

**Endangered Species Act (ESA) - Section 7 Consultation
Biological Opinion**

Action Agencies: United States Army Corps of Engineers (USACE), New Orleans District, New Orleans, Louisiana, and National Oceanic and Atmospheric Administration, Restoration Center (NOAA RC), Southeast Regional Office (SERO), St. Petersburg, Florida

Activity: Mid-Barataria Sediment Diversion Project

Consulting Agency: NOAA, National Marine Fisheries Service, Protected Resources Division (NMFS PRD), SERO, St. Petersburg, Florida

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Acronyms and Abbreviations

BIRNM	Buck Island Reef National Monument
BOEM	Bureau of Ocean Energy Management
CCL	curved carapace length
CPUE	catch per unit effort
DDT	dichlorodiphenyltrichloroethane
DNA	deoxyribonucleic acid
DO	dissolved oxygen
DPS	distinct population segment
DTRU	Dry Tortugas Recovery Unit
DWH	DEEPWATER HORIZON
EEZ	exclusive economic zone
ESA	Endangered Species Act
FMP	fishery management plan
FP	Fibropapillomatosis
F/SER2	(NMFS SERO) Sustainable Fisheries Division
F/SER3	(NMFS SERO) Protected Resources Division
FWC	Florida Fish and Wildlife Conservation Commission
GADNR	Georgia Department of Natural Resources
GARFO	(NMFS) Greater Atlantic Regional Fisheries Office
GCRU	Greater Caribbean Recovery Unit
GMFMC	Gulf of Mexico Fishery Management Council
GRBO	Gulf of Mexico Regional Biological Opinion
HAB	harmful algal bloom
HMS	highly migratory species
IPCC	Intergovernmental Panel on Climate Change
ITS	incidental take statement
LDWF	Louisiana Department of Wildlife and Fisheries
MSA	mixed stock analysis
MSFCMA	Magnuson Stevens Fishery Conservation and Management Act
NA	North Atlantic (Ocean)
NCWRC	North Carolina Wildlife Resources Commission
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFSC	(NMFS) Northeast Fisheries Science Center
NGMRU	Northern Gulf of Mexico Recovery Unit
NLAA	may affect, not likely to adversely affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	U.S. National Park Service
NRU	Northern Recovery Unit
NWA	Northwest Atlantic Ocean
PAH	polycyclic aromatic hydrocarbons

PAIS	Padre Island National Seashore
PCB	polychlorinated biphenyls
PFRU	Peninsular Florida Recovery Unit
PIM	post-interaction mortality
PVA	population viability analysis
RPMs	reasonable and prudent measures
SA	South Atlantic (Ocean)
SCL	straight carapace length
SD	standard deviation
SAFMC	South Atlantic Fishery Management Council
SAV	submerged aquatic vegetation
SCDNR	South Carolina Department of Natural Resources
SEFSC	(NMFS) Southeast Fisheries Science Center
SERO	(NMFS) Southeast Regional Office
STSSN	Sea Turtle Stranding and Salvage Network
TED	turtle excluder device
TEWG	Turtle Expert Working Group
TL	total length
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
YOY	young-of-year

Units of Measurement

°C	degree Celsius
°F	degree Fahrenheit
°N	degree north (latitude)
cm	centimeter
ft	feet
in	inch
kg	kilogram
lb	pound
m	meter
mm	millimeter
nm	nautical mile
oz	ounce

INTRODUCTION

Section 7(a)(2) of the ESA of 1973, as amended (16 U.S.C. § 1531 *et seq.*), requires each federal agency to “insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species.” Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any such action. We, along with the U.S. Fish and Wildlife Service (USFWS), share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action “may affect” listed species or designated critical habitat. Consultation is concluded after we determine the action is not likely to adversely affect listed species or critical habitat or issue a Biological Opinion (Opinion) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures [RPMs]) to reduce the effect of take, and recommends conservation measures to further the recovery of the species. Notably, no incidental destruction or adverse modification of designated critical habitat can be authorized, and thus there are no RPMs—only reasonable and prudent alternatives that must avoid destruction or adverse modification.

This document represents our Opinion on the effects of the construction and operation of the Mid-Barataria Sediment Diversion Project on threatened and endangered species and designated critical habitat, in accordance with Section 7 of the ESA. The USACE and NOAA RC are acting as co-lead agencies in this consultation process.

The regulatory authority of the USACE for this project includes Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (CWA) (collectively referred to as “Section 10/404”), as well as Section 408 of the Rivers and Harbors Act of 1899. USACE approvals and permissions under these authorities constitute a federal action that may affect ESA listed species.

Natural Resource Damage Assessment (NRDA) funds arising from the Deepwater Horizon (DWH) oil spill settlement are being considered as a potential funding source for this project. These funds are managed by the Louisiana Trustee Implementation Group (LA TIG), which includes several federal agencies (NOAA, U.S. Department of the Interior [DOI], the U.S. Environmental Protection Agency [USEPA] and U.S. Department of Agriculture [USDA]). The federal trustees’ approval of funds for this project also constitutes a federal action for the purpose of Section 7 consultation. The NOAA RC is representing the LA TIG for this ESA consultation. The consultation with the NOAA RC is an intra-agency consultation, in which NMFS is acting as both the action agency (NOAA RC) and the consulting agency (NMFS PRD). The Coastal Protection and Restoration Authority (CPRA) of Louisiana is the non-federal applicant and implementing trustee for this project.

1 CONSULTATION HISTORY

NMFS, CPRA, and the USFWS have been participating in a pre-consultation technical assistance for several years in preparation for the formal consultation process now underway. In addition,

the USACE participated as a reviewer during certain portions of the efforts described below. These agencies (along with several others listed below) have been participating on project working groups to address various aspects of the project that are relevant to the ESA consultation. These include the following:

- A Mid-Barataria Sediment Diversion (MBSD) Monitoring and Adaptive Management Plan (MAMP) development working group;
- A combined state and federal working group called the Unified Federal Team (UFT) comprised of the USACE, Federal Coordination Team (comprised of USACE, NOAA/NMFS, DOI/USFWS, EPA, and USDA/NRCS) and LA TIG (including CPRA). This working group has several subject-specific sub-groups to address technical issues related to the project including:
 - Modeling Working Group that addressed the various models being used to evaluate Project impacts, including Delft 3D, Ecosystem Models, and ADCIRC
 - Essential Fish Habitat Assessment (EFHA)/ESA Working Group that has facilitated pre-consultation coordination efforts with representatives and technical experts from NMFS and USFWS that provide agency input on draft analyses and technical documentation

On February 24, 2021, NMFD PRD received a letter from the USACE, requesting initiation of formal consultation on the proposed project. Attached to that letter (via web-link) was the final Biological Assessment (BA) for the proposed project. On March 17, 2021, NMFS PRD received a letter (via email) from the NOAA RC, also requesting initiation of formal consultation, as a co-lead Federal agency, for the proposed project. NMFS PRD has determined that because both agencies have requested consultation on the same proposed project, we will produce a single Biological Opinion based on the BA provided by USACE, and issue that Opinion to both co-lead agencies. NMFS PRD completed a review of the Final BA submitted by USACE, and determined that the BA contains sufficient information to complete the consultation process. We therefore initiated formal consultation on February 24, 2021.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

The Barataria Basin was formed as part of the Lafourche delta complex and is a sub-estuary within the Mississippi River deltaic plain. Historically, Mississippi River overbank flooding deposited sediment, fresh water, and nutrients into the Barataria Basin during annual flooding cycles, nourishing and sustaining wetland habitats. Levees and channelization of the Mississippi River altered natural sediment transport from the river into the basin, removing the source of sediment and fresh water that built and maintained the wetlands and marshes. As a result, the basin is suffering from significant coastal habitat loss. The Mid-Barataria Sediment Diversion Project will mimic natural conditions by directing sediment, fresh water and nutrients from the Mississippi River into adjacent degrading wetlands in the Barataria Basin to build and sustain wetlands.

2.1 Proposed Action

CPRA is proposing to construct, operate, and maintain the Mid-Barataria Sediment Diversion Project (referred to herein as the “MBSD” or the “Diversion Project”). The proposed project consists of a multi-component river diversion system intended to convey sediment, fresh water, and nutrients from the Mississippi River near river mile (RM) 60.7 in the vicinity of the town of Ironton, Plaquemines Parish, Louisiana, into the mid-Barataria Basin. After passing through an intake structure complex on the Mississippi River, the sediment-laden water will be transported through a conveyance channel to an outfall area in the mid-Barataria Basin located in Plaquemines and Jefferson Parishes.

Following construction, the Diversion Project will be operated based on the diversion operations plan, which is keyed to flows measured at the Mississippi River gage at Belle Chasse. According to the operations plan, a permanent base flow of 5,000 cubic-feet per second (cfs) will be maintained through the diversion system when possible. There may be times when river flows are very low, and/or basin water levels are high (king tides, storm surge, etc.) when it will not be possible to maintain the full 5,000 cfs base flow through the diversion. Under extremes of these conditions, the diversion system may be closed entirely to prevent “backflow” of water from the Basin into the River. When Mississippi River flows at Belle Chasse exceed 450,000 cfs, operational flows (above the base flow of 5,000 cfs) will commence. Operational flow rates will increase proportionately to flow in the Mississippi River until the gage at Belle Chasse reaches 1,000,000 cfs, at which point flow through the diversion system will be capped at a maximum of 75,000 cfs.

The design elements of the proposed project are separated into three categories:

- Diversion Complex – The diversion complex will comprise features that form the basic structural elements for water conveyance from the Mississippi River to the basin outfall area. These features include the intake system, the gated control structure, the conveyance channel, and the guide levees
- Basin Outfall Area – The basin outfall area is the diversion discharge area, where initial delta formation is anticipated from the sediment-laden water; outfall transition features will be constructed here that are intended to increase the efficiency of sediment accumulation.
- Auxiliary Features – The auxiliary features are project elements that accommodate existing or future services and infrastructure, including road, rail, utilities, and drainage systems. These features also include the placement of dredged sediments in beneficial use placement areas and other mitigation measures designed to offset impacts of the construction process. All of these auxiliary features are considered to be interrelated and interdependent to the proposed project.

The proposed project is expected to require 3 to 5 years of construction, depending on the extent of ground modifications and soil stabilization measures that may be required. The following section provides detailed descriptions of the major project elements from construction through operation and maintenance, including all interdependent and interrelated actions.

Site preparation for construction of the major project features includes clearing and grubbing, stockpiling and placement of material, excavating and constructing of haul roads (including

drainage channels, cross-drain structures, and access fencing), hauling of material, grading and paving, dredging, pumping of dredged material to prepared disposal sites, installation of sediment and erosion control measures and slope protection, permanent and final stabilization measures, and extension of utilities to serve project operations. A more detailed description of the proposed construction plans is provided in Appendix B of the Final Biological Assessment (Confluence 2021) for the proposed project. The specific construction details and drawings referenced in the Biological Assessment and this Opinion are based on the latest designs available at the time of submittal, approximately 30% design. As the project continues toward final design and ultimately construction, some project details are likely to be modified and refined during final design, value engineering, and other project optimization steps. Any such changes and modification are not expected to change the mechanisms of impact to ESA-listed species and designated critical habitats discussed in the Biological Assessment and this Opinion and therefore are not expected to change the analyses or conclusions in this Opinion. However, if the final project construction details are modified in a manner that causes an effect to listed species or critical habitat that was not considered in this Opinion, the action agencies must request to reinitiate consultation.

Various types of equipment will be present and operating throughout the construction of the project, including excavators, trucks, loaders, dozers, rollers, scrapers, pile drivers, cranes, barges, and well point drill rigs for dewatering. The means and methods adopted by the construction contractor will determine what specific equipment will be on site. A concrete batch plant will be placed in the proposed construction footprint to produce the large volumes of concrete needed for the large structures. A temporary offloading facility may be constructed by the contractor on either the river or the basin side of the construction area (or both) to accommodate safe materials transfer.

Areas associated with project construction activities will be located within the overall footprint of the construction limits (Figure 1). Staging areas and construction yards will occupy approximately 8 acres. An additional 4 acres will be used for the concrete batch plant. The construction area will include the following:

- Haul and access roads
- A concrete batch plant
- Barge offloading facilities located on the Mississippi River and/or in the Barataria Basin
- A staging area for barge-delivered materials
- Construction yards
- A laydown area for drying and processing clay borrow from excavations

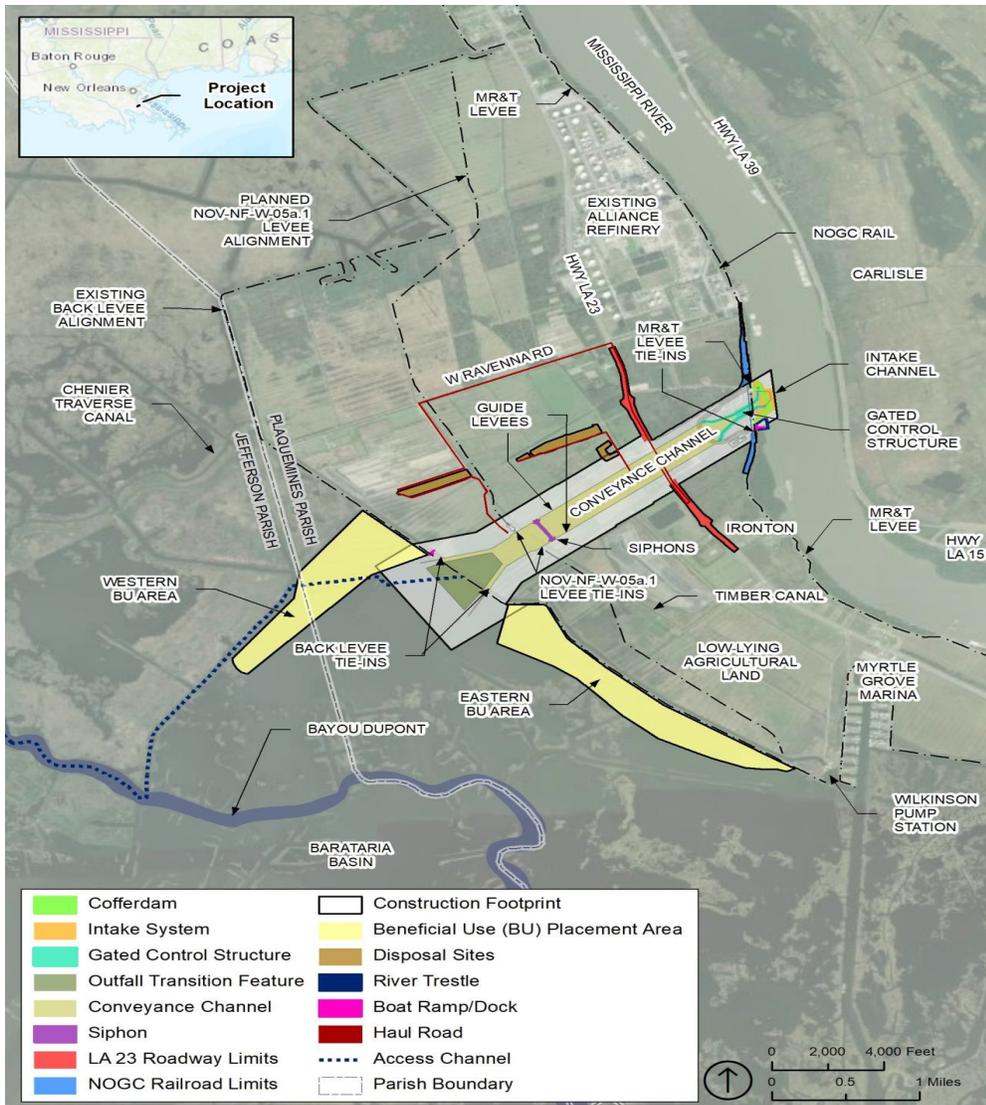


Figure 1. Project design features and construction footprint (Figure 2.2.3-1 in the Project BA)

Access routes within the Barataria Basin will be used to transport construction equipment and to dredge the outfall transition feature. There is one planned access route from the north to the proposed outfall area, as shown in Figure 2. This route follows a route used for previous restoration projects that had similar required draft for vessels. The route can be accessed from the Gulf Intracoastal Waterway via the Barataria Bay Waterway. Approximately 303,000 cubic yards of material are projected to be excavated for the access route. The proposed bottom width of the channel will be approximately 50 feet and the bottom elevation will be dredged to -9.00 feet North American Vertical Datum 1988 (NAVD 88) to provide flotation clearance during the construction phase. The current channel has an average depth of approximately -4 ft NAVD88. Excavated materials will be deposited adjacent to the channel and deposition areas are projected to create a crest that will be exposed to approximately +2 ft (NAVD88) above the mean tide line.



Figure 2. Planned access route from the northeast to the proposed outfall construction area (Figure 2.3.1-1 in Project BA)

Intake System

The intake system consists of an intake structure (with two flared training walls and an intake channel), a gated control structure, and a transition channel that will connect to the larger conveyance channel (Figure 3). The training walls will extend into the Mississippi River about 950 feet shoreward (west) of the Mississippi River navigation channel limits.

