 493, 656–661. doi: 10.1016/j.scitotenv.2014.06.051

Rohner, C.A., Flam, A.L., Pierce, S.J. and Marshall, A.D. 2017. Steep declines in sightings of manta rays and devilrays (Mobulidae) in southern Mozambique. PeerJ Preprints 5: e3051v1.

Rohner, C. A., Weeks, S. J., Richardson, A. J., Pierce, S. J., Magno-Canto, M. M., Feldman, G. C., et al. (2014). Oceanographic influences on a global whale shark hotspot in southern Mozambique. PeerJ PrePrints. 2:e661v1. doi: 10.7287/peerj.preprints.661v1

Romanov, E. V. 2002. Bycatch in the tuna purse-seine fisheries of the western Indian Ocean. Fishery Bulletin 100(1):90-105.

Rubin, R. D., K. R. Kumli, and G. Chilcott. 2008. Dive characteristics and movement patterns of acoustic and satellite-tagged manta rays *(Manta birostris)* in the Revillagigedos Islands of Mexico. American Elasmobranch Society, Montreal, Canada.

Rubin, R. 2002. Manta rays: not all black and white. Shark Focus 15: 4-5.

Saloman, C.H. and S.P. Naughton. 1984. Beach restoration with offshore dredged sand: effects on nearshore macroinfauna. NMFS Technical Memorandum NMFS-SEFSC-133. 20pp.

Saloman, C. H., S. P. Naughton, and J. L. Taylor. 1982. Benthic Community Response to Dredging Borrow Pits, Panama City Beach, Florida. National Marine Fisheries Service, Gulf Coastal Fisheries Center, Panama City, FL.

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.

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.

Setälä, O., Fleming-Lehtinen, V., and Lehtiniemi, M. 2014. Ingestion and transfer of microplastics in the planktonic food web. Environ. Pollut. 185, 77–83. doi: 10.1016/j.envpol.2013.10.013

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

Snover, M. L. 2002. Growth and ontogeny of sea turtles using skeletochronology: Methods, validation and application to conservation. Duke University.

Spotila, J. 2004. Sea Turtles: A Complete Guide to their Biology, Behavior, and Conservation. Johns Hopkins University Press, Baltimore, Maryland.

Stabenau, E.K. and K.R. Vietti. 2003. Physiological effects of short-term submergence of loggerhead sea turtles, *Caretta caretta*, in TED-equipped commercial fishing nets. Final Report to National Marine Fisheries Service, Pascagoula Laboratory, Pascagoula, Mississippi.

Stapleton, S., and C. Stapleton. 2006. Tagging and nesting research on hawksbill turtles (*Eretmochelys imbricata*) at Jumby Bay, Long Island, Antigua, West Indies: 2005 annual report. Jumby Bay Island Company, Ltd.

Stewart, J. D., E. M. Hoyos-Padilla, K. R. Kumli, and R. D. Rubin. 2016. Deep-water feeding and behavioral plasticity in *Manta birostris* revealed by archival tags and submersible observations. Zoology 119.

Stewart, J. D., M. Nuttall, E. L. Hickerson, and M. A. Johnston. 2018. Important juvenile manta ray habitat at Flower Garden Banks National Marine Sanctuary in the northwestern Gulf of Mexico. Marine Biology 165:111.

Stewart, J.D., Jaine, F.R.A., Armstrong, A.J., Armstrong, A.O., Bennett, M.B., Burgess, K.B., Couturier, L.I.E., Croll, D.A., Cronin, M.R., Deakos, M.H., Dudgeon, C.L., Fernando, D., Froman, N., Germanov, E.S., Hall, M.A., Hinojosa-Alvarez, S., Hosegood, J.E., Kashiwagi, T., Laglbauer, B.J.L., Lezama-Ochoa, N., Marshall, A.D., McGregor, F., Notarbartolo di Sciara, G., Palacios, M.D., Peel, L.R., Richardson, A.J., Rubin, R.D., Townsend, K.A., Venables, S.K. and Stevens, G.M.W. 2018. Research priorities to support effective manta and devil ray conservation. Frontiers in Marine Science 5(314).

Stewart, J. D., Barroso, A., Butler, R. H., and Munns, R. J. 2018b. Caught at the surface: myctophids make easy prey for dolphins and devil rays. Ecology. 99, 1894–1896. doi: 10.1002/ecy.2348

Stewart, J. D., Nuttall, M., Hickerson, E. L., and Johnston, M. A. 2018c. Important juvenile manta ray habitat at flower garden banks national marine sanctuary in the northwestern Gulf of Mexico. Mar. Biol. 165:111. doi: 10.1007/s00227-018-3364-5

Stewart, J. D., Beale, C. S., Fernando, D., Sianipar, A. B., Burton, R. S., Semmens, B. X., et al. (2016a). Spatial ecology and conservation of *manta birostris* in the indo-pacific. Biol. Conserv. 200, 178–183. doi: 10.1016/j.biocon.2016.05.016

Stewart, J. D., Hoyos-Padilla, E. M., Kumli, K. R., and Rubin, R. D. 2016b. Deep-water feeding and behavioral plasticity in *Manta birostris* revealed by archival tags and submersible observations. Zoology 119, 406–413. doi: 10.1016/j.zool.2016.05.010.

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(5):908-913.

Sussarellu, R., Suquet, M., Thomas, Y., Lambert, C., Fabioux, C., Pernet, M. E., et al. 2016. Oyster reproduction is affected by exposure to polystyrene microplastics. Proc. Nat. Acad. Sci. U.S.A. 113, 2430–2435. doi: 10.1073/pnas.1519019113

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

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. National Oceanic and Atmospheric Administration, National

Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group.

TEWG. 2009. An assessment of the loggerhead turtle population in the western North Atlantic ocean. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Turtle Expert Working Group, NMFS-SEFSC-575.

Tremblay-Boyer, L. and Brouwer, S. 2016. Review of information on non-key shark species including mobulids and fisheries interactions. EB-WP-08. Western Central Pacific Fisheries Commission. Scientific Committee Twelfth Regular Session. Bali, Indonesia 3–11 August 2016.

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. 1999. Fisheries Resources Annual Report, U.S. Fish and Wildlife Service Field Office, Panama City, Florida. 24 pp.

USFWS. 2004. Panama City Fisheries Resources Office, Fiscal Year 2003 Annual Report. U.S. Fish and Wildlife Service, Panama City Field Office, Panama City, Florida.

USFWS. 2005. Panama City Fisheries Resources Office, Fiscal Year 2004 Annual Report. Panama City Fisheries Resources Office, Fiscal Year 2004 Annual Report, Panama City, Florida.

USFWS. 2006. Panama City Fisheries Resources Office, Fiscal Year 2005 Annual Report. U.S. Fish and Wildlife Service, Panama City Field Office, Panama City, Florida.

USFWS. 2007. Panama City Fisheries Resources Office, Fiscal Year 2006 Annual Report. U.S. Fish and Wildlife Service, Panama City Field Office, Panama City, Florida.

van Dam, R., and L. Sarti. 1989. Sea turtle biology and conservation on Mona Island, Puerto Rico. Report for 1989.

Van Dam, R., L. Sarti M., and D. Pares J. 1991. The hawksbill sea turtles of Mona Island, Puerto Rico: Report for 1990. Sociedad Chelonia and Departmento. Recursos Naturales, Puerto Rico.

Van Dam, R. P., and C. E. Diez. 1997. Predation by hawksbill turtles on sponges at Mona Island, Puerto Rico. Pages 1421-1426 *in* Eighth International Coral Reef Symposium.

Van Dam, R. P., and C. E. Diez. 1998. Home range of immature hawksbill turtles (*Eretmochelys imbricata* (Linnaeus)) at two Caribbean islands. Journal of Experimental Marine Biology and Ecology 220:15-24.

Venables, S. 2013. Short term behavioural responses of manta rays, Manta alfredi, to tourism interactions in Coral Bay, Western Australia. Thesis. Murdoch University.

Ward-Paige, C.A., David, B. and Worm, B. 2013. Global population trends and human use patterns of Manta and Mobula rays. PLoS ONE 8(9): e74835. doi:10.1371/journal.pone.0074835.

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.

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.

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.

Westneat, M. W. 2001. Ingestion in Fish. Pages 6 *in* Encyclopedia of Life Sciences. Macmillan Publishers Ltd, Nature Publishing Group.

White, E.R., Myers, M.C., Flemming, J.M. and Baum, J.K. 2015. Shifting elasmobranch community assemblage at Cocos Island--an isolated marine protected area. Conservation Biology 29(4): 1186–1197.