The training walls will direct the flow of sediment from the river into the intake channel and restrict riverbank soils from filling in the channel. The walls will be inverted pile-founded T-walls that gradually increase in elevation from 0.0 and -13.0 feet, respectively, in the river to approximately 16.4 feet where they would connect to the intake channel walls. A temporary cofferdam system will be built around the proposed training walls to dewater the area during construction. It is estimated that the cofferdam will be in place for up to 3.5 years. After construction, the cofferdam system will be removed.

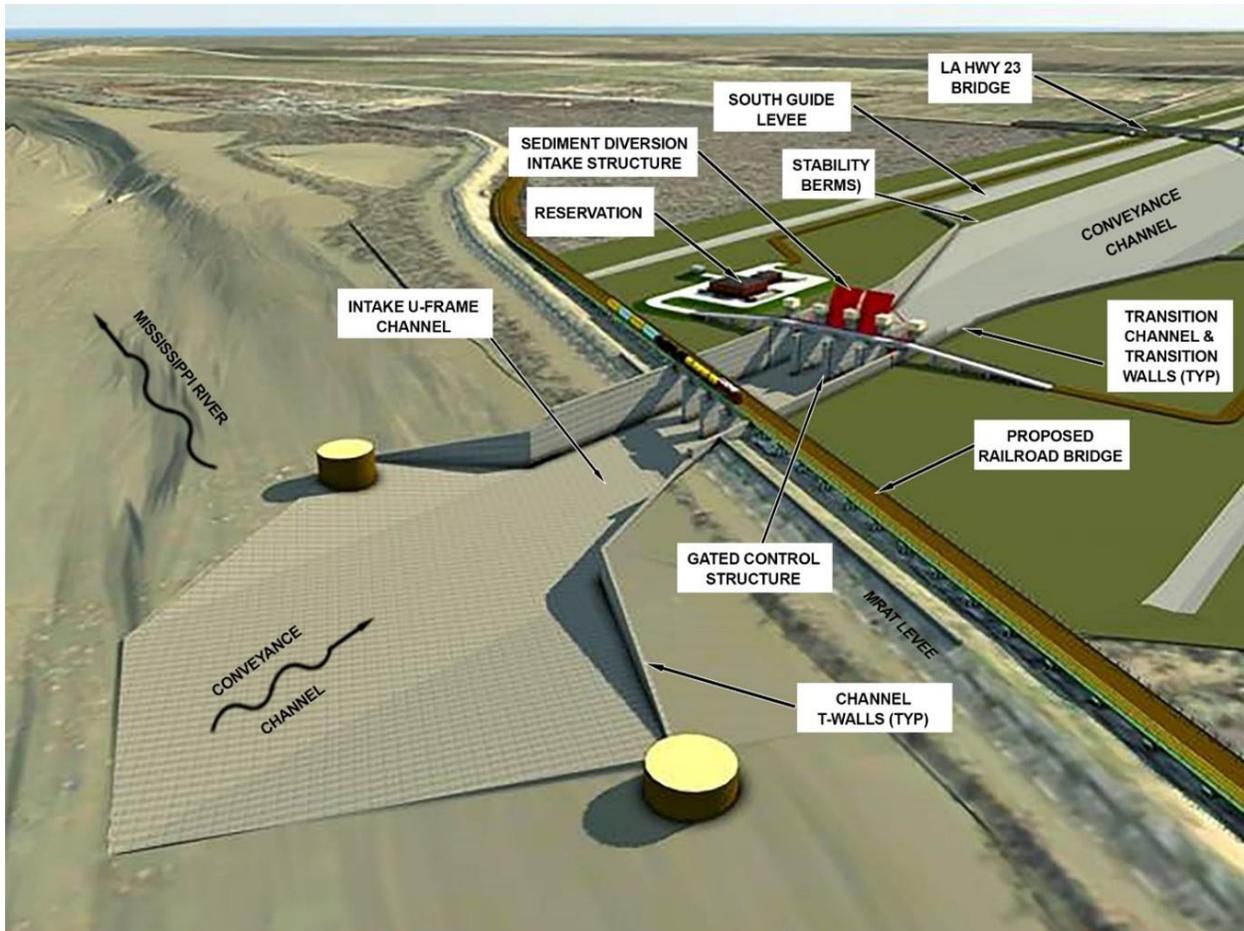


Figure 3. Overview schematic of the intake system for the MBSD (Figure 2.3.2-3 in the Project BA)

Gated Control Structure

The gated control structure consists of four steel tainter gates, which will regulate flow into the conveyance channel through the raising or lowering the gates. From the gated control structure, sediment-laden river water will be funneled through a U-shaped transition channel to the trapezoidal conveyance channel. The transition wall system under consideration will be pile-supported inverted T-walls.

Conveyance Channel

The conveyance channel conveys sediment-laden river water from the gated control structure and transition channel to the Barataria Basin. The conveyance channel will have a 300-foot bottom width with an invert elevation of -25 feet, setback berms between the top of the channel and toe of the guide levees, and guide levees (Figure 3). The total width of the conveyance channel, stability berms, and guide levees would measure 734 feet and will occupy approximately 563 acres, including the guide levees.

Construction of the conveyance channel will include clearing and grubbing of the site. Mechanical and hydraulic excavation methods will be used to excavate the channel. Two USACE-approved and environmentally cleared levee clay borrow sites located contiguous to the proposed conveyance channel will be used for fill material for embankments/levee construction

if needed. Detailed construction methods are provided in the project Draft Environmental Impact Statement (EIS) Section 2.8 (USACE 2021).

Guide Levees

Earthen guide levees will be constructed along both sides of the conveyance channel as a linear feature designed to constrain project flows (Figure 3). Drain systems will be incorporated into the levees to expedite soil consolidation and settlement. It is anticipated that multiple lifts and construction sequences will be needed to bring the guide levees to their final design height. The guide levees will also serve as hurricane flood protection against storm surges and will be built to an elevation of 15.6 feet, which is the USACE Design Grade for the proposed upgraded non-federal levee reach of the New Orleans to Venice (NFL-NOV) project. The levees will include a 10-foot-wide levee crown topped with a gravel access road. The levees will be constructed from soil material excavated for construction of the intake channel and conveyance channel.

Basin Outfall Area

The outfall area is defined as the area on the Barataria Basin side of the conveyance channel that will receive the sediment, fresh water, and nutrients from the Mississippi River via the conveyance channel. This area is delineated by Cheniere Traverse Bayou to the north, Wilkinson Canal to the south, and the Barataria Bay Waterway to the west, and is approximately 676 acres (Figure 4). The area largely consists of degraded wetland, shallow open water, and oil and gas canals. It is anticipated that a delta will form in the outfall area. Additional details about project-induced land building in the basin are provided in the project EIS Section 4.2.

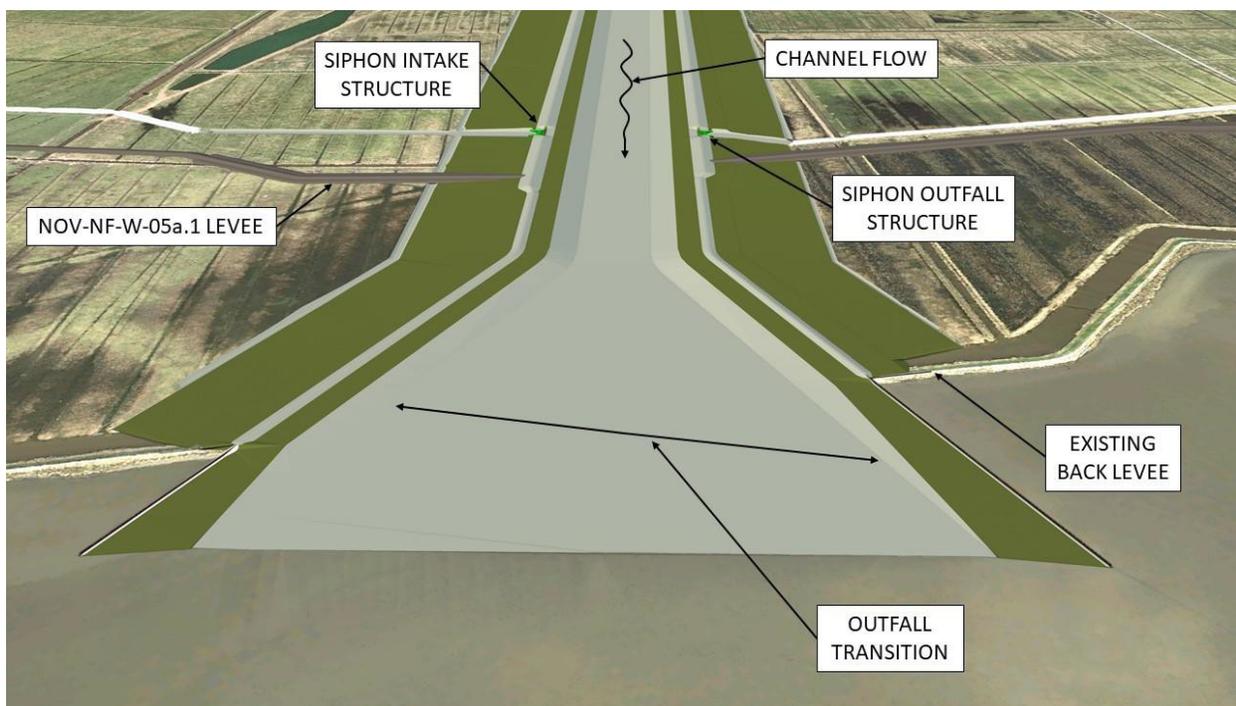


Figure 4. Overview schematic of the Basin Outfall Structure for the MBSD (Figure 2.3.2-5 in the Project BA)

Modeling indicates that, upon initiation of project operations, sand and coarse-grained sediments would be deposited within the outfall area in an initial delta formation with deposits of finer-grained sediment extending farther gulfward in the basin, forming a subaqueous delta just below the low-tide water level. Over time, the subaqueous delta will evolve into a subaerial delta above the low-tide water level as vegetation becomes established and encourages additional deposits of sediment. This would in turn extend the formation of new subaqueous delta farther gulfward into the basin. Fine-grained sediments transported by the diversion will travel farther from the outfall area and be dispersed throughout the proposed project area.

Outfall Transition Feature

The project design includes the creation of an outfall transition feature (OTF) to increase the efficiency of water and sediment delivery. To create the OTF, the receiving basin surrounding the outlet will be dredged to create a gradual gradient from the diversion channel invert elevation of -25 feet (the bottom grade elevation of the channel) to the existing bed elevation of the receiving basin (-4 feet). The OTF is designed to provide sufficient bed topography for the diversion to flow at maximum capacity, expediting initial delta formation. The OTF will be created by dredging bottom sediment from the open water area within about 640 acres (1 square mile) of the outfall transition walls of the diversion structure. These sediments will be placed at designated beneficial use locations in the receiving basin (mid-Barataria) shown in Figure 1. The bottom of the OTF will be armored with riprap.

Pile Driving

A sheet pile wall will be constructed across the mouth of the outfall transition structure. These are the only in-water steel piles proposed to be driven on the basin side of the diversion structure (where ESA-listed species under NMFS jurisdiction may be affected). Sheet piles will be driven with vibratory methods to the extent practicable, though some impact driving may be necessary. In addition, approximately 30 timber piles (12 in diameter) will be driven with an impact hammer to support the new boat pier, and up to 12 additional 12 in timber piles will be pressed into place to support navigation signs in the Basin. Estimated quantities, pile types, and duration of pile driving by location are shown in Table 1.

Project Area	Pile Type	Installation Method	Pile Depth (ft)	Pile Count (# or footage)	Blows/Pile (#)	Installation Duration	Hours/Day
Outfall	Sheet (Steel)	Vibratory or Impact Hammer	50-100	30,000 linear ft of sheet pile	100	2 months	8-12
Boat Pier	Timber Piling	Impact	20	30 timber piles (12-inch diameter)	20	5 days	8-12
Navigation Markers	Timber Piling	Press Installation	20	12 timber piles (12-inch diameter)	NA	1-2 days	8-12

Table 1. Pile Driving Details for Basin-side Construction Activities

Project Operation

The proposed project includes a 50-year diversion operations plan based on initial sediment transport and deposition modeling. A monitoring and adaptive management (MAM) plan will be implemented concurrently to observe and evaluate system performance and environmental response. The MAM plan may prescribe operational changes where necessary to improve system performance or if certain threshold environmental conditions are reached.

The diversion operation plan calls for initial opening of the sediment diversion gates when the Mississippi River gage in Belle Chasse reaches 450,000 cfs. Once operational, the gates will be operated to maintain controlled diversion rates ranging from a target minimum of 5,000 cfs to a maximum of 75,000 cfs, scaled to flow conditions in the main river channel. The maximum diversion flow of 75,000 cfs will occur when the Mississippi River gage in Belle Chasse exceeds 1,000,000 cfs. The target base flow diversion rate of 5,000 cfs would occur when Mississippi River flows drop below 450,000 cfs at the Belle Chasse gage. The primary purpose for the maintenance of the 5,000 cfs base flow is to ensure relatively stable salinity conditions in the outflow area in order to protect, sustain, and maintain fresh, intermediate, and brackish marshes expected to develop near the diversion outflow. The diversion rate between the base flow (5,000 cfs) and the maximum flow (75,000 cfs) will vary depending on the difference in water surface elevation between the Mississippi River and the Barataria Basin (the “head differential”). When the Mississippi River flow and stage are high, the increased head differential will push a higher volume of water and sediment through the diversion into the Barataria Basin. When the Mississippi River flow and stage are low, there will be less energy to push water and sediment through the diversion.

Figure 5 illustrates this variable flow rate for a representative Mississippi River hydrograph from 2011, a high spring flow year (data derived from The Water Institute of the Gulf 2014).

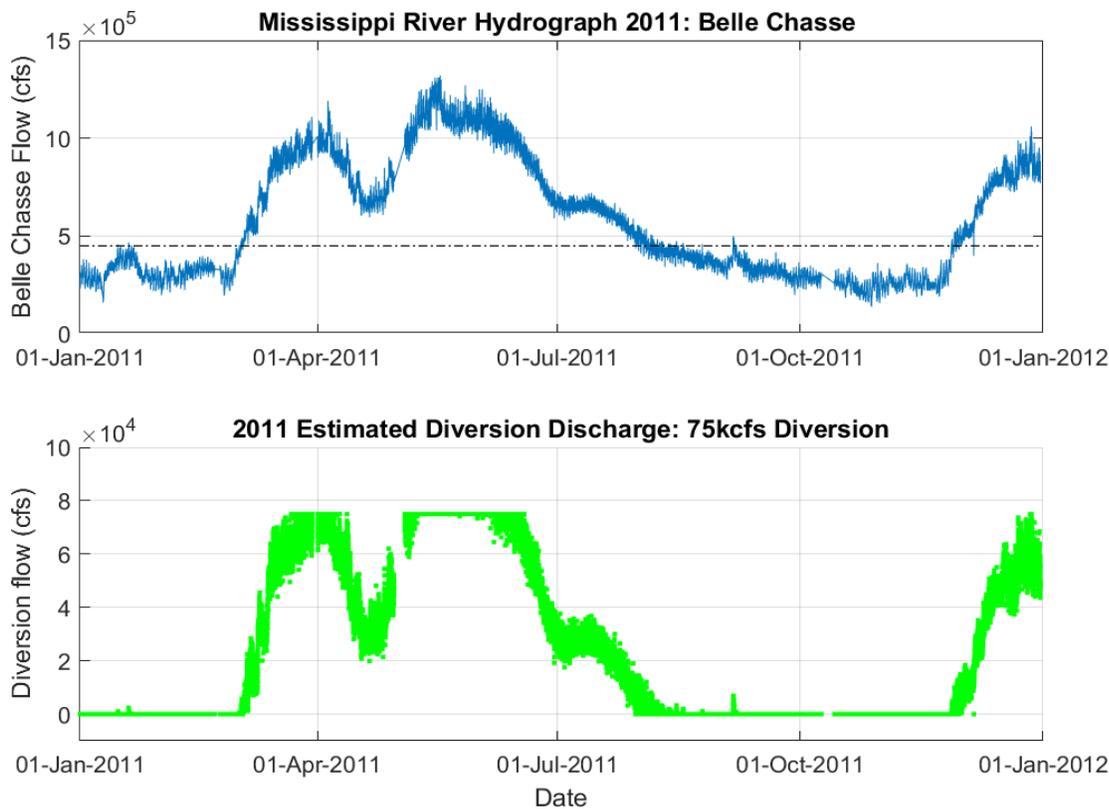


Figure 5. Proposed MBSD flow rate based on a representative Mississippi River hydrograph (Figure 2.3.3-1 in the Project BA)

Auxiliary Features

CPRA identified several auxiliary actions to the proposed project, which are described in detail in Section 2.8.1.2 of the EIS. One of these features involves the placement of dredged sediments in beneficial use placement areas around the Outfall Transition Feature (Figure 1). The other auxiliary actions include the development of road and rail crossings, and other improvements necessary to maintain existing infrastructure that crosses the project footprint. Other than the placement of dredged sediments in beneficial use placement areas, the proposed activities related to the construction of these auxiliary features are not expected to result in effects to ESA-listed species or designated critical habitat under NMFS' jurisdiction. Therefore, these proposed activities will not be discussed further in this Opinion. The effects from the placement of beneficial use dredge material are addressed in the project construction effects section below (Section 3.1).

Sea Turtle Protection Measures

Vessels supporting construction activities may encounter sea turtles in the vicinity of the transport routes, dredging areas, and construction areas. Vessels operating in these areas will follow NMFS Vessel Strike Avoidance Measures and Reporting for Mariners (NMFS 2008) and NMFS's Southeast Region *Protected Species Construction Conditions*,¹ to limit the potential for

¹ NMFS. 2021. Protected species construction conditions, revised May 24, 2021. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Saint Petersburg, FL. Available at https://media.fisheries.noaa.gov/2021-06/Protected_Species_Construction_Conditions_1.pdf?null

adverse interactions with sea turtles. These conservation measures require construction and vessel operators to take the following steps:

- Vessel operators will be notified of the potential presence of ESA protected sea turtles in the project areas and instructed on the need to avoid collisions with sea turtles.
- Siltation barriers shall be made of material in which a sea turtle cannot become entangled. The barriers shall be properly secured, and be regularly monitored to avoid protected species entrapment.
- Vessel operators and crews shall maintain a vigilant watch for sea turtles to avoid striking sighted protected species.
- Vessels shall operate at “no wake/idle” speeds at all times while in the outfall construction area and while in water depths where the draft of the vessel provides less than a 4-foot clearance from the bottom. Vessels will preferentially follow deep-water routes (for example, marked channels) whenever possible.
- When sea turtles are sighted within 100 yards of active vessel movement or operations, the vessel operator shall attempt to maintain a distance of 50 yards or greater between the animal and the vessel whenever possible.
- Operation of any mechanical construction equipment shall cease immediately if a sea turtle is detected within a 150-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition.
- When an animal is sighted in the vessel’s path or close to a moving vessel and when safety permits, the vessel operator shall reduce speed and shift the engine to neutral. Engines will not be reengaged until the animals are clear of the area.
- Any collision with and/or injury to a sea turtle or sightings of any injured or dead sea turtles shall be reported immediately to the NMFS Southeast Regional Office at 727-824-5312.

Stormwater Pollution Prevention Plan

The stormwater pollution prevention plan (SWPPP) shall be prepared to meet National Pollutant Discharge Elimination System (NPDES) permit requirements for stormwater discharges from construction sites. The SWPPP will address the following:

- Planning and organization
- Site assessment
- BMP identification
- Implementation
- Evaluation and monitoring

Temporary Erosion and Sediment Control Plan

A temporary erosion and sediment control (TESC) plan will be prepared and implemented to minimize and control pollution and erosion due to stormwater runoff. The TESC plan may be a component of the SWPPP.

Spill Prevention, Control and Countermeasure Plan

A spill prevention, control and countermeasure (SPCC) plan will be prepared and implemented by the contractor to prevent and minimize spills that may contaminate soil or nearby waters.

Monitoring and Adaptive Management Plan (MAMP)

The state and federal agencies are developing a MAMP in association with the project that will guide field monitoring of species, habitats and water quality considerations during operation of the MBSD. This plan will include monitoring efforts and management actions that may affect operations based on identified thresholds and planning processes. While the MAMP currently includes monitoring and management of fish, dolphins, oysters and other wildlife, it does not include any measures related to the monitoring and management of sea turtles. Specific measures for monitoring project effects on sea turtles are included in the Terms and Conditions (Section 8.4) of this Opinion.

2.2 Action Area

The action area, where effects to ESA-listed species resulting from the construction, operation, and maintenance of the proposed project may occur, includes the area within the hydrologic boundaries of the Barataria Basin and the western portion of the lower Mississippi River Delta Basin. The action area also includes the Mississippi River itself beginning near RM 60.7 and extending to the mouth of the river and throughout the “Birdfoot Delta” where project-related effects linked to reduced flows/sedimentation are expected to occur (Figure 6).

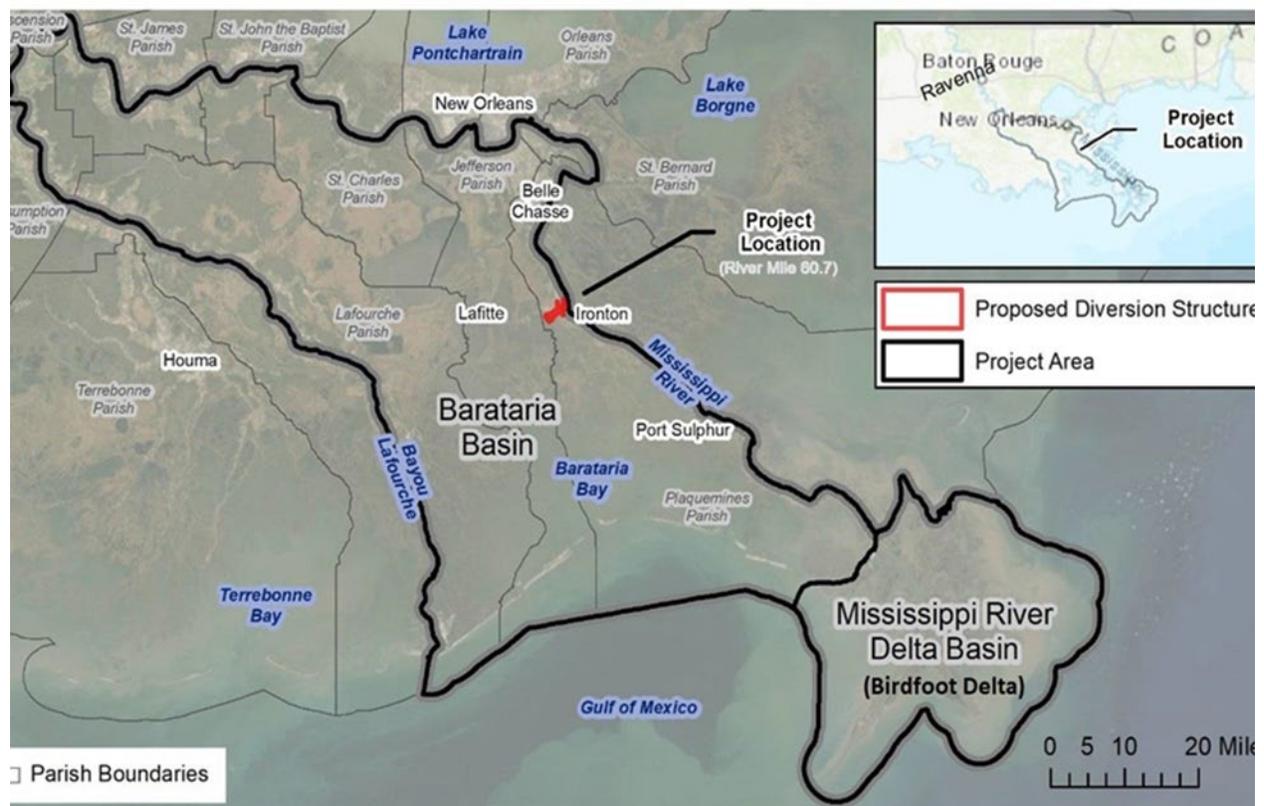


Figure 6. Overview of the Entire Action Area for the Proposed Project (Figure 2.4-1 in the project BA

3 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

The tables below document the ESA-listed species (Table 2) and designated critical habitat (Table 3) that may occur within the action area.

Table 2. Status of Listed Species in the Action Area (E= Endangered, T=Threatened)

Species	Scientific Name	Status
Sea Turtles		
Loggerhead sea turtle, Northwest Atlantic (NWA) Distinct Population Segment (DPS)	<i>Caretta caretta</i>	T
Green sea turtle, North Atlantic (NA) and South Atlantic (SA) DPSs	<i>Chelonia mydas</i>	T
Leatherback sea turtle	<i>Dermochelys coriacea</i>	E
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	E
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	E
Fish		
Giant manta ray	<i>Manta birostris</i>	T

Table 3. Designated Critical Habitat in the Action Area

Species	Critical Habitat Unit
Loggerhead sea turtle, NWA DPS	LOGG-S-02 (Sargassum Habitat)

3.1 Analysis of Potential Routes of Effects Not Likely to Adversely Affect Listed Species or Designated Critical Habitat

Hawksbill and leatherback sea turtles have very specific life history strategies, which are not well supported in the action area. Leatherback sea turtles have a pelagic, deepwater life history, where they forage primarily on jellyfish. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges. These habitat types are not prevalent in or near the action area. While there is the potential for transitory hawksbill and leatherback sea turtles to occur along the outer edges of the action area, where minor effects from project operations may occur (outside of the barrier islands and the Mississippi River outlets around the Birdfoot Delta), these species are very rare in these areas and there are no documented reports of either species in or near the Barataria Basin from stranding reports (NOAA 2019), field surveys (Fuller et al. 1987) or from field researchers. Due to the low likelihood of occurrence of these species in the action area, and the very minor project-related effects (discussed further below) expected to occur in the outer fringes where these species may occur, we believe it is extremely unlikely that the proposed project would result in adverse effects to hawksbill or leatherback sea turtles.

Giant manta rays are also expected to occur around the barrier islands and river outlets, and possibly a short ways up into the Barataria Basin. They are not expected to occur up in the shallow marsh habitats where the project construction activities will occur, and therefore are not expected to be affected by construction-related effects such as noise, turbidity and vessel traffic. Operational effects (changes in salinity, temperature and turbidity/nutrients) are expected to be very minor and ephemeral in the outer edges of the action area (see Section 5 below) where giant manta rays are expected to occur. We therefore believe that any project effects to giant manta rays will be insignificant, and are not likely to adversely affect any individuals of this species.

Kemp's ridley, green, and loggerhead sea turtles are expected to be present throughout the action area, and may be affected by the proposed action. While they are considered rare in the upper

basin where construction-related effects may occur, they have the potential to be present in the area during construction activities. Our analysis of potential effects to these species is based on the construction details provided in the Biological Assessment and include design details from approximately 30% design. As the design of the construction elements of the diversion facilities is optimized and finalized and the project goes to construction, some of the specific details may change. These modifications are not anticipated to change the impact mechanisms to these ESA-listed species and or their designated critical habitats discussed in the Biological Assessment and this Opinion, and therefore are not expected to change the analyses or conclusions in this Opinion. However, if the final project construction details are modified in a manner that causes an effect to listed species or critical habitat that was not considered in this Opinion, the action agencies must request to reinitiate consultation.

Sea turtles (namely, Kemp's ridleys, greens, and loggerheads) may be injured if struck by construction related vessels, equipment, or materials during in-water construction. We believe any such effects are extremely unlikely to occur because these species are highly mobile and are expected to avoid the noise and disturbance associated with construction activities. The implementation of NMFS's Southeast Region *Protected Species Construction Conditions* will further reduce such risks by requiring all vessels associated with the construction project to operate at "no wake/idle" speeds at all times while in the construction area, and all workers shall keep watch for protected species. Operation of any mechanical equipment will cease immediately if a protected species is seen within a 150-ft radius of the equipment, and activities will not resume until the animal has departed the project area of its own volition.

Sea turtles may be physically injured if struck or entrained during dredging of the Outfall Transition Feature. We believe any such effects are extremely unlikely to occur because these species are highly mobile and are expected to avoid the noise and disturbance associated with dredging activities. Additionally, NMFS has received limited reports of sea turtle interactions with cutterhead dredges. Thus, NMFS has previously determined that, while ocean-going hopper-type dredges may lethally entrain ESA-listed species, non-hopper type dredging methods, such as mechanical and hydraulic cutterhead methods proposed in this project, which are slower, are unlikely to adversely affect these species.²

Construction activities and related temporary increases in turbidity may prevent or deter sea turtles from entering the project area. We believe the effects to sea turtles from temporary exclusion from the project area due to construction activities will be insignificant, given the mobility of these species and the abundance and accessibility of similar habitat conditions in the surrounding areas. The use of best management practices to minimize turbidity, erosion, and sedimentation will further reduce the level of aquatic impacts from construction activities.

Sea turtles may be affected by the permanent loss of habitat due to placement of the beneficial use dredge material, outfall transition walls and sheet piles on the Basin-side of the diversion structure. We believe any potential effects from the loss of habitat will be insignificant. Sea

² NMFS. 2007b. 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. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida.

turtles are a mobile species that forage over large areas, and the area of permanent impact is relatively small compared to the surrounding estuarine habitat available. Additionally, we believe these effects will be insignificant due to the availability of more suitable habitat conditions (higher salinity and greater water depths) further down in the lower and mid Barataria Basin.

Noise created by pile driving activities can physically injure animals or change animal behavior in the affected areas. Injurious effects can occur in two ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects interfere with animals migrating, feeding, resting, or reproducing, for example. Our evaluation of effects to listed species as a result of noise created by construction activities is based on the analysis prepared in support of the biological opinion for SAJ-82 (NMFS Biological Opinion on Regional General Permit SAJ-82 [SAJ-2007-01590], Florida Keys, Monroe County, Florida, June 10, 2014).

Based on our analysis of the proposed pile driving activities, impact hammer installation of the sheet piles would result in the largest area of potential effects on sea turtles. We will therefore analyze the potential effects of driving these piles by impact hammer, and assume that the vibratory driving of the sheet piles would produce lower levels (and therefore a smaller radius) of effects than the impact-driving of the piles.

The proposed driving of sheet piles by impact hammer, requiring up to 1000 hammer strikes per day (100 strikes per pile x 10 piles per day), could cause single-strike, peak-pressure injurious noise effects for sea turtles at approximately 28.1 ft from the source pile. Due to the mobility of sea turtles, we expect them to move away from noise disturbances. Even in the unlikely event a sea turtle does not vacate the single-strike, peak-pressure injurious impact zone, the 28.1-ft radius for potential noise effects from the installation of sheet piles by impact hammer is smaller than the 150-ft radius that must be visually monitored for protected species in accordance with NMFS's *Protected Species Construction Conditions*. The requirement to cease all pile driving activity if a protected species is detected within 150 ft of the pile being driven will further reduce the potential for sea turtles to be injured through single-strike, peak-pressure noise impacts. Thus, we believe the likelihood of any single-strike, peak-pressure noise impacts is unlikely to occur.

Sea turtles could also be injured through cumulative sound exposure at a distance of 1,120 ft from the source pile (i.e., an individual would need to remain within 1,120 ft of the piles being driven throughout the entire day in order to suffer from cumulative noise injuries). Given the mobility of these species, and their natural tendency to avoid in-water construction activities, such a scenario is extremely unlikely to occur. Because we anticipate any sea turtles will move away from the noise disturbance, we believe that an animal's suffering physical injury from extended exposure to noise is extremely unlikely to occur. An animal's movement away from the injurious sound radius is a behavioral response, with the same effects discussed below.

The area of potential behavioral effects for sea turtles is approximately 3,281 ft. We believe that any effects on these species from behavioral reactions to pile driving noise will be insignificant. Due to the mobility of these species, we expect them to move away from any noise disturbances and continue their normal behavior in similar habitats outside of the affected zone. Additionally, because pile driving will occur for only 8-12 hours per day, any animals avoiding the noise will be able to pass through the impacted area during quiet periods between pile installations and throughout the night. Therefore, we anticipate any such behavioral effects will be insignificant.

Project modeling indicates that increased inflows of nutrient-rich Mississippi River water is likely to result in increased primary production and phytoplankton blooms in the action area (USACE 2021). While increased primary production and phytoplankton blooms may be beneficial to the Barataria Basin ecosystem through increased food supplies for lower trophic level organisms, they may also result in harmful algal blooms (HABs) that produce toxins that are known to accumulate in fish and shellfish which may serve as vectors of exposure to higher trophic wildlife (e.g., sea turtles). The project EIS found that the likelihood of increased HABs cannot be determined based on currently available information and modeling, and the likelihood of HABs impacting sea turtles is questionable because the species that produce the toxins are primarily fresh water species, and sea turtles are expected to stay in the more saline areas of the Bay.

The project's proposed Monitoring and Adaptive Management Plan will monitor phytoplankton blooms in the action area both pre-operations (monthly) and post-construction monitoring (monthly), with additional sampling in response to any observations of presence of cyanobacterial and/or eukaryotic algal species associated with harmful algal blooms. Detection of significant cyanobacterial and/or eukaryotic algal bloom toxins would trigger consideration of adaptive management actions, including outfall operational adaptive management.