Wilkinson, C. 2004. Status of Coral Reefs of the World: 2004. Australian Institute of Marine Science, ISSN 1447-6185.

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., M. Bresette, and R. Herren. 2006. *Chelonia mydas* - Green turtle. Chelonian Research Monographs 3:90-104.

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, and coeditors, editors. Second Western Atlantic Turtle Symposium.

Whiting, S. D. 2000. The foraging ecology of juvenile green (*Chelonia mydas*) and hawksbill (*Eretmochelys imbricata*) sea turtles in north-western Australia. Northern Territory University, Darwin, Australia.

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

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. 2003. 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.

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.

APPENDIX A

1 Handling and Reporting Protocol for ESA-listed Species Observed or Encountered and Protected Species Observer (PSO) Roles and Responsibilities

All ESA-listed species that are observed or encountered during any activity covered under SERO-2024 Texas Point NWR Nourishment, will be handled and reported as described in this Appendix, referred to as the PSO PDCs. These PDCs outline the requirements of vessel crew to report observations and for the PSO to observe for and handle ESA-listed species captured during dredging or relocation trawling. These requirements are in addition to any other applicable Mitigation Measures and PDCs outlined in SERO-2024 Texas Point NWR Nourishment. Vessel crew and PSOs working on projects covered under SERO-2024 Texas Point NWR Nourishment should also be aware of the conditions in the PDCs that are applicable to the project upon which they are working on under SERO-2024 Texas Point NWR Nourishment. Modifications to the handling procedures may be necessary to improve safe handling practices for both crew and animals. The current handling guidance (PSO PDCs) is available at (https://dqm.usace.army.mil/odess/#/technicalInfo).

2 Observations and Reporting Observations of ESA-listed Species

This outlines how staff operating on a project covered under SERO-2024 Texas Point NWR Nourishment will respond to ESA-listed species that are observed, but with no physical interaction occurring with the animal.

OBSERVE.1 For generally stationary construction with work contained to a specific project area, such as mechanical dredging equipment:

- All personnel working on the project will report ESA-listed species observed in the area to the on-site crew member in charge of operations.
- Operations of moving equipment will cease if an ESA-listed species is observed within 150 ft of operations by any personnel working on a project covered under this Opinion (e.g., sea turtles, sturgeon, elasmobranchs [smalltooth sawfish, giant manta ray, scalloped hammerhead shark, oceanic white tip shark] or ESA-listed marine mammal).
- Activities will not resume until the ESA-listed species has departed the project area of its own volition (e.g., species was observed departing or 20 minutes have passed since the animal was last seen in the area).

OBSERVE.2 For a vessel underway, such as a hopper dredge or support vessel, traveling within or between operations must follow speed and distance requirements, defined below, while ensuring vessel safety:

- All personnel working onboard will report ESA-listed species observed in the area to the vessel captain.
- If an ESA-listed species is spotted within the vessel’s path, initiate evasive maneuvers to avoid collision.

- If a whale (other than a North Atlantic right whale) is spotted, maintain a distance of at least 300 ft.

OBSERVE.3 Report sightings (not encountered, collided with, or injured by a project covered SERO-2024 TX Point NWR Nourishment) of the following species:

- Giant manta ray: Report sightings by E-mail at: manta.ray@noaa.gov.
- Also, report all whale sightings to the NMFS Southeast Marine Mammal Stranding Hotline at (877) WHALE-HELP (877-942-5343).

OBSERVE.4 Any collision(s) with an ESA-listed species must be immediately reported to the USACE and BOEM according to their internal protocol and to NMFS consistent with the reporting requirements in Section 2.1.2 of SERO-2024 TX Point NWR Nourishment. A vessel collision with an ESA-listed species is counted as a take for the project.

In addition, reports of certain species shall also be reported as listed below.

- Sea turtle take will also be reported to the appropriate state species representative (https://www.fisheries.noaa.gov/state-coordinators-sea-turtle-stranding-and-salvage-network).

OBSERVE.5 Any collision with a marine mammal will be reported immediately to the Southeast Regional Marine Mammal Stranding hotline at 1-877-WHALE-HELP (1-877-942-5343) for guidance. This includes both ESA and non-ESA listed marine mammals.

3 PSO Credentials

All handling, tagging, and genetic sampling of ESA-listed species captured on projects covered under SERO-2024 TX Point NWR Nourishment will be conducted by a PSO that meets the qualifications provided by NMFS.

PSO.1 Protected Species Training and Experience: PSOs selected to work on projects covered under SERO-2024 TX Point NWR Nourishment will meet the following requirements:

- PSOs will meet the training and experience requirements outlined by NMFS. At the time of the completion of SERO-2024 TX Point NWR Nourishment, PSO qualifications are confirmed by the NMFS Greater Atlantic Region Office, as defined on their website (https://www.fisheries.noaa.gov/new-england-mid-atlantic/careers-and-opportunities/protected-species-observers) for endangered species observers.
- PSOs will be trained and have experience to operate on the specific equipment they are aboard (e.g., hopper dredge, relocation trawler). PSO will have training and experience to identify and handle all species that may occur in the geographic area of the project.

- PSO will be trained to safely install the specific tags being used and or collect genetic samples required under GRBO (SER-2000-01287).
- ESA-listed species specific safe handling procedures, tagging procedures, and genetic sampling procedures must be followed, as outlined in these PSO PDCs. The PSO must carry a copy of the PSO PDCs and all other applicable PDCs while on the vessel for easy reference.
- The SERO-2024 TX Point NWR Nourishment Opinion serves as the authority for the PSO to handle, tag, and genetic sample ESA-listed species for those projects.

PSO.2 To minimize the risk of vessel collisions, a PSO trained in species observation is also responsible for monitoring for the presence of ESA-listed species when the vessel is in motion and must therefore have the training and experience needed to identifying ESA-listed species and marine mammals in their natural environment.

4 PSO Responsibilities

The Section outlines the responsibilities of a PSO working on a relocation trawler or hopper dredge. The PSO is also responsible for all other duties outlined in the PDCs of this appendix.

Note: PSOs are also trained and may be responsible for monitoring for non-ESA-listed species including marine mammals protected under the Marine Mammal Protection Act. While the requirements outlined in SERO-2024 TX Point NWR Nourishment PDCs are limited to ESA-listed species, the PSO PDCs include guidance to minimize the risk of encounter with non-ESA listed marine mammals. SERO-2024 TX Point NWR Nourishment do not provide MMPA authorization.

4.1 PSO Guidance for handling ESA-listed species captured or observed injured or dead

The following PDCs describe how the PSO will handle ESA-listed species captured in hopper dredging and relocation trawling. If an ESA-listed species is observed injured or dead during other forms of dredging or material placement, this guidance also applies (e.g., observed during beach sand placement, in an upland disposal area, and while mechanical or cutterhead dredging).

PSO.3 PSOs observer coverage requirements are required to monitor for ESA-listed species as described below. PSOs on any project will not be assigned any other task (i.e., captain or other vessel crew position or task) while performing the role of PSO:

- Hopper dredging:
  - More than 1 PSO will be aboard the hopper dredge at all times.
  - The PSO on-duty is responsible for personally monitoring, handling, and reporting all captured ESA-listed species at all times when the hopper

dredge is operating and follow the requirements of SERO-2024 TX Point NWR Nourishment.

  - The PSOs will stand watch to detect ESA-listed species in the area and to alert the captain of their presence to avoid vessel collision whenever the vessel is moving. The on-duty PSO will only be responsible for standing watch and not performing other tasks such as inspecting or handling captures when the vessel is in motion.

- Relocation trawling: The PSO(s) will be aboard the trawling vessel at all times.
  - The PSO is responsible for all handling and reporting of ESA-listed species.
  - Trawling crew may assist in the removal of species from the nets and data recording only and the PSO is responsible for all tagging, genetic sampling, and assuring information reported is accurate.
  - All crew aboard the vessel, including the PSO, are responsible for monitoring for the presence of ESA-listed species in the area and reporting it to the vessel captain and PSO.