Based on the best available scientific and commercial information, we assume that any potential effects from increased phytoplankton blooms on ESA-listed sea turtles will be insignificant. However, if either the proposed phytoplankton/HAB monitoring or the sea turtle monitoring required by Section 8 of this Opinion, reveal adverse effects on sea turtles from increased HABs in a manner or to an extent not previously considered, reinitiation of ESA Section 7 consultation may be required.

Loggerhead Sea Turtle NWA DPS Critical Habitat

Loggerhead sea turtle designated critical habitat (Unit LOGG-S-02, Gulf of Mexico *Sargassum*) extends into the outer edges of the action area where operational effects (changes in salinity, temperature and turbidity/nutrients) are expected to be very minor and ephemeral (see Section 5 below). The *Sargassum* 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 inhabitation 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).

We do not believe that any of these PCEs may be affected by the proposed action due to the ephemeral nature of the effects on the outer edges of the action area.

3.2 Potential Routes of Effects Likely to Adversely Affect Listed Species

We anticipate that Kemp's ridley, green, and loggerhead sea turtles may be adversely affected by the proposed action due to the potential for habitat alteration and fisheries bycatch. A discussion on these effects is included in Section 5.

3.2.1 General Threats Faced by All Sea Turtle Species

Sea turtles face numerous natural and man-made threats that shape their status and affect their ability to recover. Many of the threats are either the same or similar in nature for all listed sea turtle species. 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 sections where appropriate.

Fisheries

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and a 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 and other 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 (i.e., thousands of sea turtles as calculated in SERO-2021-00087 and referred to herein as the "2021 Shrimp Opinion") (NMFS 2021)) 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, 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 captures 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 2020a). Sea turtles entering coastal or inshore areas have also been affected by entrainment in the cooling-water systems of electrical generating plants. Other nearshore threats include harassment and/or injury resulting from private and commercial vessel operations, military detonations and training exercises, in-water construction activities, and scientific research activities.

Coastal Development and Erosion Control

Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 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), 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.

On April 20, 2010, while working on an exploratory well approximately 50 nm offshore Louisiana, the semi-submersible drilling rig DEEPWATER HORIZON (DWH) experienced an explosion and fire. The rig subsequently sank and oil and natural gas began leaking into the Gulf of Mexico. Oil flowed for 86 days, until the well was finally capped on July 15, 2010. Millions of barrels of oil were released into the Gulf of Mexico. Additionally, approximately 84 million gallons of chemical dispersant was applied both subsurface and on the surface to attempt to break down the oil. There is no question that the unprecedented DWH event and associated response activities (e.g., skimming, burning, and application of dispersants) have resulted in adverse effects on listed sea turtles. An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2016). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. The full long-term effects of the oil spill on ESA-listed sea turtles are not yet known. The DWH Programmatic Damage Assessment and Restoration Plan (PDARP), completed in 2016, estimated that 89,560 Kemps ridley, 55,100 green, and 13,980 loggerhead sea turtles were killed as a result of the spill and related remediation efforts.

Additional information on the spill impacts to individual sea turtle species is presented in the Status of the Species sections for each species.

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

Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see <http://www.climate.gov>). The potential effects, and the expected related effects to ESA-listed species, stemming from climate change are the result of a slow and steady shift over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. As previously mentioned, we have elected to view the effects of climate change on affected species on a more manageable and predictable 10-year time period due to this reality.

While we cannot currently predict impacts on sea turtles stemming from climate change with any degree of certainty, we are aware that 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 over time 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 and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

A combination of rising sea surface temperatures that could alter nesting behavior to more northern latitudes and sea level rise resulting in increased beach erosion north of Cape Hatteras, North Carolina (Sallenger et al. 2012) and reduced availability of existing beaches, could ultimately affect sea turtle nesting success in those areas. However, we expect those effects, should they occur, would likely occur over a fairly long time period encompassing several sea turtle generations, and not in the short term (e.g., over the next decade). Furthermore, modeled climate data from Van Houtan and Halley (2011) showed a future positive trend for loggerhead nesting in Florida, by far the species' most important nesting area in the Atlantic, with increases through 2040 as a result of the Atlantic Multidecadal Oscillation signal. A more recent study by Arendt et al. (2013), which is a follow up review and critique of the Van Houtan and Halley (2011) analysis, suggested the mechanistic underpinning between climate and loggerhead nesting rates on Florida beaches was primarily acting on the mature adult females as opposed to the hatchlings. Nonetheless, Arendt et al. (2013) suggest that the population of loggerheads nesting in Florida could attain the demographic criteria for recovery by 2027 if annual nest counts from 2013-2019 are comparable to what were seen from 2008-2012. Since loggerhead sea turtles are known to nest on Florida beaches in large numbers (and likely will continue to do so in the short-term future), we believe that any impacts of the sea level rise described in Sallenger et al. (2012) are likely to be offset by increased nesting in Florida over the next few decades.

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

Other Threats

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

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

3.2.2 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 two pairs of prefrontal scales on the head, five vertebral scutes, usually five pairs of costal scutes, and generally twelve pairs of marginal scutes on the carapace. In each bridge adjoining the plastron to the carapace, there are four scutes, each of which is perforated by a pore.

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

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

Life History Information

Kemp's ridley sea turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. After 45-58 days of embryonic development, the hatchlings emerge and swim offshore into deeper, ocean water where they feed and grow until returning at a larger size. Hatchlings generally range from 1.65-1.89 in (42-48 mm) straight carapace length (SCL), 1.26-1.73 in (32-44 mm) in width, and 0.3-0.4 lb (15-20 g) in weight. Their return to nearshore coastal habitats typically occurs around two 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 $2.2-2.9 \pm 2.4$ in per year ($5.5-7.5 \pm 6.2$ cm/year) (Schmid and Barichivich 2006; Schmid and Woodhead 2000). Age to sexual maturity ranges greatly from 5-16 years, though NMFS et al. (2011) determined the best estimate of age to maturity for Kemp's ridley sea turtles was twelve 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 two 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 seven 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 1), which indicates the species is recovering.

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. More recent data, however, indicated an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017), but nesting for 2018 declined to 17,945, with another steep drop to 11,090 nests in 2019 (Gladys Porter Zoo 2019). At this time, it is unclear whether the increases and declines in nesting

seen over the past decade represents a population oscillating around an equilibrium point or if nesting will decline or increase in the future.

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

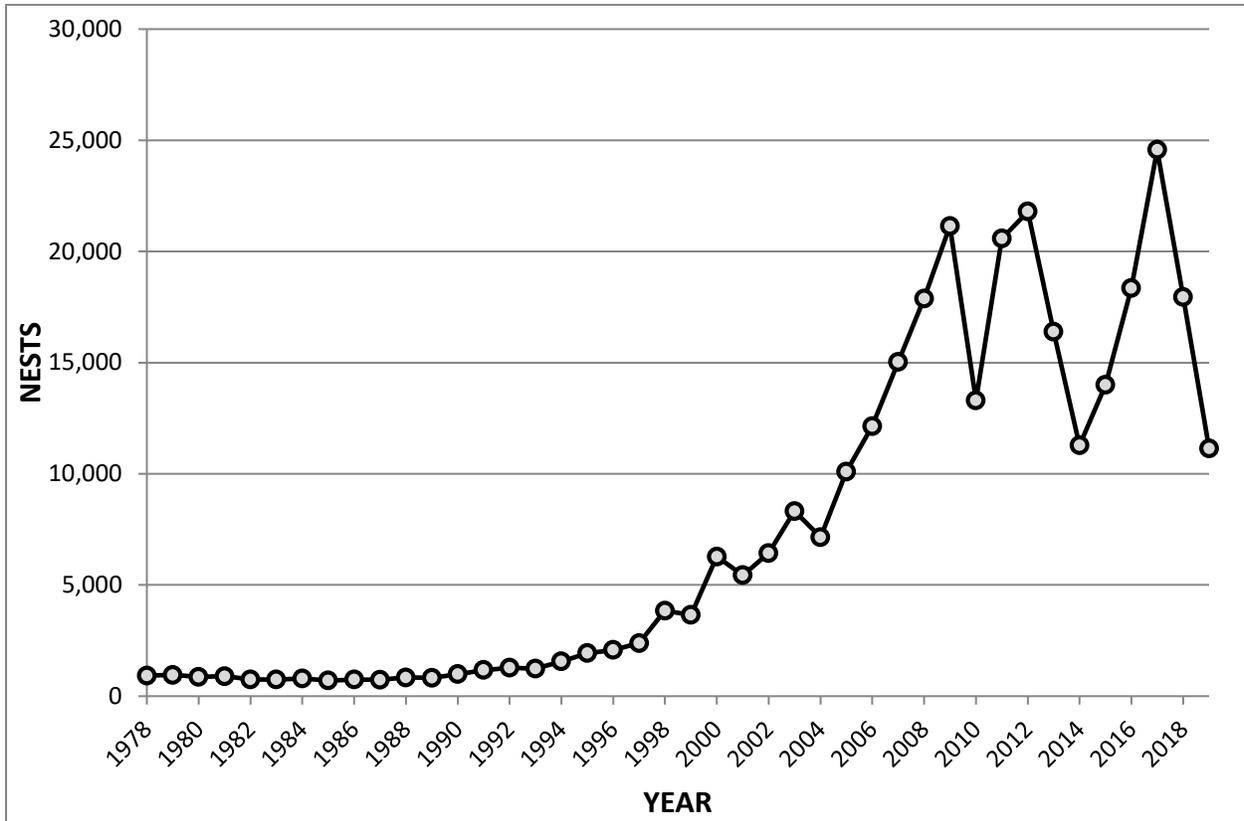


Figure 7. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019)

Through modelling, Heppell et al. (2005) predicted the population is expected to increase at least 12-16% per year and could reach at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011) produced an updated model that predicted the population to increase 19% per year and to attain at least 10,000 females nesting on Mexico beaches by 2011.

Approximately 25,000 nests would be needed for an estimate of 10,000 nesters on the beach, based on an average 2.5 nests/nesting female. While counts did not reach 25,000 nests by 2015, it is clear that the population has increased over the long term. The increases in Kemp's ridley sea turtle nesting over the last two decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998; TEWG 2000). While these results are encouraging, the species' limited range as well as

low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all factors which are often difficult to predict with any certainty. Additionally, the significant nesting declines observed in 2010 and 2013-2014 potentially indicate a serious population-level impact, and there is cause for concern regarding the ongoing recovery trajectory.

Threats

Kemp's ridley sea turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.2.1; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact Kemp's ridley sea turtles.

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

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

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

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 five years were Kemp's ridleys is notable; however, this could simply be a function of the species' preference for shallow, inshore waters coupled with increased population abundance, as reflected in recent Kemp's ridley nesting increases.

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl 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 (one sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small juvenile specimens, ranging from 7.6-19.0 in (19.4-48.3 cm) curved carapace length (CCL). Subsequent years of observation noted additional captures in the skimmer trawl fisheries, including some mortalities. The small average size of encountered Kemp's ridleys introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum 4-in bar spacing of TEDs currently required in the shrimp fisheries. Due to this issue, a proposed 2012 rule to require 4-in bar spacing TEDs in the skimmer trawl fisheries (77 FR 27411) was not implemented. Following additional gear testing, however, we proposed a new rule in 2016 (81 FR 91097) to require TEDs with 3-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 ft and greater in length to use TEDs designed to exclude small sea turtles in their nets effective April 1, 2021. As we previously noted, we delayed the effective date of this final rule until August 1, 2021, due to safety and travel restrictions related to the COVID-19 pandemic that prevented necessary training and outreach for fishers. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf of Mexico may continue to be an issue of concern for the species, and one that may potentially slow the rate of recovery for Kemp's ridley sea turtles.

While oil spill impacts are discussed generally for all species in Section 3.2.1, specific impacts of the DWH 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 of Mexico throughout their lives (DWH Trustees 2016).

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

3.2.3 Green Sea Turtle

The green sea turtle was originally listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered. On April 6, 2016, the original listing was replaced with the listing of 11 DPSs (81 FR 20057 2016) (Figure 8). The Mediterranean, Central West Pacific, and Central South Pacific DPSs were listed as endangered. The North Atlantic, South Atlantic, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific DPSs were listed as threatened. For the purposes of this consultation, only the North Atlantic DPS (NA DPS) and South Atlantic DPS (SA DPS) will be considered, as they are the only two DPSs with individuals occurring in the Atlantic and Gulf of Mexico waters of the United States.

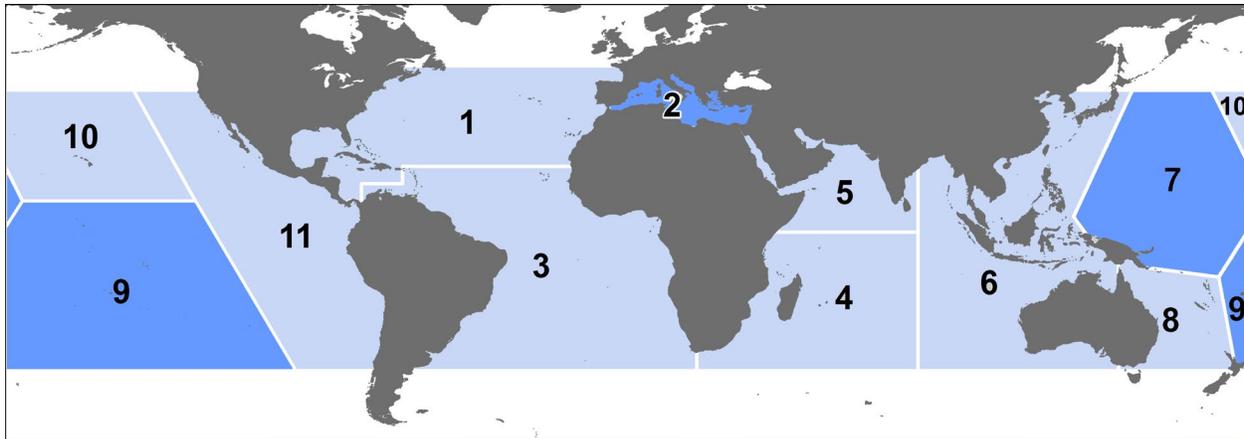


Figure 8. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic (NA); 2. Mediterranean; 3. South Atlantic (SA); 4. Southwest Indian; 5. North Indian; 6. East Indian-West Pacific; 7. Central West Pacific; 8. Southwest Pacific; 9. Central South Pacific; 10. Central North Pacific; 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 pounds (lb) (159 kilograms [kg]) with an 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 NA DPS), and Raine Island, on the Pacific coast of Australia along the Great Barrier Reef.

Differences in mitochondrial deoxyribonucleic acid (DNA) properties of green sea turtles from different nesting regions indicate there are genetic subpopulations (Bowen et al. 1992; FitzSimmons et al. 2006). Despite the genetic differences, sea turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. Within U.S. waters, individuals from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, two small-scale studies provide an insight into the degree of mixing on the foraging grounds. An analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley et al. 2007). On the Atlantic coast of Florida, a study on the foraging grounds off Hutchinson Island found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting assemblage, which is part of the SA DPS (Bass and Witzell

2000). All of the individuals in both studies were benthic juveniles. Available information on green turtle migratory behavior indicates that long distance dispersal is only seen for juvenile turtles. This suggests that larger adult-sized turtles return to forage within the region of their natal rookeries, thereby limiting the potential for gene flow across larger scales (Monzón-Argüello et al. 2010). While all of the mainland U.S. nesting individuals are part of the NA DPS, the U.S. Caribbean nesting assemblages are split between the NA and SA DPS. Nesters in Puerto Rico are part of the NA DPS, while those in the U.S. Virgin Islands are part of the SA DPS. We do not currently have information on what percent of individuals on the U.S. Caribbean foraging grounds come from which DPS.

NA DPS Distribution

The NA DPS boundary is illustrated in Figure 8. Four regions support nesting concentrations of particular interest in the NA DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. By far the most important nesting concentration for green turtles in this DPS is Tortuguero, Costa Rica. Nesting also occurs in the Bahamas, Belize, Cayman Islands, Dominican Republic, Haiti, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico, Turks and Caicos Islands, and North Carolina, South Carolina, Georgia, and Texas, U.S.A. In the eastern North Atlantic, nesting has been reported in Mauritania (Fretey 2001).

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

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

SA DPS Distribution

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

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

Life History Information

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches and along migratory routes. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 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 (oz). 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) (Campbell 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 2007c). 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/or satellite telemetry. Based on these studies, the majority of adult female Florida green sea turtles are believed to reside in nearshore foraging areas throughout the Florida Keys and in the waters southwest of Cape Sable, and some post-nesting turtles also reside in Bahamian waters as well (NMFS and USFWS 2007c).

Status and Population Dynamics

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

NA DPS Status and Population Dynamics

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

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 2007c). 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 2007c). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more resulted in an estimate of the Tortuguero; Costa Rica population is growing at 4.9% annually.

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (Meylan 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). 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 9). According to data collected from Florida’s index nesting beach survey from 1989-2019, 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, and a return to the trend of biennial peaks in abundance thereafter (Figure 9). 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 National Wildlife Refuge growing at an annual rate of 13.9% at that time. Increases have been even more rapid in recent years.

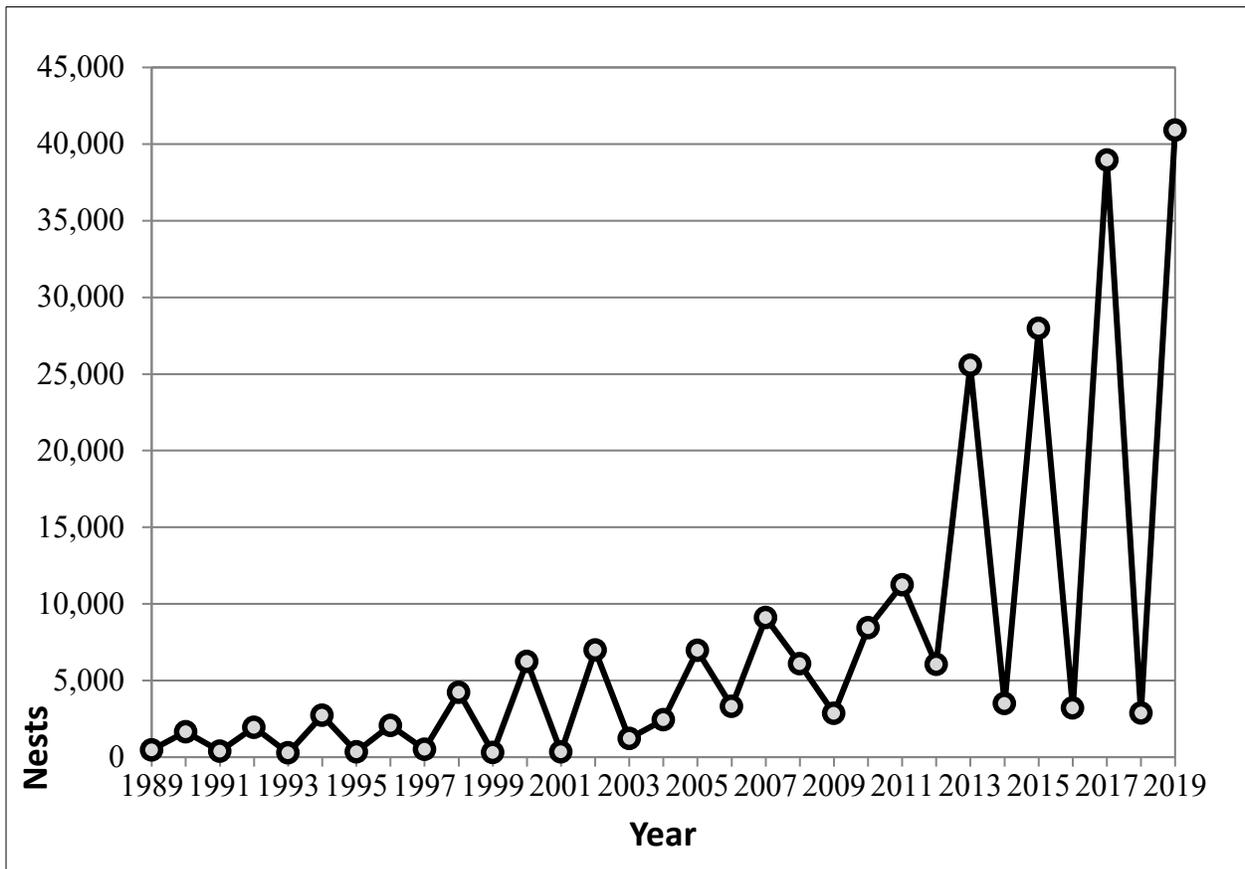


Figure 9. Green sea turtle nesting at Florida index beaches since 1989

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% 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).

SA DPS Status and Population Dynamics

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

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

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of the species for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. Green sea turtles also face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (e.g., plastics, petroleum products, petrochemicals), ecosystem alterations (e.g., nesting beach development, beach nourishment and shoreline stabilization, vegetation changes), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.2.1.

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

numbers of animals in specific areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991).

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

Whereas oil spill impacts are discussed generally for all species in Section 3.2.1, specific impacts of the DWH spill on green sea turtles are considered here. Impacts to green sea turtles occurred to offshore small juveniles only. A total of 154,000 small juvenile greens (36.6% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. A large number of small juveniles were removed from the population, as 57,300 small juveniles greens are estimated to have died as a result of the exposure. A total of four nests (580 eggs) were also translocated during response efforts, with 455 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 and/or dispersants, and loss of foraging resources, which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

While green turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of Mexico at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of Mexico were reduced as a result of the DWH oil spill of 2010, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event, as well as the impacts being primarily to smaller juveniles (lower reproductive value than adults and large juveniles), reduces the impact to the overall population. It is unclear what impact these losses may have caused on a population level, but it is not expected to have had a large impact on the population trajectory moving forward. However, recovery of green turtle numbers equivalent to what was lost in the northern Gulf of Mexico as a result of the spill will likely take decades of sustained efforts to reduce the existing threats and enhance survivorship of multiple life stages (DWH Trustees 2016).

3.2.4 Loggerhead Sea Turtle (NWA DPS)

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

Species Description and Distribution

Loggerheads are large sea turtles. Adults in the southeast United States average about 3 ft (92 cm) 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 vertebrales, 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 use within these areas vary by life stage. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd Jr. 1988). Subadult and adult loggerheads are primarily found in coastal waters and eat benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990). For the NWA DPS, most nesting occurs along the coast of the United States, from southern Virginia to Alabama. Additional nesting beaches for this DPS are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison 1997; Addison and Morford 1996), off the southwestern coast of Cuba (Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

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

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf Coast of Florida. Previous Section 7 analyses have recognized at least 5 western Atlantic subpopulations, divided geographically as follows: 1) a Northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29°N; 2) a South Florida nesting subpopulation, occurring from 29°N on the east coast of the state to Sarasota on the west coast;

3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; 4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez M. 1990; TEWG 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 NWA DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the NWA DPS.

Life History Information

The Northwest Atlantic Loggerhead Recovery Team defined the following eight 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 zone⁴); 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

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

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 Gulf of Mexico (Witzell 2002).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Estuarine waters of the United States, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, as well as numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the Atlantic and Gulf of Mexico shoreline, essentially all shelf waters are inhabited by loggerheads (Conant 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 of Mexico. Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been documented (Hawkes et al. 2007; Georgia Department of Natural Resources [GADNR], unpublished data; South Carolina Department of Natural Resources [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 five 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 2009a; 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 has 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 two important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population.

Peninsular Florida Recovery Unit

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

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 10). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2017; <https://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead/>). Over that time period, three distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent nine years. A large increase in loggerhead nesting has occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represented a new record for loggerheads on the core index beaches. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but nonsignificant 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 slightly again to 48,983 in 2018 and then 53,507 in 2019, which is the third highest total since 2001. However, it is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.) it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani, et al. 2019).

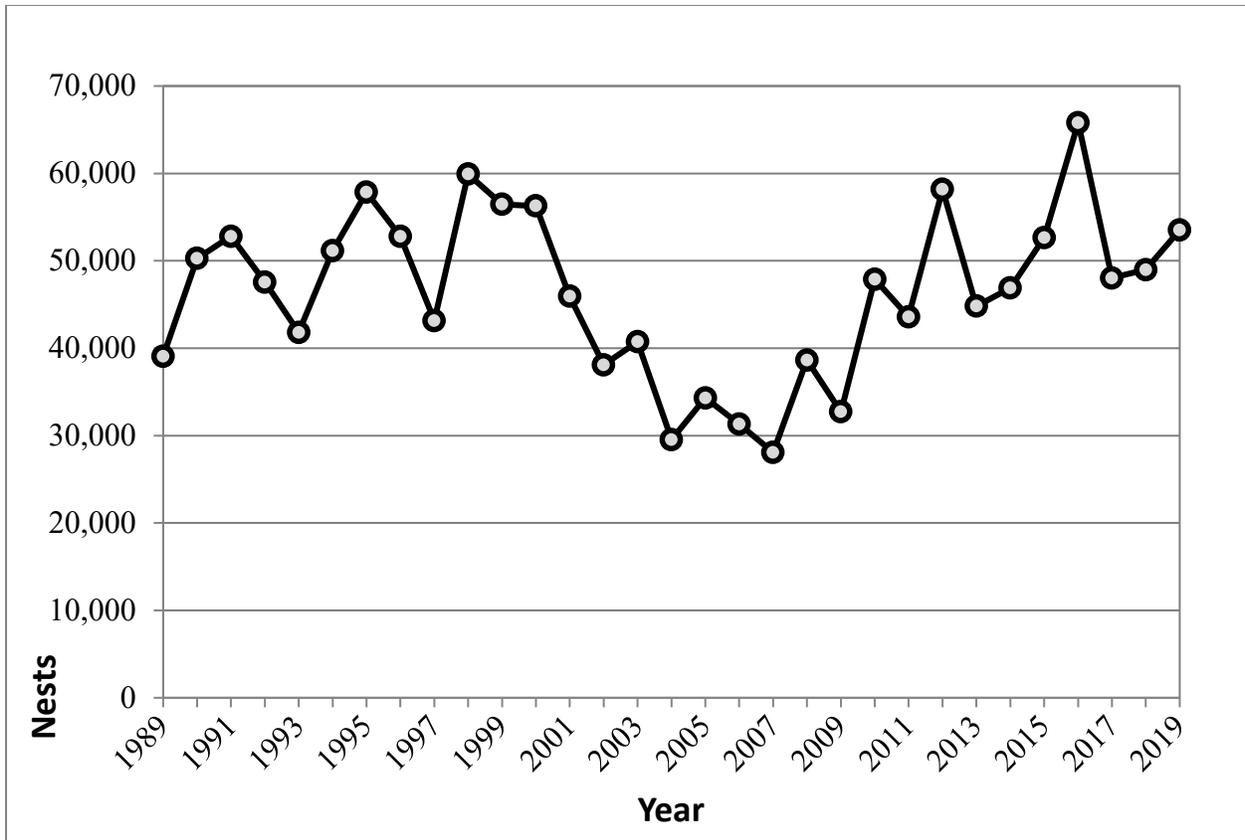


Figure 10. Loggerhead sea turtle nesting at Florida index beaches since 1989

Northern Recovery Unit

Annual nest totals from beaches within the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (GADNR unpublished data, North Carolina Wildlife Resources Commission [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 (<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.

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

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

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record (Figure 11).

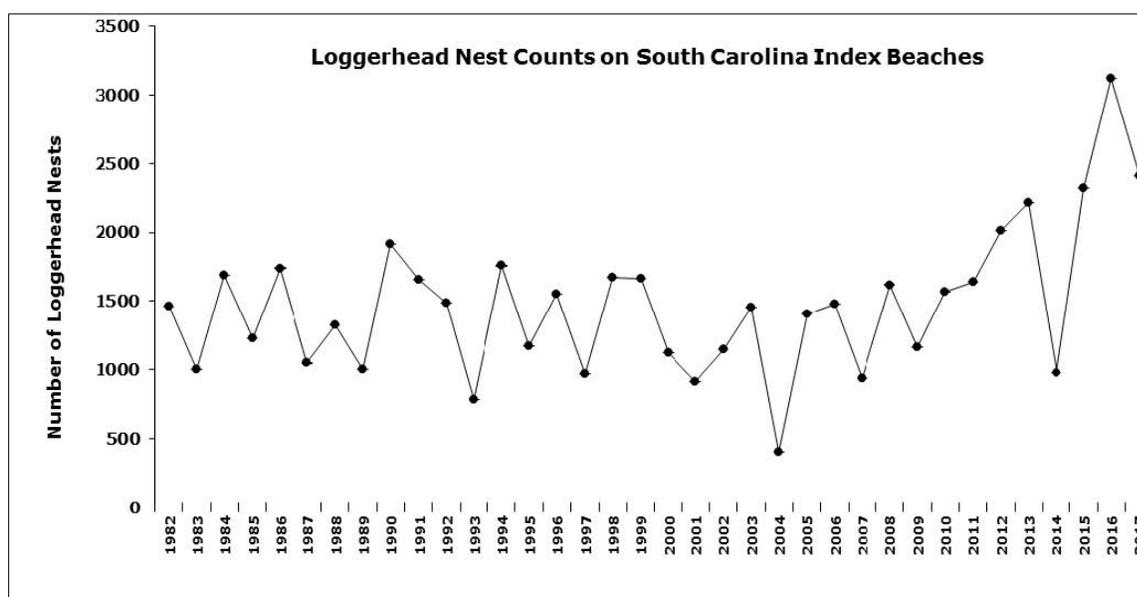


Figure 11. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: <http://www.dnr.sc.gov/seaturtle/nest.htm>)

Other NWA DPS Recovery Units

The remaining 3 recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU)—are much smaller nesting assemblages, but they are still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida’s statewide survey program. Survey effort was relatively stable

during the 9-year period from 1995-2004, although the 2002 year was missed. Nest counts ranged from 168-270, with a mean of 246, but there was no detectable trend during this period (NMFS and USFWS 2008). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. Analysis of the 12-year dataset (1997-2008) of index nesting beaches in the area shows a statistically significant declining trend of 4.7% annually. Nesting on the Florida Panhandle index beaches, which represents the majority of NGMRU nesting, had shown a large increase in 2008, but then declined again in 2009 and 2010 before rising back to a level similar to the 2003-2007 average in 2011. Nesting survey effort has been inconsistent among the GCRU nesting beaches, and no trend can be determined for this subpopulation (NMFS and USFWS 2008). Zurita et al. (2003) found a statistically significant increase in the number of nests on seven 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

Our Southeast Fisheries Science Center (SEFSC) developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS 2009a). 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 2009a). 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 2009a). 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 2011a).

Threats

The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 3.2.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 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 3.2.1, 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 and/or dispersants, and loss of foraging resources that could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

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

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

4 ENVIRONMENTAL BASELINE

By regulation, the environmental baseline for an Opinion refers to the condition of the listed species or their 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 state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, as well as the impact of state or private actions which are contemporaneous with the consultation in process. The consequences to the listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Focusing on the impacts of the activities in the action area specifically, allows us to assess the prior experience and condition of threatened and endangered species, and areas of designated critical habitat that occur in an action area, and that will be exposed to effects from the action under consultation. This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and the ecosystem, within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time. It does not include the effects of the action under review in this consultation. The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of loggerhead, green, and Kemp's ridley sea turtles within the action area.

4.1 Status of Species within the Action Area

Based on the best available species life history data, STSSN stranding and capture data, fisheries observer data, and other scientific research, we believe green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be in the action area and are likely to be adversely affected by indirect effects of the proposed action. All of these sea turtle species are migratory, traveling to forage grounds or for reproduction purposes. The Gulf of Mexico waters within the action area are likely used by these species of sea turtle for nearshore reproductive, developmental, and foraging habitat. NMFS believes that no individual sea turtle is likely to be a permanent resident of the action area, although some individuals may be present at any given time. These same individuals will migrate into offshore waters of the Gulf of Mexico, Caribbean Sea, and other areas of the North Atlantic Ocean at certain times of the year, and thus may be affected by activities occurring there. Therefore, the status of the sea turtles species in the action area are considered to be the same as those discussed in Sections 3.2.1-3.2.4.

4.2.1 Factors Affecting Listed Species within the Action Area

4.2.1 Federal Actions

We have undertaken a number of Section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered species within the action area, and when appropriate, have authorized the incidental taking of these species. Each of those consultations sought to minimize the adverse effects of the action on these affected species. The summary below of federal actions and the effects these actions have had on ESA-listed species includes only those federal actions in the action area, which have already concluded or are currently undergoing formal Section 7 consultation.

4.2.1.1 Fisheries

There is a small portion of the action area that reaches out into Federal waters (which start 3 miles out from the nearest land), in the area beyond the barrier islands that delineate the outer edge of the Barataria Basin. The only federal commercial fishery that regularly operates in this area is the Southeast U.S. Shrimp Fishery, which employs both otter trawling and skimmer trawling techniques in this area. Impacts of this fishery on five sea turtle species (i.e., Kemp's ridley, loggerhead, green, leatherback and hawksbill) were recently evaluated through Section 7 consultation (SERO-2021-00087 and referred to herein as the "2021 Shrimp Opinion") (NMFS 2021). This and previous consultations on this fishery resulted in mandatory terms and conditions, and subsequent rulemaking to reduce the impacts of the fishery on sea turtle populations. Examples include mandatory use of turtle excluder devices (TED) and other gear and trawl-time restrictions, along with robust monitoring, sampling and ecological studies of the shrimp fishery effects on sea turtles.