PSO.4 Reporting Captures of ESA-listed Species:

- Report to NMFS: All nonlethal captures and dead ESA-listed species observed or collected during a project covered under SERO-2024 TX Point NWR Nourishment will be recorded and reported to NMFS according to the procedures outlined in SERO-2024 TX Point NWR Nourishment Section 2.1.2. The captures will be recorded as follows:
  - Nonlethal take:
    - ESA-listed species captured and released back into the wild alive and healthy, will be considered nonlethal take.
    - If a sea turtle is entrained in a hopper dredge and is retrieved alive, the specialist such as a state sea turtle coordinator or sea turtle rehabilitation center specialist must be contacted to determine how the turtle should be handled (e.g., euthanized or taken to a rehabilitation facility). The take for a live turtle entrained in a hopper dredge is considered lethal until deemed healthy after an evaluation or rehabilitation and released back into the wild, then the take can be revised to be nonlethal.
    - If a sea turtle is captured in relocation trawling and is deemed unhealthy or injured and requires being sent to a specialist for further evaluation, the take is considered nonlethal, unless the species cannot be released back into the wild or dies, in which case the take must be updated to a lethal take.
  - Lethal take: All ESA-listed species that are captured that are determined to be fresh dead, will be considered lethal take associated with the

project and counted under the total allowed take for SERO-2024 TX Point NWR Nourishment. This includes the capture of ESA-listed species in relocation trawling or found within the project area including material removal and material placement areas. An explanation of how to determine if a species is fresh dead or decomposed and how to handle and report the specimen is provided in PSO PDC Section 4 below.

  - Recovered dead: All ESA-listed species captured or observed in the project area that are decomposing will be considered a recovered specimen and will not be counted against SERO-2024 TX Point NWR Nourishment Incidental Take Statement. An explanation of how to determine if a species is fresh dead or decomposed and how to handle and report the specimen is provided in PSO PDC Section 4 below.

- Report captures to other agencies:
  - Sea turtles: All captures will be reported to the appropriate state species representative including live, fresh dead, and recovered dead (https://www.fisheries.noaa.gov/state-coordinators-sea-turtle-stranding-and-salvage-network).
  - Giant manta ray will be reported to manta.ray@noaa.gov.

PSO.5 Photo Documentation: Photograph all captured ESA-listed species for identification purposes and classify sex where applicable (e.g., sea turtles). In addition, take photographs of all injuries to ESA-listed species and provide a high resolution digital image with the take reporting forms as part of the reporting requirements outlined in SERO-2024 TX Point NWR Nourishment Section 2.1.2, as follows:

- Captures in relocation trawling that are not brought aboard the vessel or are released from the net will be photographed for identification purposes. Photographing should be done as quickly as possible to minimize the time the animal is out of the water and will not require manipulating the animal to improve the photograph.
- All injured, deceased, or otherwise debilitated sea turtles encountered during the course of dredging operations, whether intact, damaged, or partial remains, are thoroughly photographed.
- All surfaces should be clearly represented in the photos with both wide vantage and close-up images that portray any injuries and postmortem condition (if deceased).
- Minimally, this includes multiple images of the dorsal (top) and ventral (bottom) aspects of each specimen taken from different angles and perspectives.
- An identification placard and scale should appear in the images but should not obscure the specimen, injury, or specific area of interest. The identification placard will include the location of capture, date, time, and species. In

addition, the time settings on the camera should be current so that the time stamp within the photo metadata is accurate.

- For any live capture that is injured or otherwise debilitated and will be taken to a rehabilitation facility, photographs can be delayed in order to minimize stress and risk of further injury prior to veterinary examination.
- For deceased specimens, photos will be taken within 2 hours following discovery so that postmortem state in the images accurately portrays the condition at the time of discovery.

PSO.6 Written Documentation: Document all relevant details of the capture according to the reporting requirements in SERO-2024 TX Point NWR Nourishment Section 2.1.2 (e.g., species, size, sex, condition upon release, location of capture, and time of capture) that can be observed or measured by the PSO without causing harm to the animal.

PSO.7 Tagging: Nonlethal captures of ESA-listed species captured by projects covered under SERO-2024 TX Point NWR Nourishment Section 2.1.2 will be tagged according to the following requirements. Tagging requirements only apply to those ESA-listed species that are brought aboard a relocation trawler (PSO PDC Section 3) or those captured and ultimately released alive from a hopper dredge after being evaluated by a specialist and rehabilitated, if necessary.

- Scanning: All ESA-listed species (live and dead) and species parts captured by a hopper dredge or brought aboard a relocation trawler will be scanned for passive integrated transponder (PIT) tags to determine if the animal has been previously tagged. The presence of any external tags (e.g., flipper tags, dart tags) will also be noted. All previous tag numbers must be recorded and reported on the appropriate forms outlined for each species in PSO PDC Sections 5-9 below.
- Tagging: All ESA-listed species captured alive and in good health by a hopper dredge or brought aboard a relocation trawler that are scanned and lack a previous pit tag, will be PIT tagged according to the specific species procedures identified in PDC PSO.7. Additional external tags (e.g., flipper tags) are optional. The cost associated with tagging is the responsibility of the federal action agency overseeing the project (i.e., USACE or BOEM) or the company awarded the contract.

PSO.8 Genetic Sampling: All nonlethal and lethal captures ESA-listed species captured by projects covered under SERO-2024 TX Point NWR Nourishment will be have genetic samples taken except:

- Live ESA-listed species that are not brought aboard a relocation trawler.
- Any leatherback sea turtles, even if brought aboard the vessel to untangle and safely release.
- If the PSO believes that collecting a sample would imperil human or animal safety. The rationale for this decision will be recorded on the species observation form and available digitally as part of the reporting

requirements outlined in the SERO-2024 TX Point NWR Nourishment Section 2.1.2.

PSO.9 Genetic samples will be collected according to the handling procedures defined for each species in the PSO PDCs Section 5-9 below.

- A tissue sample will be collected from any dead ESA-listed species. If multiple dead animal parts are found, a sample will be collected from all parts that are not connected to one another regardless of whether the tissues are believed to be from the same turtle. For example, if part of a sea turtle flipper and a detached head are found at the same time, a sample from each part will be collected for genetic analysis.
- All genetic samples will be preserved in RNAlater™ preservative. Once the sample is in buffer solution, refrigeration/freezing is not required, but care should be taken not to expose the sample to excessive heat or sunlight. Label each sample with the animal's unique identification number (PIT tag number). Since giant mantas will not be pit tagged, label any samples collected with the date, project name, and species name. Do not use glass vials; a 2 millimeter screw top plastic vial is preferred (e.g., MidWest Scientific AVFS2002 and AVC100N). Gently shake the sample to ensure the solution covers the entire sample.
- Genetic samples will be mailed to the addresses listed below with information provided in the container stating the sample was collected under SERO-2024-02130 TX Point NWR Nourishment. Package the genetic samples with an absorbent material within a double-sealed container (e.g., zip lock bag). If more than 1 sample is being sent to an address, package all of the samples together. The cost associated with taking the sample and delivering it to the appropriate entity listed below is the responsibility of the federal action agency overseeing the project (i.e., USACE or BOEM) or the company awarded the contract.
  - <u>Sea turtles</u>: Sea Turtle Program NOAA Southeast Fisheries Science Center Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149. Contact number: 305-361-4212 Lisa.Belskis@noaa.gov
  - <u>Elasmobranchs</u>: NOAA Southeast Fisheries Science Center, Attention Dr. John Carlson, National Marine Fisheries Service, Panama City Laboratory, 3500 Delwood Beach Rd, Panama City, Florida, 32408.

4.2 PSO Guidance on Relocation Trawling

The following PDCs describe how the PSO will handle ESA-listed species captured during relocation trawling including a flow chart summarizing how to handle different species and text describing the general handling guidance, the order to release species if multiple ESA-listed species are captured in trawling, and where they should be released. Trawling within the range of ESA-listed corals is not covered under this Opinion.

Table 12. PSO Handling Guidance

Species and handling protocol	Handling priority for multiple captures	Required to bring aboard (Y/N)	Directly measure all required data	Estimate all required data	Photograph (PDC PSO.5)	Tagging and Genetic Sampling (PDC PSO.7-10)	Relocate
Sharks PSO PDC Section 9	2	A	No	Yes	Yes	No	No
Giant manta ray PSO PDC Section 8	3	A, C	No	Yes	Yes	No	No
Leatherback sea turtle PSO PDC Section 5	4	A	No	Yes	Yes	No	No
Green, hawksbill, Kemp's ridley, loggerhead sea turtles PSO PDC Section 5	6	B, E	Yes	No	Yes	Yes	F

A. Animals will not be brought aboard and will remain and be released from net while still in water. If necessary, cut the net to expedite release.

B. Animals will be brought aboard, except if the PSO directs removal from net to protect the safety of the animal or crew (e.g., turtle in net with large shark).