The 2021 Shrimp Opinion (and all previous shrimp fisheries opinions) included an ITS and determined that fishing activities as considered (i.e., with the sea turtle conservation regulations) would not jeopardize ESA-listed sea turtles. Table 5 shows the total (otter and skimmer trawl fisheries, all nets combined) incidental takes of Kemp's ridley, loggerhead and green sea turtle throughout the southeast U.S. shrimp fisheries anticipated over a 5-year monitoring period. Only

a very small (unspecified) portion of these takes would be expected to occur within the action area for the proposed project (Figure 6)

Table 5. Total (otter and skimmer trawl fisheries, all nets combined) incidental Kemp’s ridley, loggerhead and green sea turtle takes in the southeast U.S. shrimp fisheries anticipated over the 5-year monitoring periods (NMFS 2021)

Species	Captures	Mortalities
Kemp’s Ridley Sea Turtle	84,495	8,505
Loggerhead Sea Turtle	72,670	2,150
Green Sea Turtle	21,214	1,700

4.2.1.2 Federal Dredging Activity

Marine dredging for construction and maintenance of federal navigation channels and dredging for borrow materials for marsh creation/restoration are common within the action area. Hopper dredges are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes the resting or swimming turtle. Entrained sea turtles rarely survive. To reduce impacts to sea turtles, relocation trawling may be utilized to capture and relocate sea turtles. In relocation trawling, a boat equipped with nets precedes the dredge to capture turtles and then releases the animals out of the dredge pathway, thus avoiding lethal take.

Other forms of dredging such as mechanical and hydraulic suction dredging utilize slower moving underwater equipment that is not expected to contact or injure sea turtles. However, these dredging techniques, along with hopper dredging, can cause impacts to aquatic habitat utilized by sea turtles, including: 1) direct removal/burial of prey organisms; 2) turbidity/siltation effects; 3) contaminant re-suspension; and 4) noise/disturbance.

In summary, dredging to maintain navigation channels and dredging/placement of sediments for habitat restoration occurs frequently within the action area.

We originally completed formal consultation on the impacts of USACE’s hopper-dredging operations in the Gulf of Mexico in 2003 (i.e., GRBO). We revised the GRBO in 2007 (NMFS 2007c), in which we concluded that: 1) Gulf of Mexico hopper dredging would adversely affect 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 of Mexico would not likely adversely affect leatherback sea turtles.

The GRBO considers maintenance dredging and sand mining operations. We have conducted numerous other informal consultations that analyzed non-hopper dredging projects (e.g., marsh and beach restoration projects) that did not fall partially or entirely under the scope of actions contemplated by the GRBO. All of these consultations have determined that the proposed actions would not likely adversely affect any species of sea turtles or other listed species, or critical habitat of any listed species.

4.2.1.3 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 by the vessels or their 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 of the Bureau of Ocean Energy Management (BOEM), Federal Energy Regulatory Commission, USCG, NOAA, and USACE. We have conducted Section 7 consultations with all of these agencies, analyzing effects of federal vessel operation in the Gulf of Mexico. Many of these consultations required or confirmed the implementation of conservation measures for vessel operations, designed to avoid or minimize adverse effects to listed species. At the present time, federal vessel operation in the action area continues to present the potential for some level of interaction.

4.2.1.4 Federal Energy Development and Distribution

Federal and state oil and gas production, development, and distribution impact sea turtles in the action area. Pipeline and platform construction, marine debris, vessel traffic, and oil spills have resulted in lethal and sub-lethal impacts to sea turtles, and major habitat alteration/destruction within the Barataria Basin. Many Section 7 consultations have been completed with FERC, BOEM and USACE on oil- and gas-related activities. Through the Section 7 process, where applicable, we have and will continue to establish conservation measures for all these projects and operations to avoid or minimize adverse effects to listed species.

Impact of DWH Oil Spill on Status of Sea Turtles

As discussed in Section 3.2.1, the DWH event and associated response activities (e.g., skimming, burning, and application of dispersants) have resulted in adverse effects on ESA-listed sea turtles within the Gulf of Mexico. The Barataria Basin was one of the hardest hit areas in the entire Gulf, with significant oiling and many indirect impacts from cleanup and remediation activities. The DWH Programmatic Damage Assessment and Restoration Plan (PDARP), completed in 2016, estimated that 89,560 Kemp's ridley, 55,100 green, and 13,980 loggerhead sea turtles were killed as a result of the spill and related remediation efforts. An undetermined number of these mortalities are thought to have occurred within the action area.

In addition to direct injuries to subadult and adult sea turtles, the 2010 May through September sea turtle nesting season in the northern Gulf may also have been adversely affected by the DWH oil spill. Setting booms to protect beaches, cleanup activities, lights, people, and equipment all may have had unintended effects, such as preventing females from reaching nesting beaches and thereby reducing nesting in the northern Gulf of Mexico.

The oil spill may also have adversely affected emergence success. In the northern Gulf of Mexico area, approximately 700 nests are laid annually in the Florida Panhandle and up to 80 nests are laid annually in Alabama. Most nests are made by loggerhead sea turtles; however, a few Kemp's ridley and green turtle nests were also documented in 2010. Hatchlings begin emerging from nests in early to mid-July; the number of hatchlings estimated to be produced

from northern Gulf sea turtle nests in 2010 was 50,000. To try to avoid the loss of most, if not all, of 2010's northern Gulf of Mexico hatchling cohort, all sea turtle nests laid along the northern Gulf Coast were visibly marked to ensure that nests were not harmed during oil spill cleanup operations that are undertaken on beaches. In addition, a sea turtle late-term nest collection and hatchling release plan was implemented to provide the best possible protection for sea turtle hatchlings emerging from nests in Alabama and the Florida Panhandle. Starting in June, northern Gulf of Mexico nests were relocated to the Atlantic to provide the highest probability of reducing the anticipated risks to hatchlings as a result of the DWH oil spill. A total of 274 nests, all loggerheads except for 4 green turtle and 5 Kemp's ridley nests, were translocated just prior to emergence from northern Gulf of Mexico beaches to the east coast of Florida so that the hatchlings could be released in areas not affected by the oil spill (Table 6). In mid-August, it was determined that the risks to hatchlings emerging from beaches and entering waters off the northern Gulf Coast had diminished significantly, and all nest translocations were ceased by August 19, 2010.

Table 6. Number of Turtle Nests Translocated from the Gulf Coast and Hatchlings Released in the Atlantic Ocean. The sea turtle nest translocation effort ceased on August 19, 2010.

Turtle Species	Translocated Nests	Hatchlings Released
Green turtle (<i>Chelonia mydas</i>)	4	455
Kemp's ridley turtle (<i>Lepidochelys kempii</i>)	5	125
Loggerhead turtle (<i>Caretta caretta</i>)	265 ¹	14,216

¹ Does not include one nest that included a single hatchling and no eggs.

The survivorship and future nesting success of individuals from one nesting beach being transported to and released at another nesting beach is unknown. The loggerheads nesting and emerging from nests in the Florida Panhandle and Alabama are part of the NGMRU and differ genetically from loggerheads produced along the Atlantic Coast of Florida, but they are part of NWA DPS. Evidence suggests that some portion of loggerheads produced on Northern Gulf beaches are transported naturally into the Atlantic by currents and spend portions of their life cycles away from the Gulf of Mexico. This is based on the presence of some loggerheads with a northern Gulf of Mexico genetic signature in the Atlantic. These turtles are assumed to make their way back to the Gulf of Mexico as subadults and adults. It is unknown what the impact of the nesting relocation efforts will be on the NGMRU in particular, or the NWA DPS generally.

As noted above, the vast majority of sea turtles impacted and killed by the DWH oil spill event were Kemp's ridleys. It is likely that the Kemp's ridley sea turtle was also the species most impacted by the DWH spill event on a population level. Relative to the other species, Kemp's ridley populations are much smaller, yet recoveries and estimated mortalities during the DWH oil spill and response were much higher. The location and timing of the DWH oil spill event were also important factors. Although significant assemblages of juvenile Kemp's ridleys occur along the U.S. Atlantic coast, Kemp's ridley sea turtles use the Gulf of Mexico as their primary habitat for most life stages, including all of the mating and nesting. As a result, all mating and nesting adults in the population necessarily spend significant time in the Gulf of Mexico, as do all hatchlings as they leave the beach and enter the pelagic environment. Still, not all of those individuals will have encountered oil and/or dispersants, depending on the timing and location of their movements relative to the location of the subsurface and surface oil. In addition to

mortalities, the effects of the spill may have included disruptions to foraging and resource availability, migrations, and other unknown effects as the spill began in late April just before peak mating/nesting season (May-July) although the distance from the DWH well to the primary mating and nesting areas in Tamaulipas, Mexico greatly reduces the chance of these disruptions to adults breeding in 2010. Yet, turtle returns from nesting beaches to foraging areas in the northern Gulf of Mexico occurred while the well was still spilling oil. At this time, we cannot determine the specific reasons accounting for year-to-year fluctuations in numbers of Kemp's ridley nests (the number of nests increased in 2011 as compared to 2010); however, there may yet be long-term population impacts resulting from the oil spill. How quickly the species returns to the previous fast pace of recovery may depend in part on how much of an impact the DWH event has had on Kemp's ridley food resources (Crowder and Heppell 2011).

While the DWH event clearly had adverse effects on loggerheads, the population level effect was not likely as severe as it was for Kemp's ridleys. In comparison to Kemp's ridleys, the relative proportion of the population exposed to the effects of the event was much smaller, the number of turtles recovered (alive and dead) are fewer in absolute numbers, and the overall population size is believed to be many times larger. Additionally, unlike Kemp's ridleys, the majority of nesting for the NWA DPS occurs on the Atlantic coast. However, it is likely that impacts to the NGMRU of the NWA DPS would be proportionally much greater than the impacts occurring to other recovery units because of impacts to nesting (as described above) and a larger proportion of the NGMRU recovery unit, especially mating and nesting adults, being exposed to the spill. However, the impacts to that recovery unit, and the possible effect of such a disproportionate impact on that small recovery unit to the NWA DPS and the species, remain unknown.

Green sea turtles comprised the second-most common species impacted/killed by the DWH spill. While green sea turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic. As described in the Status of the Species section, nesting is relatively rare on the northern Gulf Coast. Similar to loggerhead sea turtles, it is estimated that significant adverse impacts occurred, but that the relative proportion of the population that was exposed to and directly impacted by the DWH event is relatively low. Thus, the population-level impact is likely much smaller than for Kemp's ridleys.

4.2.1.5 Loss of Marsh Habitat/Land Loss

The combined effects of several factors discussed above (industrial development, oil spills, etc.), along with sea level rise and land subsidence (discussed further below), are expected to combine to result in the loss of over 85% of the above-water land/marsh habitat remaining in the Barataria Basin over the next 50 years. Project modeling indicates that all marsh habitat types (fresh-water, saline, and brackish marsh) within the Barataria Basin will be severely reduced over the next 50 years (Figure 12). This loss of marsh habitat, and conversion to mud-bottom open water, is expected to have devastating effects on the entire ecosystem of the Barataria Basin, including the habitats and prey species relied upon by sea turtles in the action area.

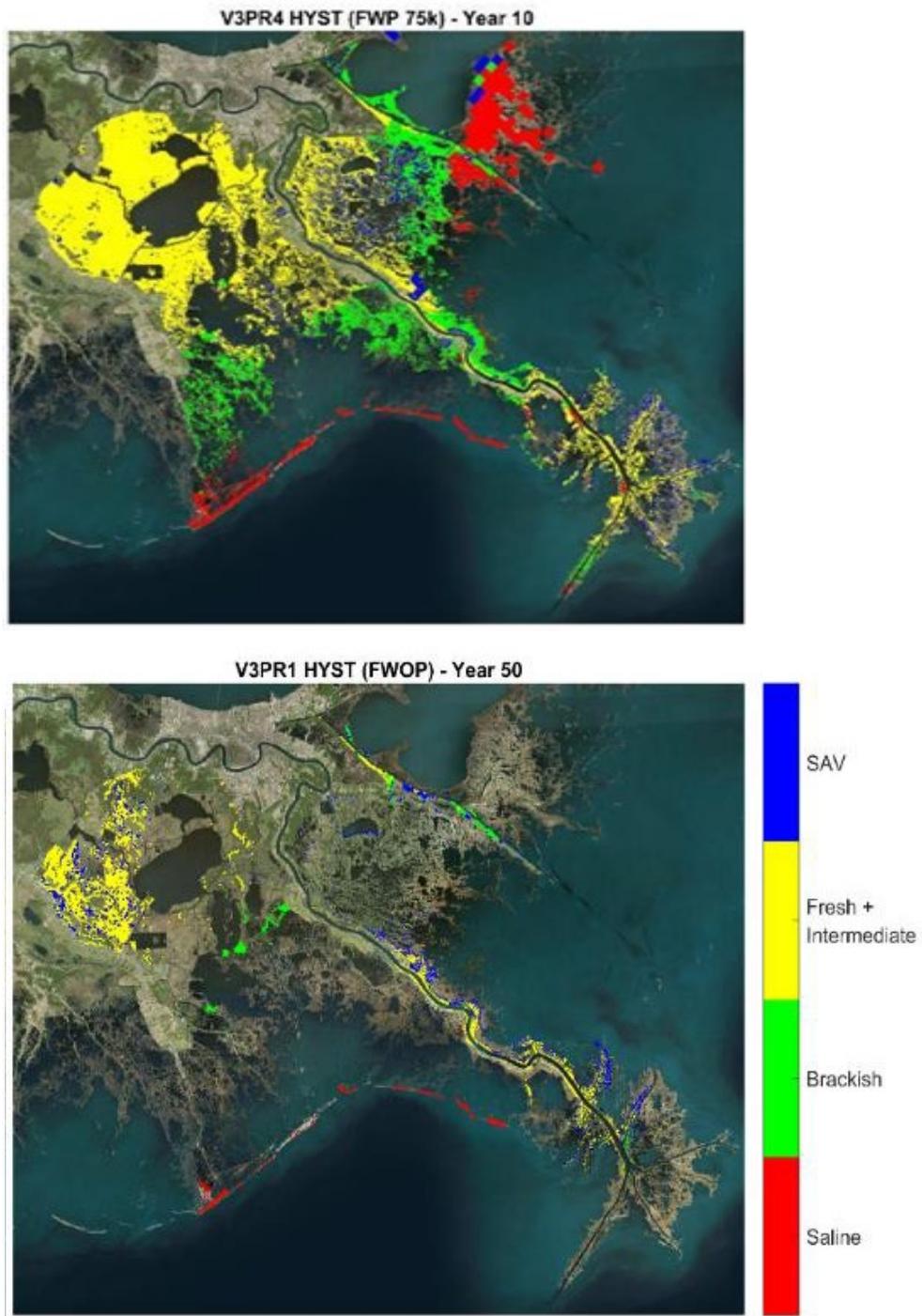


Figure 12. Modeled habitat loss in the action area over the next 50 years

4.2.1.6 Construction and Operation of Fishing Piers

In 2019, we consulted with the NOAA RC on the construction and operation of a fishing pier within the action area, at Grand Island State Park (SERO-2019-00147) (NMFS 2019). It was determined that the ongoing operation of this pier is expected to have adverse effects on ESA-listed sea turtles due to the impacts of recreational fishing from the pier. The consultation concluded that up to 2 loggerhead, 2 green, and 20 Kemps ridley sea turtles are expected to be taken (lethally and non-lethally) over any consecutive 3-year period during the life of the pier. The consultation also concluded the fishing pier would not jeopardize the continued existence of these species, and an ITS was issued for the project.

4.2.1.7 Federally-Permitted Discharges

Federally regulated stormwater and industrial discharges and chemically treated discharges from sewage treatment systems may impact sea turtles and their critical habitat. We continue to consult with EPA to minimize the effects of these activities on both listed species and designated critical habitat. In addition, other federally permitted construction activities, such as beach restoration, have the potential to impact sea turtles.

4.2.1.8 ESA Permits

Regulations developed under the ESA allow for the issuance of permits allowing take of certain ESA-listed species for the purposes of scientific research under Section 10(a)(1)(a) of the ESA. Since issuance of the permit is a federal activity, the action must be reviewed for compliance with Section 7(a)(2) of the ESA to ensure that issuance of the permit does not result in jeopardy to the species or adverse modification of its critical habitat. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, to blood sampling, tissue sampling (biopsy), and performing laparoscopy on intentionally captured sea turtles. The number of authorized takes varies widely depending on the research and species involved, but may involve the taking of hundreds of sea turtles annually. Most takes authorized under these permits are expected to be (and are) nonlethal.

4.2.2 State or Private Actions

A number of activities in state waters that may directly or indirectly affect ESA-listed sea turtles include recreational and commercial fishing, construction, discharges from wastewater systems, dredging, ocean pumping and disposal, and aquaculture facilities. The impacts from these activities are difficult to measure. However, where possible, conservation actions through the ESA Section 7 consultation process, ESA Section 10 permitting, and state permitting programs are being implemented to monitor or study impacts from these sources. Some of these activities likely affect sea turtles in the action area. Additional discussion on some of these activities follows.