C. If juvenile manta rays or smalltooth sawfish need to be brought aboard to safely disentangle, only allowed if animal is small enough to be picked up by crew and released according to PSO handling guidance

D. Sturgeon will be brought aboard and place in holding tank. Must release within 30 minutes (20 minute if tank unavailable), even if not relocated.

E. Turtle will be kept cool, wet, and kept in a safe area such as a kiddie pool to contain for safe transportation to the relocation site. If sick, injured, or requiring resuscitation, see PSO PDC Section 5 for guidance.

F. Animals brought aboard will be measured and data collected as quick as possible to return them to the water safely.

G. Relocate according to guidance in PDC PSO.11-13.

PSO.11 <u>Marine Relocation Trawling</u>: Relocation trawling is authorized in the marine environment as a measure to minimize lethal take of ESA-listed species.

- Sea turtles (with the exception of leatherback sea turtles) and sturgeon will be relocated 3-5 miles from the dredge project, if relocation can be done safely, according to the guidance in PSO PDC Section 5.
- The PSO will determine the appropriate release site based on the species captured and surrounding habitat.

PSO.12 <u>Estuarine Relocation Trawling</u>: Relocation trawling is authorized in the estuarine environment as a measure to minimize lethal take of ESA-listed species.

- For the purposes of relocation trawling authorized SERO-2024 TX Point NWR Nourishment, the estuarine environment consists of bays, harbors, estuaries, or other semi-confined areas inland of the COLREGS Demarcation Line, but outside of a river. The start of a river is not defined and varies by location and should be determined by best professional judgment. When in doubt, NMFS may be contacted for clarification.
- The PSO will determine the appropriate release site based on the species captured and surrounding habitat.

PSO.13 <u>Riverine Relocation Trawling</u>: Relocation trawling is not authorized within rivers, as noted in PDC PSO.12 above, the start of a river is not defined and should be determined by best professional judgment.

PSO.14 For relocation trawling:

- If any marine mammals, or aggregation of any other species not targeted for relocation trawling (e.g., fever of rays or school of fish) are sighted prior to deploying the nets and believed to be at-risk of interaction (e.g. moving in the direction of the vessel/gear and moms/calves close to the gear), gear deployment should be delayed until the animal(s) are no longer at-risk or have left the area of their own volition.
- During relocation trawling, the PSO and vessel staff will monitor for species presence at all times. Gear will be immediately retrieved if marine mammals or other species not targeted for relocation trawling are believed to be captured/entangled or at-risk of capture/entanglement. Operations may resume when interaction with these species is deemed unlikely, based on best professional judgment and through coordination with the PSO onboard.
- If a non ESA-listed marine mammal is injured or captured during relocation trawling, we recommend that trawling activities cease if other marine mammals may be in the area that are at risk of capture until provided guidance on how to proceed by NMFS or the marine mammal stranding staff. SERO-2024 TX Point NWR Nourishment does not consider effects to non-ESA-listed marine mammal species.

PSO.15 Relocation trawling handling and training:

- The PSO will train all crew members on the vessel how to safely handle and remove animals from the net and record tow capture data.
    - Training will occur with each new crew before heading out to begin work (e.g., if the crew will be at sea for 3 weeks before rotating staff, the training will be done at the beginning of the 3-week period, even for crews that have worked together before).
    - ESA and non-ESA listed animals captured may be removed from the net by crew other than the PSO, if trained by the PSO on proper handling and release techniques to minimize the risk of harm to these animals.
    - All ESA-listed species tagging, and genetic sampling will be performed by the PSO. Other crew members may assist with data collection, which be checked by the PSO for accuracy before reporting.
- All crew members will have easy access to equipment used to untangle animals from the net or to cut the nets to free the animal including knives, line-cutting poles, long-handled dehookers, or boat hooks.
- The nets will be checked during every tow for the presence of ESA-listed species. This may require pulling the tail end of the net to the boat to confirm nothing has been captured.
- For all species, ensure the vessel is in neutral and release animal over the side, head first.

5 Handling and Reporting Dead ESA-listed Species

All dead ESA-listed species collected within the construction area or by equipment used on a project covered under SERO-2024 TX Point NWR Nourishment, will be handled and recorded as described in the PSO PDCs and SERO-2024 TX Point NWR Nourishment Section 2.1.2.

PSO.16 Dead ESA-listed species collected within the area of work will be rated as fresh dead or decomposed and documented as described in PSO PDC.4. The determination of a specimen's condition (fresh dead or decomposed) is as follows:

- Decomposed specimens are those that exhibit obvious bloating (expansion of the body or tissues by putrefactive gases); detachment of skin upon handling; or liquefaction of organs and tissues. Examples of decomposition in sea turtles are provided in Figure 75 below. Note: foul odor alone is not considered definitive evidence of decomposition.
- If it is not clear whether the specimen is fresh dead or decomposed, the specimen will be retained for further examination by an individual that has demonstrated expertise in sea turtle necropsy and forensic pathology. Such examinations typically include complete gross examination and selective histopathology, depending on postmortem condition. Individuals that will

conduct examinations should be identified prior to the onset of dredging operations along with the necessary logistical planning for transportation and storage needs. The associated stranding coordinator for the state or region of the operation may be able to advise or assist in this regard as such needs are regularly required during stranding response. NMFS retains the right to review evidence or seek the opinion of an expert if a take determined to be decomposed should have been listed as fresh take and take associated with the project.

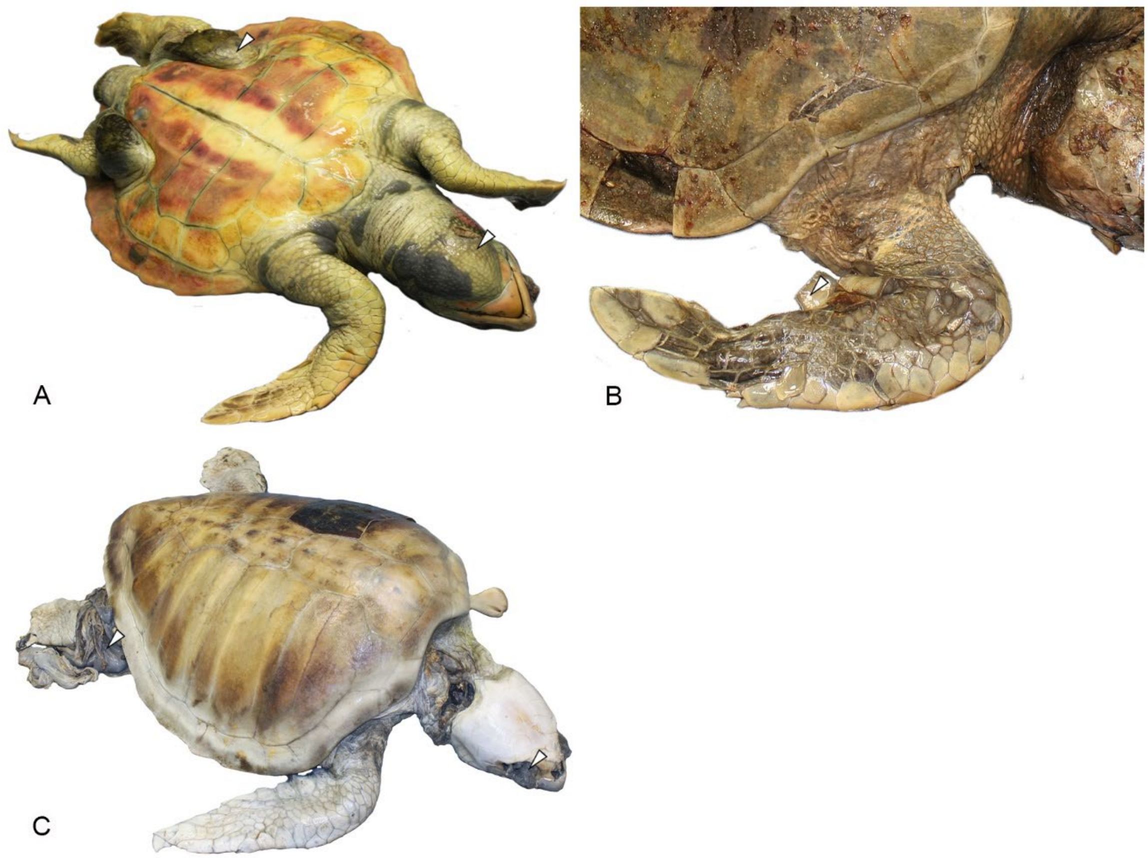


Figure 10. Examples of obvious signs of decomposition.

(A) Bloating expands the loose skin around the flippers and neck. (B) The skin starts to detach in sheets. (C) Soft tissues beginning to fall apart and easily tear when handled.