4.2.2.1 State Fisheries

The majority of recreational and commercial fishing that occurs in the action area is in state-managed waters, but information on these fisheries is sparse (NMFS 2001). Most of the state

data are based on extremely low observer coverage, or sea turtles were not part of data collection. Thus, while these data provide insight into gear interactions that could occur but are not indicative of the magnitude of the overall impacts.

Trawl Fisheries

Shrimp and other trawl fisheries, such as ones operating for blue crab and sheepshead, likely interact with sea turtles in state waters. At this time, however, we lack sufficient information to quantify the level of anticipated take that may be occurring in these trawl fisheries in state waters.

Recreational Fishing

Recreational fishing from private vessels may occur in the action area, and these activities may interact with sea turtles. For example, observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, fishing piers (see previous discussion in Section 4.2.1.6), beaches, banks, and jetties. Additionally, lost fishing gear such as lines cut after snagging on rocks, or discarded hooks and lines, can also pose an entanglement threat to sea turtles in the area. A detailed summary of the known impacts of hook-and-line incidental captures to sea turtles can be found in the SEFSC Turtle Expert Working Group (TEWG) reports (TEWG 1998; TEWG 2000).

4.2.2.2 Vessel Traffic

Commercial traffic and recreational boating pursuits can have adverse effects on sea turtles via propeller and boat strike damage. Data show that vessel traffic is one cause of sea turtle mortality (Hazel and Gyuris 2006; Lutcavage et al. 1997), and the STSSN includes many records of vessel interactions (propeller injury) with 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, particularly off Florida where there are high levels of vessel traffic.

4.2.2.3 Coastal Development

Commercial and industrial development resulting in artificial lighting and marsh erosion are ongoing activities throughout the action area. These activities potentially reduce or degrade sea turtle foraging habitats and interfere with nesting and hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities impact sea turtles and nesting/hatchling production within the action area is unknown.

4.2.3 Other Potential Sources of Impacts to the Environmental Baseline

4.2.3.1 Stochastic events

Stochastic (i.e., random) events, such as hurricanes, occur in the southeastern U.S., and can affect the action area. These events are by nature unpredictable, and their effect on the recovery of the species is unknown; yet, they have the potential to directly impede recovery if animals die

as a result or indirectly if important habitats are damaged. Conversely, these events, such as the record 2020 Atlantic hurricane season, may also result in some benefits to listed species, particularly sea turtles. For example, the impacts of hurricanes may compromise fisheries infrastructure and reduce fishing effort, which may subsequently reduce fishery related bycatch. Other stochastic events, such as a winter cold snap, can injure or kill sea turtles.

4.2.3.2 Marine Pollution and Environmental Contamination

In general, marine pollution includes a wide variety of impacts stemming from a diversity of activities and sources. Sources of pollutants within or adjacent to the action area include, but are not limited to, marine debris and plastics, noise pollution from vessel traffic, atmospheric loading of pollutants such as PCBs, agricultural and industrial runoff into rivers and canals emptying into Barataria Bay and the ocean (e.g., Mississippi River into the Gulf of Mexico), 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. An example is the large area of the Louisiana continental shelf with seasonally-depleted oxygen levels (< 2 mg/Liter) is caused by eutrophication from both point and non-point sources. Most aquatic species cannot survive at such low oxygen levels and these areas are known as “dead zones.” The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in mid-summer, and disappears in the fall. Since 1993, the average extent of mid-summer, bottom-water hypoxia in the northern Gulf of Mexico has been approximately 16,000 km², approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 22,000 km², which is larger than the state of Massachusetts (USGS 2008). The 2020 Gulf of Mexico hypoxic zone measured 5,480 km² and was the 3rd smallest in the 34-year record of surveys; the 5-year average is now down to 14,007 km² (EPA 2020). The hypoxic zone has impacts on the animals found there, including sea turtles, and the ecosystem-level impacts continue to be investigated.

Additional direct and indirect sources of pollution include dredging (i.e., resuspension of pollutants in contaminated sediments), aquaculture, and oil and gas development and distribution, each of which 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. Although these contaminant concentrations do not likely affect the more pelagic waters, 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.

Sea turtles may ingest marine debris, particularly plastics, which can cause intestinal blockage and internal injury, dietary dilution, malnutrition, and increased buoyancy, which, in turn, can result in poor health, reduced growth rates and reproductive output, or death (Nelms et al. 2016). Entanglement in plastic debris (including ghost fishing gear) is known to cause lacerations, increased drag—which reduces the ability to forage effectively or escape threats—and may lead to drowning or death by starvation.

The Gulf of Mexico is an area of high-density offshore oil extraction with chronic, low-level spills and occasional massive spills (e.g., DWH oil spill event). Oil spills can impact wildlife directly through 3 primary pathways: 1) ingestion—when animals swallow oil particles directly or consume prey items that have been exposed to oil; 2) absorption—when animals come into direct contact with oil; and 3) inhalation—when animals breathe volatile organics released from oil or from “dispersants” applied by response teams in an effort to increase the rate of degradation of the oil in seawater. Several aspects of sea turtle biology and behavior place them at particular risk, including the lack of avoidance behavior, indiscriminate feeding in convergence zones, and large pre-dive inhalations (Milton et al. 2003). When large quantities of oil enter a body of water, chronic effects such as cancer, and direct mortality of wildlife becomes more likely (Lutcavage et al. 1997). Oil spills in the vicinity of nesting beaches just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts et al. 1982; Lutcavage et al. 1997; Witherington 1999). Continuous low-level exposure to oil in the form of tar balls, slicks, or elevated background concentrations also challenge animals facing other natural and anthropogenic stresses. Types of trauma can include skin irritation, altering of the immune system, reproductive or developmental damage, and liver disease (Keller et al. 2004; Keller et al. 2006). Chronic exposure may not be lethal by itself, but it may impair a turtle’s overall fitness so that it is less able to withstand other stressors (Milton et al. 2003).

The earlier life stages of living marine resources are usually at greater risk from an oil spill than adults. This is especially true for sea turtle hatchlings, since they spend a greater portion of their time at the sea surface than adults do; thus, their risk of exposure to floating oil slicks is increased (Lutcavage et al. 1995). One of the reasons might be the simple effects of scale: for example, a given amount of oil may overwhelm a smaller immature organism relative to the larger adult. The metabolic machinery an animal uses to detoxify or cleanse itself of a contaminant may not be fully developed in younger life stages. In addition, in early life stages, animals may contain proportionally higher concentrations of lipids, to which many contaminants such as petroleum hydrocarbons bind. Most reports of oiled hatchlings originate from convergence zones, ocean areas where currents meet to form collection points for material at or near the surface of the water.

Unfortunately, little is known about the effects of dispersants on sea turtles, and such impacts are difficult to predict in the absence of direct testing. While inhaling petroleum vapors can irritate turtles’ lungs, dispersants can interfere with lung function through their surfactant (detergent) effect. Dispersant components absorbed through the lungs or gut may affect multiple organ systems, interfering with digestion, respiration, excretion, and/or salt-gland function—similar to the empirically demonstrated effects of oil alone (Shigenaka et al. 2003). Oil cleanup activities can also be harmful. Earth-moving equipment can dissuade females from nesting and destroy nests, containment booms can entrap hatchlings, and lighting from nighttime activities can misdirect turtles (Witherington 1999).

There are studies on organic contaminants and trace metal accumulation in green sea turtles (Aguirre et al. 1994; Caurant et al. 1999; Corsolini et al. 2000). McKenzie et al. (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994

and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback sea turtles (Storelli et al. 2008). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Sakai et al. (1995) found the presence of metal residues points for material at or near the surface of the water. Sixty-five of 103 post-hatchling loggerheads in convergence zones off Florida's east coast were found with tar in the mouth, esophagus or stomach (Loehfener et al. 1989). Thirty-four percent of post-hatchlings captured in *Sargassum* off the Florida coast had tar in the mouth or esophagus and more than 50% had tar caked in their jaws (Witherington 1994). These zones aggregate oil slicks, such as a Langmuir cell, where surface currents collide before pushing down and around, and represents a virtually closed system where a smaller weaker sea turtle can easily become trapped (Carr 1987; Witherington 2002). Lutz and Lutcavage (1989) reported that hatchlings have been found apparently starved to death, their beaks and esophagi blocked with tarballs. Hatchlings sticky with oil residue may have a more difficult time crawling and swimming, rendering them more vulnerable to predation.

Frazier (1980) suggested that olfactory impairment from chemical contamination could represent a substantial indirect effect in sea turtles, since a keen sense of smell apparently plays an important role in navigation and orientation. A related problem is the possibility that an oil spill impacting nesting beaches may affect the locational imprinting of hatchlings, and thus impair their ability to return to their natal beaches to breed and nest (Milton et al. 2003). Whether hatchlings, juveniles, or adults, tar balls in a turtle's gut are likely to have a variety of effects – starvation from gut blockage, decreased absorption efficiency, absorption of toxins, effects of general intestinal blockage (such as local necrosis or ulceration), interference with fat metabolism, and buoyancy problems caused by the buildup of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats), among others. In addition, trapped oil can kill the seagrass beds upon which turtles feed.

4.2.4 Conservation and Recovery Actions Shaping the Environmental Baseline

We have implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include TED requirements for the Southeast shrimp trawl fisheries, discussed above in Section 4.2.1.1. These regulations have relieved some of the stressors on sea turtle populations.

Under Section 6 of the ESA, we may enter into cooperative research and conservation agreements with states to assist in recovery actions of listed species. We have agreements with all states in the action area for sea turtles. Prior to issuance of these agreements, the research and conservation proposals must be reviewed for compliance with Section 7 of the ESA.

Along with cooperating states, we have established an extensive network of STSSN participants along the Gulf Coast that not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles. Data are compiled through the efforts of network participants who document marine turtle strandings in their respective areas and contribute those data to the centralized STSSN database

We published a final rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the final rule. These measures help to prevent mortality of hard-shelled turtles caught in fishing or scientific research gear.

A final rule (70 FR 42508) published on July 25, 2005, allows any of our agents or employees, the USFWS, the U.S. Coast Guard, or any other federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. We afford the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

TED regulations, which were first introduced in the 1990s in the shrimp fisheries (with a major subsequent revision in 2003), have benefited sea turtle populations by reducing incidental fisheries bycatch and mortality (ASSRT 2007). Other gear-related modifications in other fisheries, such as the chain mat requirement in the scallop fishery, are also aimed at reducing overall fisheries bycatch mortality of sea turtles.

We have also published rules to require selected fishing vessels to carry observers to collect data on sea turtle interactions during fishing operations (August 3, 2007, 72 FR 43176), and to implement sea turtle release gear requirements and release protocols in specific commercial fisheries (e.g., South Atlantic snapper-grouper fishery, November 8, 2011, 76 FR 69230).

4.3 Summary

In summary, several factors adversely affect sea turtles in the action area. These factors are ongoing and are expected to continue to occur contemporaneously with the proposed action. Fisheries in the action area likely had the greatest adverse impacts on sea turtles in the mid to late 1980s, when effort in most fisheries was near or at peak levels. With the decline of the health of managed species, effort since that time has generally been declining. Over the past 5 years, the sea turtle impacts associated with fisheries have also been reduced through the Section 7 consultation process and regulations implementing effective bycatch reduction strategies. However, interactions with commercial and recreational fishing gear are still ongoing and are expected to continue to occur contemporaneously with the proposed action. Other environmental impacts including effects of vessel operations, dredging, oil and gas development, permits allowing take under the ESA, private vessel traffic, and marine pollution have also had and will continue to have adverse effects on sea turtles in the action area. The DWH oil spill had an adverse impact on the baseline for sea turtles, but the extent of that impact is not yet fully understood. Finally, actions to conserve and recover sea turtles have significantly increased over the past 10 years and are expected to continue.

4.4 Climate Change

In addition to the information on climate change presented in the Section 3 (Status of the Species) for sea turtles, the discussion below presents further background information on global climate change as well as past and predicted future effects of global climate change we expect within the action area. Also, below is the best available information on predicted effects of climate change in the action area and how listed sea turtles may be affected by those predicted environmental changes. The effects are summarized on the time span of the proposed action, for which we can realistically analyze impacts, yet are discussed and considered for longer time periods when feasible. Yet, as mentioned previously, the potential effects, and the expected related climate change effects to sea turtles and their habitats, are the result of slow and steady shifts or alterations over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. As a result, for the purposes of this Opinion we have elected to view the effects of climate change on affected species on a more manageable and predictable 10-year time period due to this reality. While climate change is also relevant to the Cumulative Effects section of this Opinion, we are synthesizing all additional information here rather than include partial discussions in other sections of this Opinion.

Background Information on Global Climate Change

The global mean temperature has risen 0.76°C (1.36°F) over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (IPCC 2007). Precipitation has increased nationally by 5%-10%, mostly due to an increase in heavy downpours (NAST 2000). In comparison, ocean temperatures have only increased by about 0.18°F in the last century, with the changes occurring from the surface to depths of about 2,300 ft. There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and other pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007); these trends are most apparent over the past few decades. Information on future impacts of climate change in the action area is discussed below.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Both of the principal climate models used by the National Assessment Synthesis Team (NAST) project warming in the southeast by the 2090s, but at different rates (NAST 2000): the Canadian model scenario shows the southeast U.S. experiencing a high degree of warming, which translates into lower soil moisture as higher temperatures increase evaporation; the Hadley model scenario projects less warming and a significant increase in precipitation (about 20%). The scenarios examined, which assume no major interventions to reduce continued growth of world greenhouse gases (GHG), indicate that temperatures in the U.S. will rise by about 5°-9°F on average in the next 100 years, which is more than the projected global increase (NAST 2000). A warming of about 0.4°F per decade is projected for the next 2 decades over a range of emission scenarios (IPCC 2007). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions.

Climate warming has resulted in increased precipitation, river discharge, and glacial and sea-ice melting (Greene et al. 2008).

The past 3 decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene et al. 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (Greene et al. 2008, IPCC 2007). With respect to the North Atlantic Oscillation (NAO) specifically, changes in salinity and temperature are expected to be the result of changes in the earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through 2006 show that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s, but declined since (IPCC 2007). This warming extends more than 0.62 miles deep—deeper than anywhere in the world oceans—and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (Greene et al. 2008; IPCC 2007). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the whole earth system (Greene et al. 2008).

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on smaller geographic scales, such as the Barataria Basin, especially as climate variability is a dominant factor in shaping coastal and marine systems. Warming is very likely to continue in the U.S. over the next 25 to 50 years regardless of reduction in GHG emissions due to emissions that have already occurred (NAST 2000); therefore, it is also expected to continue during the 50-year operation plan proposed for the MBSD. It is very likely that the magnitude and frequency of ecosystem changes will increase in the next 25 to 50 years, and it is possible that changes will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation (IPCC 2007).

A warmer and drier climate is expected to result in reductions in stream flows and increases in water temperatures. Consequences could be a decrease in the amount of DO in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch et al. 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes

in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch et al. 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources in the southeast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer et al. 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change.

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.4°F per decade; and 3) a rise in sea level (NAST 2000). Sea level is expected to continue rising: during the twentieth century, global sea level has increased 6 to 8 in.

Sea turtle species have persisted for millions of years. They are ectotherms, meaning that their body temperatures depends on ambient temperatures. Throughout this time, they have experienced wide variations in global climate conditions and are thought to have previously adapted to these changes through changes in nesting phenology and behavior (Poloczanska et al. 2009). Given this, climate change at normal rates (i.e., thousands of years) is not thought to have historically been a problem for sea turtle species. At the current rate of global climate change, however, future effects to sea turtles are probable. Climate change has been identified as a threat to all species of sea turtles found in the action area (Conant et al. 2009; NMFS and USFWS 2013a; NMFS et al. 2011; Seminoff et al. 2015). Trying to assess the likely effects of climate change on sea turtles, however, is extremely difficult given the uncertainty in all climate change models, the difficulty in determining the likely rate of temperature increases, and the scope and scale of any accompanying habitat or behavior effects. In the Northwest Atlantic, specifically, loggerhead, green, and leatherback sea turtles are predicted to be among the more resilient species to climate change, while Kemp's ridley turtles are among the least resilient (Fuentes et al. 2013).

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

1. Changing air/land temperatures and rainfall at nesting beaches that could affect reproductive output including hatching success, hatchling emergence rate, and hatchling sex ratios;
2. Sea level rise, which could result in a reduction or shift in available nesting beach habitat, an increased risk of erosion and nest inundation, and reduced nest success;
3. Changes in the abundance and distribution of forage species, which could result in changes in the foraging behavior and distribution of sea turtle species as well as changes in sea turtle fitness and growth;

4. Changes in water temperature, which could possibly lead to a shift in their range, changes in phenology (timing of nesting seasons, timing of migrations) and different threat exposure; and
5. Increased frequency and severity of storm events, which could impact nests and nesting habitat, thus reducing nesting and hatching success.