PSO.18 Dead ESA-listed species and species parts that need further examination by a specialist to determine the cause of death will be refrigerated, iced, or frozen as soon as possible, (must be iced or frozen no more than 2 hours from discovery). The timeline from discovery to transfer for examination, including ambient temperature, must be thoroughly documented. Whether the carcass/part is refrigerated or frozen will depend on predetermined logistical parameters for a given project. In general, a carcass/part may be kept refrigerated or iced, but not frozen if it will be examined within 48 hours. Remains may be frozen if examination will be delayed or maintaining refrigeration is not possible for any reason.

- Dead turtles: Follow the protocol outlined on the *Protocol for Collecting Tissue From Dead Turtles for Genetic Analysis* (https://dqm.usace.army.mil/odess/documents/geneticsampleprotocol.pdf). If a revised document is released, the PSO is required to follow the revised protocols. This document and any revisions will also be available on the NMFS dredging webpage (https://www.fisheries.noaa.gov/content/southeast-dredging).
- Dead elasmobranchs specimens will be stored as described in PDC PSO.16 until advised how to dispose of or provide to Dr. John Carlson, NOAA Fisheries, Panama City Laboratory at 1-850-234-6541 x 221. Dead smalltooth sawfish will also be reported to 1-844-4SAWFISH (1-844-472-93474).

6 Sea Turtle Handling, Tagging and Genetic Sampling Protocol for Relocation Trawling

6.1 Identification

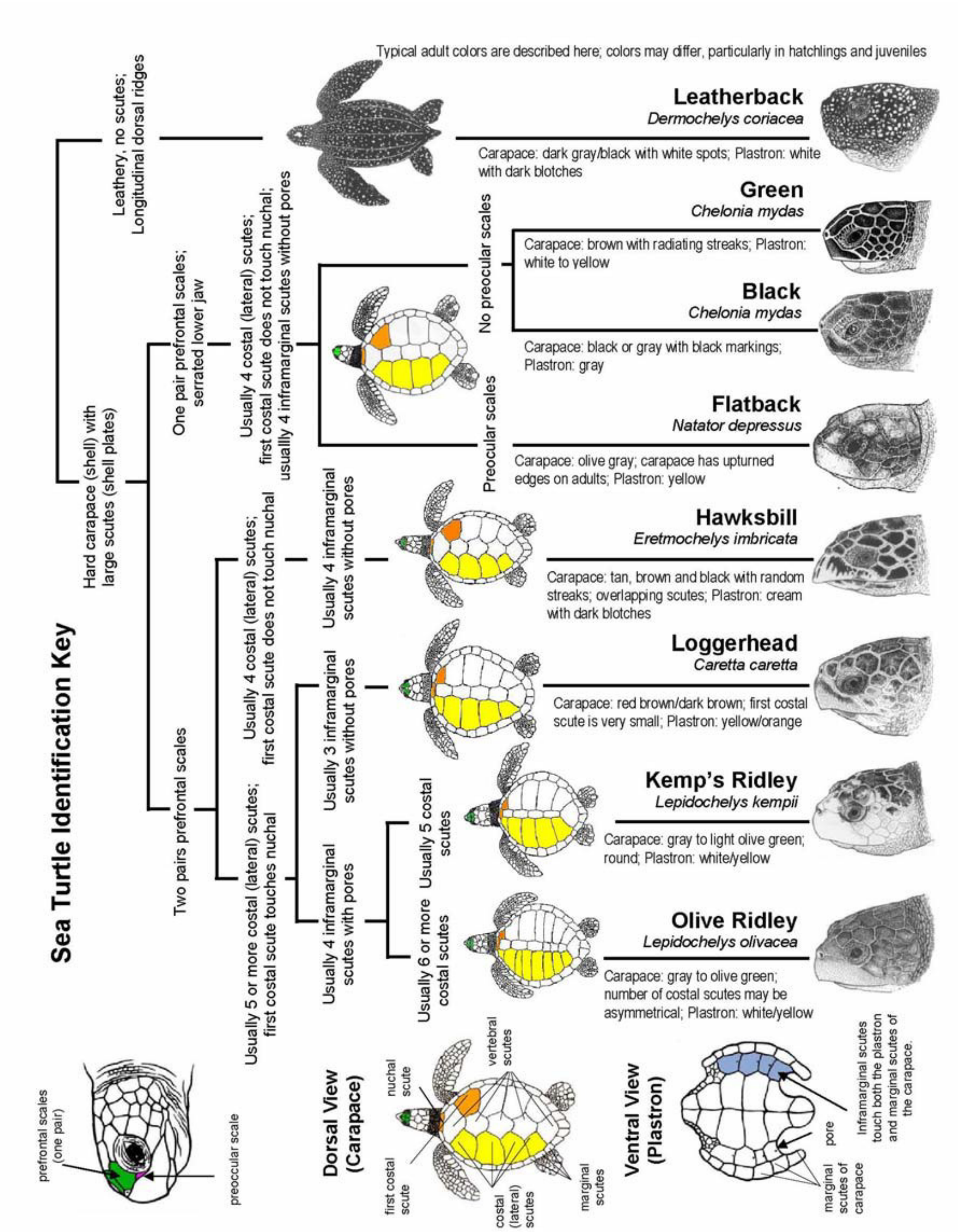


Figure 11. Sea Turtle Identification Key Image from the Southeast Fisheries Science Center Sea Turtle Research Techniques Manual, updated January 2013 (NOAA Technical Memorandum NMFS-SEFSC-579, https://repository.library.noaa.gov/view/noaa/3626)(NMFS 2008)

6.2 Handling

- Sick or injured sea turtles will be evaluated by a specialist to determine the best course of action including euthanizing animals that are severely injured or rehabilitating sea turtles before releasing them back in to the wild.
- A specialist trained to evaluate sea turtles and a sea turtle rehabilitation center will be identified prior to starting a project. Directions of how sick or injured sea turtles will be transported for an evaluation or rehabilitation will be provided to the PSO and dredging or trawling staff. NMFS will assist with identifying specialist and rehabilitation centers, if needed.

6.3 Relocating

- Do not relocate leatherback sea turtles. Release them immediately, as described in PSO Section 3.2 above.
- Green, Kemp's ridley, loggerhead, and hawksbill sea turtles will be relocated and released not less than 3 nmi from the dredge site, unless sick or injured. If 2 or more released turtles are later recaptured, subsequent turtle captures will be released not less than 5 nmi away. If it can be done safely and without injury to the turtle, turtles may be transferred onto another vessel for transport to the release area to enable the relocation trawler to keep sweeping the dredge site without interruption. These turtles will be kept no longer than 12 hours prior to release. The area in which a turtle will be relocated is determined by the PSO.

6.4 Data Recording

- Record the carapace length and width (straight and curved measurements), plastron length and width, head width, and sex (if possible).
- Follow the protocol outlined in the *Southeast Fisheries Science Center Sea Turtle Observer Manual*, updated January 2013 (NOAA Technical Memorandum NMFS-SEFSC-589, https://repository.library.noaa.gov/view/noaa/4392). Additional, specific handling techniques are required when handling turtles with fibropapilloma tumors. If a revised document is released, the PSO is required to follow the revised protocols. This document and any revisions will also be available on the NMFS dredge webpage (Https://www.fisheries.noaa.gov/content/southeast-dredging).

6.5 Tagging and Genetic Sampling

- Follow the protocol outlined in the *Southeast Fisheries Science Center Sea Turtle Observer Manual*, Updated January 2013 (NOAA Technical Memorandum NMFS-SEFSC-589, https://repository.library.noaa.gov/view/noaa/4392). If a revised document is released, the PSO is required to follow the revised protocols. This document and any revisions will also be available on the NMFS dredge webpage (Https://www.fisheries.noaa.gov/content/southeast-dredging).

- Tagging and genetic sampling of leatherback sea turtles is not required under this Opinion and priority should be given to quickly and safely release the animals due to the sensitivity of these animals to being handled.

6.6 Resuscitation

- Follow the protocol outlined in the *Southeast Fisheries Science Center Sea Turtle Observer Manual*, Updated January 2013 (NOAA Technical Memorandum NMFS-SEFSC-589, https://repository.library.noaa.gov/view/noaa/4392). If a revised document is released, the PSO is required to follow the revised protocols. This document and any revisions will also be available on the NMFS dredge webpage (https://www.fisheries.noaa.gov/content/southeast-dredging).

7 Giant Manta Handling Data Recording, and Genetic Sampling Protocol for Relocation Trawling

7.1 Identification

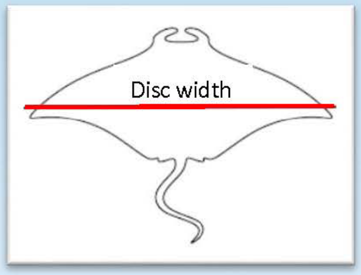
NOAA FISHERIES

Mobula Ray Identification Guide For Fisheries Observers

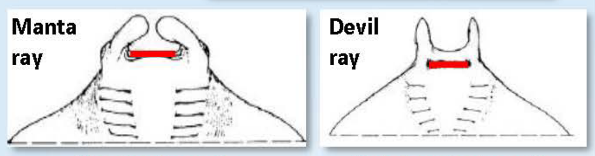
Purpose: This guide is intended to assist fishery observers in the visual identification of the giant manta ray and several devil ray species that occur in the Southeast and Mid-Atlantic.

General Observations: The size, coloring patterns, and a few morphological differences can be used to distinguish between species.

- Giant manta rays are larger than devil rays. Measurements should be taken by estimating the distance over their wingspan [“Disc Width” (DW)].



- Giant manta rays have a terminal mouth (i.e., mouth points straight forward, in front of the head); Devil rays have a sub-terminal mouth (i.e., mouth beneath the head).



Terminal mouth Sub-terminal mouth

Manta birostris

Common Names: Giant Manta Ray, Oceanic Manta Ray

Status: U.S.: Listed as *Threatened* under Endangered Species Act.

Size: Up to 700 cm DW; appx. 200 cm DW at birth.

Dorsal Coloration: Black with distinct white patches creating a T-shaped shoulder pattern.

Ventral Coloration: White with dark spots; spots rarely found between gill slits. Dark shading along the posterior edges of the pectoral fins.

NOAA Fisheries, Southeast Region, Protected Resources Division

Mobula mobular

Common Names: Giant Devil Ray, Spinetail Devil Ray

Status: U.S.: Not listed. International Union for Conservation of Nature (IUCN): *Endangered*

Size: Up to 520 cm DW

Dorsal Coloration: Predominantly dark gray; with a black (crescent shape) stripe that runs from side to side on upper shoulders. White tip on the dorsal fin.

Ventral Coloration: White.

Mobula tarapacana

Common Names: Chilean Devil Ray, Sicklefin Devil Ray, Box Ray

Status: U.S.: Not listed. IUCN: *Vulnerable*

Size: Up to 340 cm DW

Dorsal Coloration: Golden brown to olive green.

Ventral Coloration: Predominately white with gray shading along the posterior margin of pectoral fins.

Mobula hypostoma

Common Names: Atlantic Devil Ray, Lesser Devil Ray

Status: U.S.: Not listed. IUCN: *Data Deficient*

Size: Up to 120 cm DW

Dorsal Coloration: Variable, brown, gray to black. Sometimes have a dark gray/black stripe that runs from side to side on the "neck" right behind the eyes.

Ventral Coloration: White.

Figure 12. Mobula Ray Identification Guide

7.2 Handling

- Removing the giant manta ray from the water can increase the likelihood of injuries, mostly due to the crushing the animal's organs due to the weight of gravity.
- If a manta ray needs to be brought aboard, support the ray's weight by at least 2 points (i.e. one point of contact being the midsection, and the other being the posterior end of the body) or preferably have 2 or 3 people carry the ray by the sides of each wing.
- Follow the safe handling guidance: https://www.fisheries.noaa.gov/webdam/download/91927887

7.3 Relocating

- Do not relocate giant manta rays. Release them immediately, as described above.

7.4 Data recording

- Record the total disc width from wing tip to wing tip, as shown in the *Mobula Ray Identification Guide for Fisheries Observers* (Figure 81). Estimate the disc width, if released directly from the net and not brought aboard the vessel.
- Photograph animal. Manta's have unique spot patterns on the ventral side used for identification so photograph as much of the animal as possible without flipping or manipulating the animal.

7.5 Tagging and Genetic Sampling

- Tagging and genetic sampling of giant manta rays is not required under this Opinion and priority should be given to quickly and safely release the animals due to the sensitivity of these animals to being handled. Tagging of giant mantas is not recommended under SERO-2024 Texas Point NWR Nourishment unless it is part of cooperative research with NMFS.
- If a tissue samples is taken, it should be a small tissue (1.0 cm^2) fin clip taken from dorsal fin or posterior edge of pectoral fin. Use a knife, scalpel, or scissors that has been thoroughly cleaned and wiped with alcohol.
- Collected genetic samples must be stored in accordance with the requirements described in PSO PDC Section 3 above.

7.6 Additional Resources for Review

- Giant manta ray safe handling guidelines, https://repository.library.noaa.gov/view/noaa/22926 (Carlson et al. 2019).
- The giant manta ray can be visually distinguished from other rays by size, coloring, and a few morphological differences, as shown in *Mobula Ray Identification Guide for Fisheries Observers* (Figure 81).

8 Shark Handling, Tagging and Genetic Sampling Protocol for Relocation Trawling

8.1 Identification

Scalloped hammerhead and oceanic whitetip shark are ESA-listed species occurring within the action area. However, oceanic whitetip shark are a deep water (pelagic) species that are not expected to be captured during relocation trawling. Scalloped hammerhead shark may be encountered during relocation trawling, but are only protected under the ESA if they are a part of the Central and Southwest Atlantic DPS, which would only expected in the U.S. Caribbean (79 FR 38242). Scalloped hammerhead sharks encountered outside of the U.S. Caribbean are not protected under the ESA, but are still expected to be handled according to the PSO guidance in this Appendix.

Identification of both scalloped hammerhead and oceanic whitetip shark are provided on the placard used for the *Shark Identification and Federal Regulations for the Recreational Fishery of the U.S. Atlantic, Gulf of Mexico, and Caribbean* shown in Figure 82 along with identification guidance for other sharks that may be encounter that are not ESA-listed. Safe handling practices outlined in this section will be followed regardless of the ESA-listing status of the shark encountered.

8.2 Handling

- Large sharks should be released directly from the net into the water and not brought aboard the vessel.
- If sharks must be brought aboard to safely remove them from the net, cut the net quickly and release them back to the water. If necessary to bring a smaller animal aboard to free it from the net, make sure to keep shark wet and work quickly to get it safely back in the water. Smaller sharks can be returned to the water by grasping the animal under the jaw and ensuring the jaw is closed. Depending on the size of the shark, this may require 2 hands to hold the jaw closed while a second crew member helps to carry the shark back to the water.
- Sharks are reported to frequently chew through a portion of the net and are retrieved trapped in the net at the gills. In instances such as this, the net will be quickly cut and the shark removed.
- Do not pull sharks free or carry them by the gills.

8.3 Relocating

- Do not relocate sharks. It is more important to release them as soon as possible and described above.

8.4 Data Recording

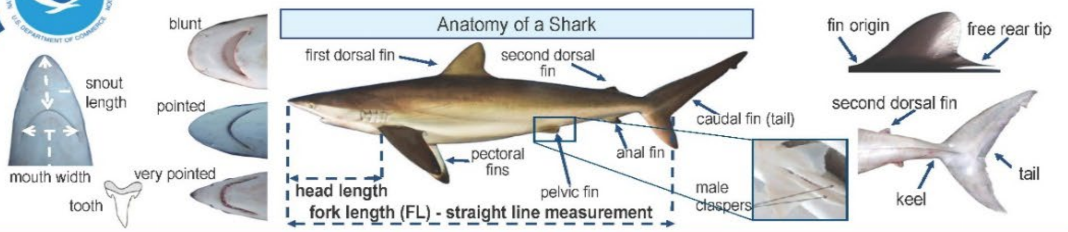
- Record the total length of the shark either by measuring the shark if brought aboard or by estimating the length based on the photo taken of the shark in the net, if necessary.

8.5 Tagging and Genetic Sampling

- Tagging and genetic sampling of sharks is not required under this Opinion and priority should be given to quickly and safely release the animals due to the sensitivity of these animals to being handled.

Shark Identification and Federal Regulations

for the Recreational Fishery of the U.S. Atlantic, Gulf of Mexico and Caribbean



Federal fishing permit required in federal waters. Purchase at hmspermits.noaa.gov.

HMS recreational permit holders that fish for sharks will need to obtain a shark endorsement.

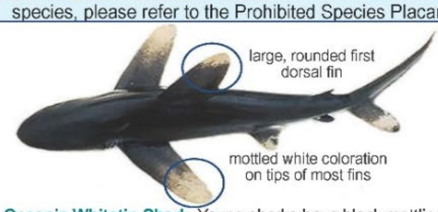
Authorized species	Minimum size (fork lenth)	Bag limit (per trip)
Smoothhound Shark	None	None
Atlantic sharpnose Shark	None	1 per person
Bonnethead Shark	None	1 per person
Shortfin Mako Shark	71 inches male 83 inches female	1 shortfin mako, hammerhead, or other shark per vessel
Hammerheads (great, scalloped, and smooth)	78 inches	
Other sharks	54 inches	

Recreational anglers are required to use non-offset, non-stainless steel circle hooks except when fishing with flies or artificial lures.

Ridgeback sharks have an **interdorsal ridge** (a visible line, or crease of raised skin between dorsal fins)

All ridgeback sharks are prohibited, except **Tiger, Oceanic Whitetip, and Smoothhound**.
Prohibited ridgeback sharks include **Bignose, Caribbean Reef, Dusky, Galapagos, Night, Sandbar,** and **Silky**. For more details on prohibited species, please refer to the Prohibited Species Placard.

Tiger Shark: Snout length much shorter than mouth width; markings fade with age; max. size 15 feet; coastal and offshore



Oceanic Whitetip Shark: Young sharks have black mottling on most fins; does not always have interdorsal ridge; max. size 8 ft; offshore
Cannot be retained if tuna, swordfish, or billfish are onboard

Smoothhound: (a.k.a. smooth dogfish and Florida/Gulf smouthhound) Predorsal ridge present; second dorsal fin slightly smaller than first dorsal fin and much larger than anal fin; max. size 5ft; coastal and offshore

Spiny Dogfish: Max. size 4 ft; coastal and offshore
There are no recreational restrictions for **Spiny Dogfish**

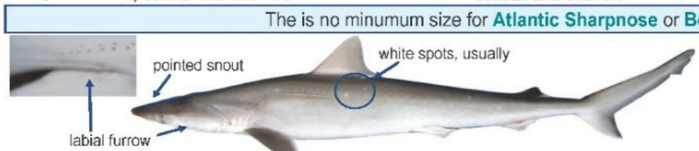
Scalloped Hammerheads, Great Hammerheads, and Smooth Hammerheads
Cannot be retained if tuna, swordfish, or billfish are onboard

Scalloped Hammerhead: Max. size 11 ft; coastal and offshore

Great Hammerhead: Max. size 15 ft; coastal and offshore

Smooth Hammerhead: Max. size 12 ft; coastal and offshore

The is no minumum size for **Atlantic Sharpnose** or **Bonnethead Sharks**



Atlantic Sharpnose Shark: Max. size 3 ft; coastal and offshore; similar species: **Smalltail** sharks have very reduced labial furrows and **Caribbean Sharpnose** sharks lack white spots.

Bonnethead: small, black spots on body; max. size 4 ft; mostly coastal

All sharks are not identical. These are common characteristics. Young sharks can vary in appearance from adults. Maximum sizes are approximate.

Photographs and illustrations provided by NMFS, J. Castro, W.B. Driggers III, E.R. Hoffmayer, and S. Iglésias. Prohibited species are underlined in red
https://www.fisheries.noaa.gov/topic/atlantic-highly-migratory-species. Revised March 2019

If you don't know, let it go

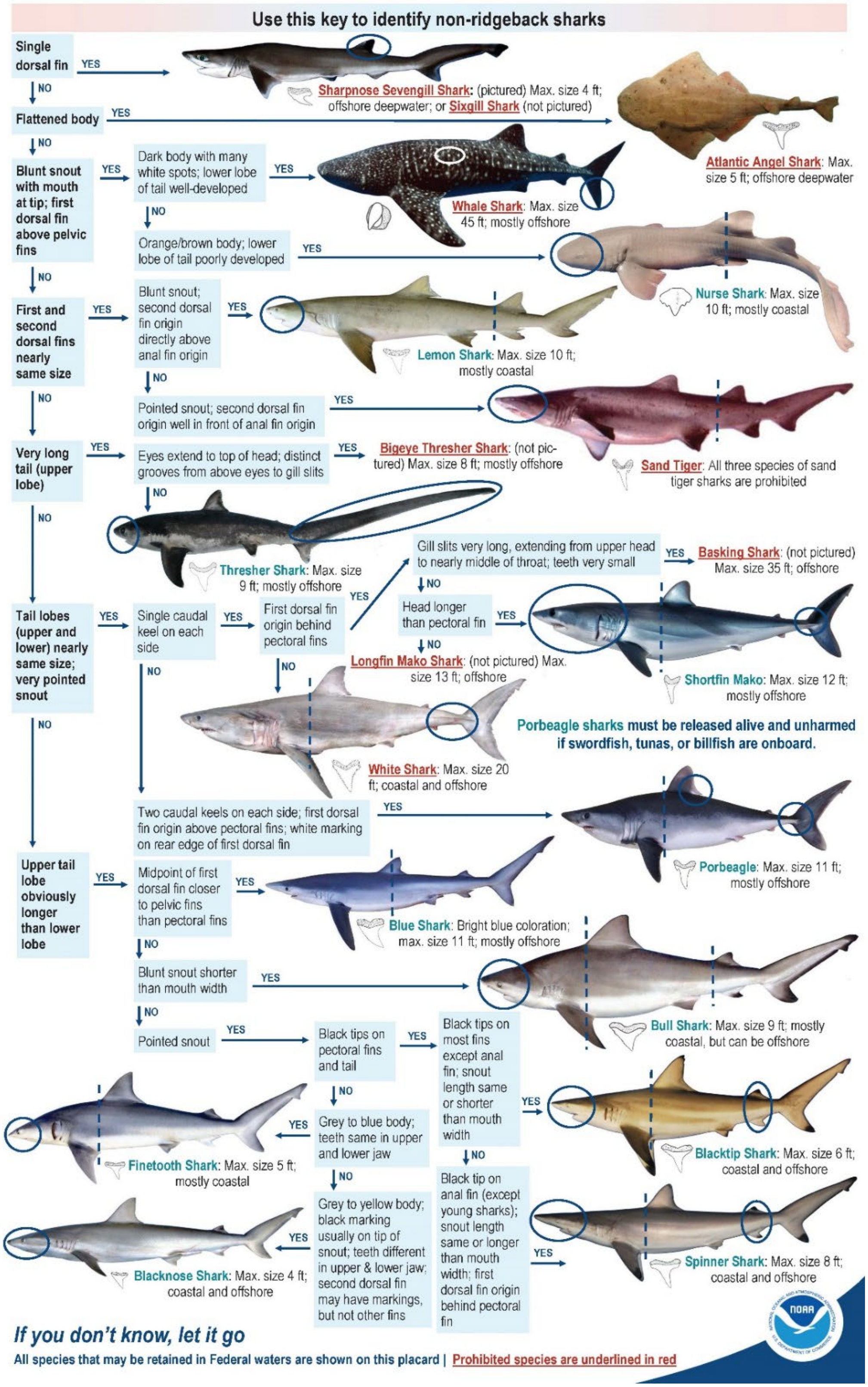


Figure 13. Shark Identification and Federal Regulations for the Recreational Fishery of the U.S. Atlantic, the Gulf, and Caribbean
(https://www.fisheries.noaa.gov/resource/outreach-and-education/shark-identification-placard)

APPENDIX B RELOCATION TRAWLING NET GUIDANCE

The relocation net specifications for a lazy line required in Section 2.1.2 (Mitigation Measures) of this Opinion are based on the guidance in the memo included in this appendix.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
Mississippi Laboratories
P.O. Drawer 1207
Pascagoula, MS 39568-1207

November 30, 2007

MEMORANDUM FOR: Stacy Carlson, Protected Resources Divison, SERO

FROM: John Mitchell & Wendy Taylor
Harvesting Systems Branch, SEFSC

SUBJECT: Recommendations for lazyline configuration to reduce dolphin interactions with turtle relocation trawlers

This memo is in reference to the conference call of November 5th during which representatives from SERO Protected Species Branch, SEFSC Harvesting Systems Branch, Army COE and several sea turtle relocation contract companies discussed methods of preventing the accidental entanglement of dolphins in the lazylines of contracted sea turtle relocation trawlers. At the conclusion of the call, I offered to summarize the various techniques which were discussed in order to provide a reference for contractors who may wish to trial a particular method during future turtle relocation work. NOAA Fisheries would like to acknowledge the efforts of Captain Steve Bosarge, of Bosarge Boats, Pascagoula Mississippi, for allowing us to provide details of his method of lazyline rigging which seems to have real potential for reducing dolphin entanglement.

Conventional lazyline rigging (Figure 1)

Conventional lazylines are attached at their forward end to the top/back edge of the inside trawl door and at their aft end to a ring in the "elephant ear", a triangle of reinforced webbing sewn to the trawl bag which acts as a lifting strap (Figure 1). The length of the lazyline is dependent on trawl size. As an example, a 55-ft. headrope length trawl might have a lazyline which is 80 to 85 feet in length. The conventional lazyline must be of sufficient length so as to allow the line to be hauled to the side of the boat upon haul back. The line is then led through a snatch block and wound around a cat head to in order to lift the bag to the side of the boat and eventually emptied on deck. When in a fishing configuration, the ample length of the lazyline forms a 10-12 foot loop behind the tailbag. This loop floats even with, or slightly above and behind the tailbag. It is in this loop of the lazyline, near the trawl bag, that underwater video obtained by NOAA Harvesting Systems gear researchers has documented dolphin interactions while the trawl is fishing. The animals appear to be using the line as a scratching post, moving back and forth against the line, rubbing it along their backs and bellies. Based on our observations, it is conceivable that a dolphin could put a complete wrap of the lazyline around it's torso. With the tail flukes acting as a stop, the animal would be unable to free itself. The following alternate lazyline rigging methods offer potential means to prevent dolphin entanglement.

Method A : Conventional rigging using stiffer lazyline (PolyDAC or Polyester)

This method simply replaces the conventional ¾" to 1" diameter polypropylene rope typically used for shrimp trawl lazylines with line made from polyDAC (a combination of polypropylene and polyester) or a polyester line. Both lines should be made with a "crab lay" which is a term relating to stiffness of the rope. Crab lay rope is used in the commercial crab fishery of the Alaska and provides an exceptionally tight twist to the rope to prevent loops when coiling. Both a polyDAC and polyester ¾" crab lay line were evaluated by Harvesting Systems divers in June, 2007 during annual gear tests. Divers found the polyDAC and polyester lines to be significantly stiffer and less pliable underwater than the conventional polypropylene lines. It was difficult for divers to form loops in either of the two line types. Divers also noted that the polypropylene arced upward (positive buoyancy) and polydacron arced downward (negative buoyancy) while being towed.

PolyDAC or Polyester ¾" crab lay line can be purchased from major U.S. rope suppliers such as TrawlWorks, Sampson and others. A recent check of cost resulted in a price of between 50 to 60 cents/foot for either rope type.

Method B: Bosarge Method of lazyline configuration (Figure 2).

This method replaces the conventional polypropylene lazyline with a stainless steel 3/8" cable. Steve Bosarge provides a very good description of the method in the following text:

"The modification to the original system totally removes the standard lazy lines and sugar line and replaces them with two 3/8 inch by 250 foot stainless steel cables in an entirely different routing arrangement. Now the routing begins with the stainless steel cables spooled on a deck winch. From there the cables run to the top of the boom where they go through separate blocks that are affixed to the boom. The cables then run to the webbing strap (elephant ear). This new system has benefited both the crew and the observers aboard the vessel by making gear retrieval faster and safer in inclement weather."

Steve's method of rigging the lazyline is likely to be much safer for dolphins for the following reasons; 1.) The diameter of the cable is significantly smaller than standard polypropylene lazyline, and thus is probably less enticing to dolphins for rubbing and scratching interactions; 2.) The fishing angle of the cable is likely higher than that of the conventional lazyline due to the cable being led from the vessel boom. We think it would be difficult for dolphins to interact with the cable at a higher fishing angle because they would have to orient themselves somewhat vertically while maintaining forward motion to do so.3.) In comparison to conventional polypropylene line, cable requires more force/exertion in order to form a tight loop when fishing, thus decreasing the probability of entanglement.

As Steve mentions above, operational benefits to the Bosarge method include quicker and safer retrieval of the tailbags (time is not lost to crewmembers having to grapple the lazylines, feed the lines through blocks and then wind them around winch cat heads to bring bags aboard). With the cable method, both tailbags are winched aboard and positioned over the deck for emptying in one simultaneous and continuous operation.

For the average shrimp fisher, there is an additional expense and some amount of special rigging which is required to use the cable method. First, a dedicated winch, capable of hauling in two tailbags simultaneously is needed. It is very likely that a vessels' try-net winch could be used for this purpose. Approximately 500 ft. of 3/8" stainless steel cable is required (estimated cost $750.00) as well as two (2), 5-ton "fat-boy" style try-net blocks (estimated cost $100.00 ea.).

Method C: Bosarge Method of lazyline configuration using PolyDAC or PE "crab lay" line

This method is identical in all respects to the above (Method B), with the replacement of 3/8" stainless steel cable with PolyDAC or Polyethylene "crab lay" line. Routing of the lazyline is the same as in the cable method. For the contractor, the advantage to this method over Method B is that a dedicated winch for the lazyline retrieval is not necessary. The trawl winch cat heads could be used to retrieve the lazyline. When fishing, the lazylines could be "tied-off" to the pin rail just aft of the trawl winches. Because the lines are routed through the boom, as in the cable method, we expect that the in-water fishing angle of the line would be higher (like the cable). The higher fishing angle along with stiffer lazyline should lessen the potential for dolphin entanglement over a standard lazyline configuration.

In FY08, the Harvesting Systems Branch plans to conduct qualitative assessments of all three of the above methods during TED evaluations aboard the *R/V Georgia Bulldog* (Feb.-April) using trawl-mounted underwater video cameras, and a DIDSON scanning sonar system. Additionally, we plan to conduct diver assessments and obtain underwater video of all three methods during annual gear evaluations using NOAA SCUBA divers in Panama City, Florida (June, 2008).

We would greatly appreciate feedback from the turtle relocation contractors who may trial the above mitigation methods. We are especially interested to know the following.

- Do contractors feel the methods are effective at preventing dolphin interactions/entanglements?
- What are the advantages and or disadvantages to working with PolyDAC / PE crab lay line during normal relocation operations?
- Is the stiffness of the the PolyDAC / PE crab lay line resilient, or is it degraded over the course of normal operations, i.e. winding around cat heads?
- Are their additional methods and or rigging modifications that may be worth investigating?

Responses can be emailed to my attention at john.mitchell@noaa.gov.

We look forward to continued collaboration with you, and the relocation contractors on this issue and hope that you will not hesitate to contact us if you have any questions.

Figure 1
Standard Lazyline Configuration

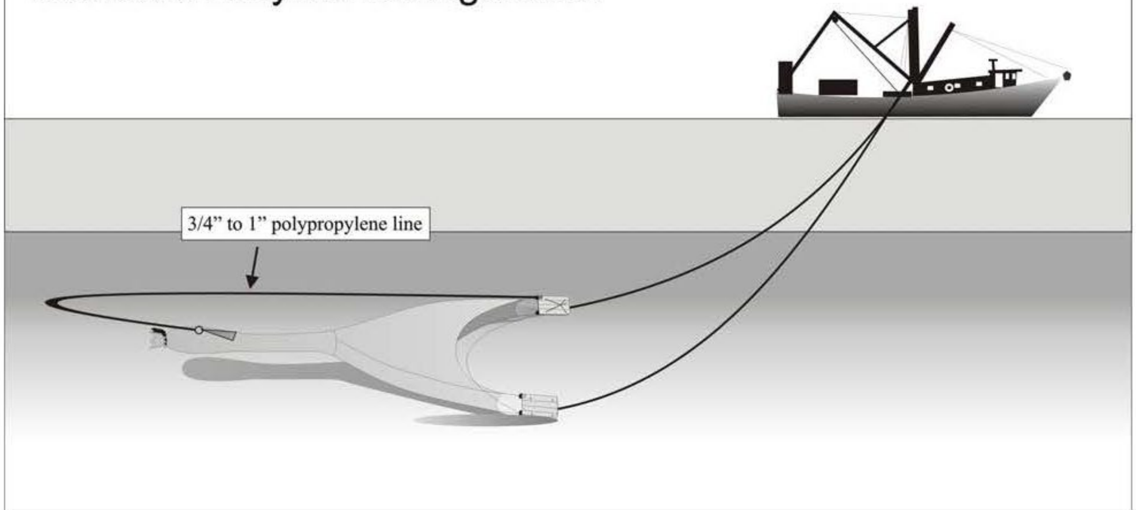


Figure 2
Bosarge Lazyline Method
Courtesy Steve Bosarge, Bosarge Boats
Pascagoula, MS