Current approaches have limited power to predict the magnitude of future climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species. Over the next 10 years, sea surface temperatures are expected to rise less than 1°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution and recruitment of sea turtles or their prey. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or present for longer periods.

As climate continues to warm, feminization of sea turtle populations is a concern for many sea turtle species, which undergo temperature-dependent sex determinations. Rapidly increasing global temperatures may result in warmer incubation temperatures and higher female-biased sex ratios (Glen and Mrosovsky 2004; Hawkes et al. 2009). Increases in precipitation might cool beaches (Houghton et al. 2007), mitigating some impacts relative to increasing sand temperature. Though the predicted level of warming over the period of the action is small (i.e., <1°C), feminization occurs over a small temperature range (1-4°C) (Wibbels 2003) and several populations in the action area already are female biased (Gledhill 2007; Laloë et al. 2016; Patino-Martinez et al. 2012; Witt et al. 2010). The existing female bias among juvenile loggerhead sea turtles is estimated at approximately 3:2 females per males (Witt et al. 2010).

Feminization is a particular concern in tropical nesting areas where over 95% female-biased nests are already suspected for green turtles (Laloë et al. 2014; Laloë et al. 2016; Patino-Martinez et al. 2012). It is possible for populations to persist, and potentially increase with increased egg production, with strong female biases (Broderick et al. 2000; Coyne and Landry 2007; Godfrey et al. 1999; Hays et al. 2003), but population productivity could decline if access to males becomes scarce (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population. Behavioral changes could help mitigate the impacts of climate change, including shifting breeding season and location to avoid warmer temperatures. For example, the start of the nesting season for loggerheads has already shifted as the climate has warmed (Weishampel et al. 2004). Nesting selectivity could also help mitigate the impacts of climate on sex ratios as well (Kamel and Mrosovsky 2004).

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

with this change, by selecting cooler areas of the beach or shifting their nesting distribution to other beaches with smaller increases in sand temperature, is currently unknown.

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

Potential effects of climate change include range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson et al. 2009). McMahon and Hays (2006) reported that warming has caused a generally northerly migration of the 15°C sea surface temperature isotherm from 1983 to 2006. In response to this, leatherbacks, for example, have expanded their range in the Atlantic north by 330 km (Ibid). An increase in cold stunning of Kemp's ridley sea turtles in New England has also been linked to climate change and could pose an additional threat to population resilience (Griffin et al. 2019).

Furthermore, although nesting occurs in the south and mid-Atlantic (i.e., North Carolina and into Virginia), recent observations have caused some speculation that the nesting range of some sea turtle species may shift northward as the climate warms and that nest crowding may increase as sea level rises and available nesting habitat shrinks (Reece et al. 2013). Recent instances include a Kemp's ridley nesting in New York in July 2018 (96 hatchlings), a loggerhead nesting in Delaware in July 2018 (48 hatchlings), and a loggerhead nesting in Maryland in September 2017 (seven live hatchlings). The ability to shift nesting in time and space towards cooler areas could reduce some of the temperature-induced impacts of climate change (e.g., female biased sex ratio). Fuentes et al. (2020) modelled the geographic distribution of climatically suitable nesting habitat for sea turtles in the U.S. Atlantic under future climate scenarios, identified potential range shifts by 2050, determined sea-level rise impacts, and explored changes in exposure to coastal development as a result of range shifts. Overall, the researchers found that, with the exception of the northern nesting boundaries for loggerhead sea turtles, the nesting ranges were not predicted to change. Fuentes et al. (2020) noted that range shifts may be hindered by expanding development. They also found that loggerhead sea turtles would experience a decrease (10%) in suitable nesting habitat followed by green turtles. Sea level rise is projected to inundate current habitats; however, new beaches will also be formed and suitable habitats could be gained (Ibid).

Climate change may also increase hurricane activity, leading to an increase in debris in nearshore and offshore environments. This, in turn, could increase the occurrence of entanglements, ingestion of pollutants, or drowning. In addition, increased hurricane activity may damage nesting beaches or inundate nests with seawater. Increasing temperatures are expected to result in increased polar melting and changes in precipitation that may lead to rising sea levels (Titus and Narayanan 1995). Hurricanes and tropical storms occur frequently in the action area. They impact nesting beaches by increasing erosion and sand loss and depositing large amounts of debris on the beach. These storm events may ultimately affect the amount of suitable nesting beach habitat, potentially resulting in reduced productivity (TEWG 2007). These storms may also result in egg loss through nest destruction or inundation. Climate change may be increasing the frequency and patterns of hurricanes (IPCC 2014), which may result in impacts that are more frequent. These environmental/climatic changes could result in increased erosion rates along nesting beaches, increased inundation of nesting sites, a decrease in available nesting habitat, and an increase in nest crowding (Baker et al. 2006; Daniels et al. 1993; Fish et al. 2005; Reece et al. 2013). Changes in environmental and oceanographic conditions (e.g., increases in the frequency of storms, changes in prevailing currents), as a result of climate change, could accelerate the loss of sea turtle nesting habitat, and thus, loss of eggs (Antonelis et al. 2006; Baker et al. 2006; Conant et al. 2009; Ehrhart et al. 2014).

Tidal inundation and excess precipitation can contribute to reduce hatchling output, particularly in wetter climates (Pike 2014; Pike et al. 2015; Santidrián Tomillo et al. 2015). This is especially problematic in areas with intense coastal storm events and in highly-developed areas where the beach has nowhere to migrate. Females may deposit eggs seaward of erosion control structures, potentially subjecting nests to repeated tidal inundation. A recent study by the USGS found that sea levels in a 620-mile “hot spot” along the East Coast are rising 3 to 4 times faster than the global average (Sallenger et al. 2012). In the next 100 years, the study predicted that sea levels would rise an additional 20-27 cm along the Atlantic coast “hot spot” (Ibid). The disproportionate sea level rise is due to the slowing of Atlantic currents caused by fresh water from the melting of the Greenland Ice Sheet. If warming temperatures moved favorable nesting sites northward, it is possible that rises in sea level could constrain the availability of nesting sites on existing beaches (Reece et al. 2013). There is limited evidence of a potential northward range shift of nesting loggerheads in Florida, and it is predicted that this shift, along with sea level rise, could result in more crowded nesting beaches (Ibid).

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

Changes in water temperature may also alter the forage base and, therefore, the foraging behavior of sea turtles (Conant et al. 2009). Likewise, if changes in water temperature affected the prey base for green, loggerhead, or Kemp's ridley sea turtles, there may be changes in the abundance and distribution of these species in the action area. Depending on whether there was an increase or decrease in the forage base and/or a seasonal shift in water temperature, there could be an increase or decrease in the number of sea turtles in the action area. Submerged aquatic vegetation (SAV) habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as changes in salinity, light levels, and temperature (Duarte 2002; Saunders et al. 2013; Short and Neckles 1999). If SAV in the action area declines, it is reasonable to expect that the number of foraging green sea turtles would also decline as well. Loggerhead sea turtles are thought to be generalists (NMFS and USFWS 2008), and, therefore, may be more resilient to changes in prey availability. As noted above, because we do not know the adaptive capacity of these individuals, or what level of temperature change would cause a shift in distribution, it is not possible to predict changes to the foraging behavior of sea turtles over the next 10 years. If sea turtle distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact to sea turtles due to the availability of food. Similarly, if sea turtles shifted to areas where different forage was available, and sea turtles were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. However, should climatic changes cause sea turtles to shift to an area or time where insufficient forage is available, impacts to these species would be greater. Despite site-specific vulnerabilities of the NWA DPS of loggerhead sea turtles, this DPS may be more resilient to changing climate than other management units (Fuentes et al. 2013). Van Houtan and Halley (2011) recently developed climate based models to investigate loggerhead nesting (considering juvenile recruitment and breeding remigration) in the Northwest Atlantic and North Pacific. These models found that climatic conditions and oceanographic influences explain loggerhead-nesting variability. Specifically, the climate models alone explained an average 60% (range 18%-88%) of the observed nesting changes in the Northwest Atlantic and North Pacific over the past several decades. In terms of future nesting projections, modeled climate data predict a positive trend for Florida nesting (NWA DPS), with increases through 2040 as a result of the Atlantic Multidecadal Oscillation (Van Houtan and Halley 2011). In a separate model, Arendt *et al* (2013) suggested that the variability represents a lagged perturbation response to historical anthropogenic impacts. The nest count increases since 2008 may reflect a potential recovery response (Ibid).

5 EFFECTS OF THE ACTION

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

In this section of our Opinion, we assess the effects of the proposed action on listed species that are likely to be adversely affected. The analysis in this section forms the foundation for our

jeopardy analysis found in Section 7 (Integration and Synthesis of Effects). The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the action. Data are limited, so we are often forced to make assumptions to overcome the limits in our knowledge. Sometimes, the best available information may include a range of values for a particular aspect under consideration, or different analytical approaches may be applied to the same data set. In those cases, the uncertainty is resolved in favor of the species (House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 [1979]). We generally select the value or make the assumption that would lead to conclusions of higher, rather than lower risk to endangered or threatened species. This approach provides the “benefit of the doubt” to threatened and endangered species.

In this section, we assess the effects of the proposed operation of the MBSD on green (NA and SA DPSs), loggerhead (NWA DPS), and Kemp’s ridley sea turtles. Potential routes of effects of the proposed action on these species include alterations of habitat conditions such as salinity, turbidity and water temperature, which may drive these species and their prey species out of the currently occupied habitats in the Barataria Basin, and may concentrate harmful commercial fishing activities (shrimp trawling) into the lower basin, where these sea turtles are more prevalent, thereby increasing adverse interactions between the sea turtles and the shrimp trawling gear (detailed further below).

5.1 Delft3D Model Overview

The Barataria Basin is a dynamic system, which has experienced extensive land loss, and is predicted to continue to experience land loss into the future. The basin is also predicted to be impacted by sea level rise. These changing baseline conditions are expected to influence a wide range of environmental conditions within Barataria Basin. Therefore, the project proponents have worked with The Water Institute of the Gulf (TWI) to develop a basin-wide model that can be used to assess conditions in the basin at various points in time with and without the proposed project.

The Delft3D model is a modeling suite developed by Deltares (2014) and designed to model “hydrodynamics, sediment transport and morphology and water quality for riverine, estuarine, and coastal environments” (Sadid et al. 2018). As developed by TWI, the Delft3D model integrates several modules, including hydrodynamics, morphodynamics, nutrient dynamics, and vegetation dynamics.

The results presented here are based on Version 3 of the basin-wide Delft3D model, implemented specifically to model the proposed action. The Delft3D model predicts how conditions would change over 50 years, including changes in wetland area, water level, water quality (including salinity), and vegetation characteristics. Many of the results from the Delft3D model are expressed as the difference between the “future with project” (FWP) and “future without project” (FWOP) scenarios. Delft3D modeling predictions allow for comparisons of environmental conditions over time with and without the proposed action. Additional details on the development and design of the Delft3D model can be found in the BA for the proposed project (Confluence 2021).

The main drivers of habitat changes throughout the action area due to the proposed action are salinity, water temperature, and sediment transport/deposition. Many of these characteristics are also forecast to change as a result of future climate and sea level conditions. Figure 13 illustrates the major trends of these drivers of change in the FWOP and FWP scenarios. These drivers and additional details are discussed throughout Section 5.2.

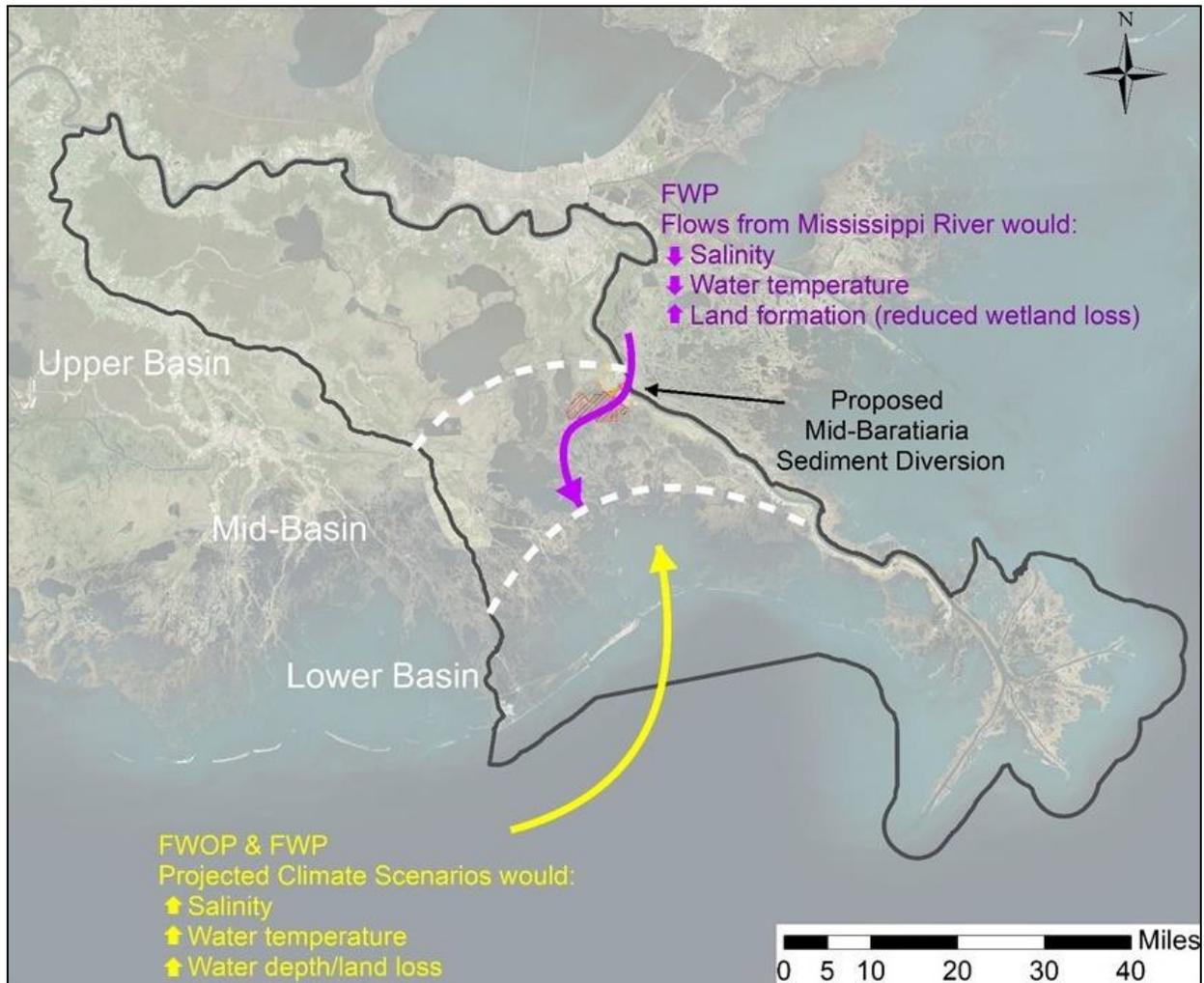


Figure 13. FWP and FWOP main effects on habitat in Barataria Basin and the Birdfoot Delta (Figure 5.3-1 in the Project BA)

5.2 Effects of Project Operations

In response to sea level rise, saltwater intrusion into the estuary is anticipated to increase over time. As such, average salinity throughout the basin is anticipated to increase over time, though effects would be most consequential in the lower–mid and lower regions of the Barataria Basin. The projections of effects of the proposed action described below include the influence of the predicted effects from climate change and sea level rise.

Proposed Action Effects on Salinity

The proposed action would divert fresh water from the Mississippi River into the brackish Barataria Basin (current salinity conditions throughout the action area are described in more detail in Section 4.2.2 of the project BA (Confluence 2021)). The majority of the Barataria Basin is estuarine, with low year-round salinity (0- 10 practical salinity units [psu]) in the upper and mid-basin, and regular seasonal influxes of more saline marine waters in the lower basin (10-20 psu). Compared to the FWOP, the proposed action is anticipated to decrease salinity throughout the Barataria Basin, with strongest effects on the southern half of the basin below the diversion outfall. Modeled proposed action effects predict lowered salinity throughout the mid and lower regions of the Barataria Basin, throughout all seasons of the year. Salinity effects due to the diversion are primarily during periods of operation and immediately following the reduction of the diversion to base flow; however, base flow (5,000 cfs) would continue to exert an influence on salinity. Salinity effects are most remarkable during months of highest river flow (above 450,000 cfs) when the diversion would be operating above base flows, increasing incrementally to a maximum diversion of 75,000 cfs. Salinity changes due to the proposed action are not anticipated to extend north of the diversion into the predominantly freshwater upper Barataria Basin. Salinity in the Birdfoot Delta is predicted to be minimally higher as a result of diverting volumes of fresh water upriver from the delta. An overview of predicted salinity trends over time within the action area is shown above in Figure 13, while a more specific comparison of salinity conditions in FWP and FWOP, within each Delft3D modeled region, is shown below in Figure 14.

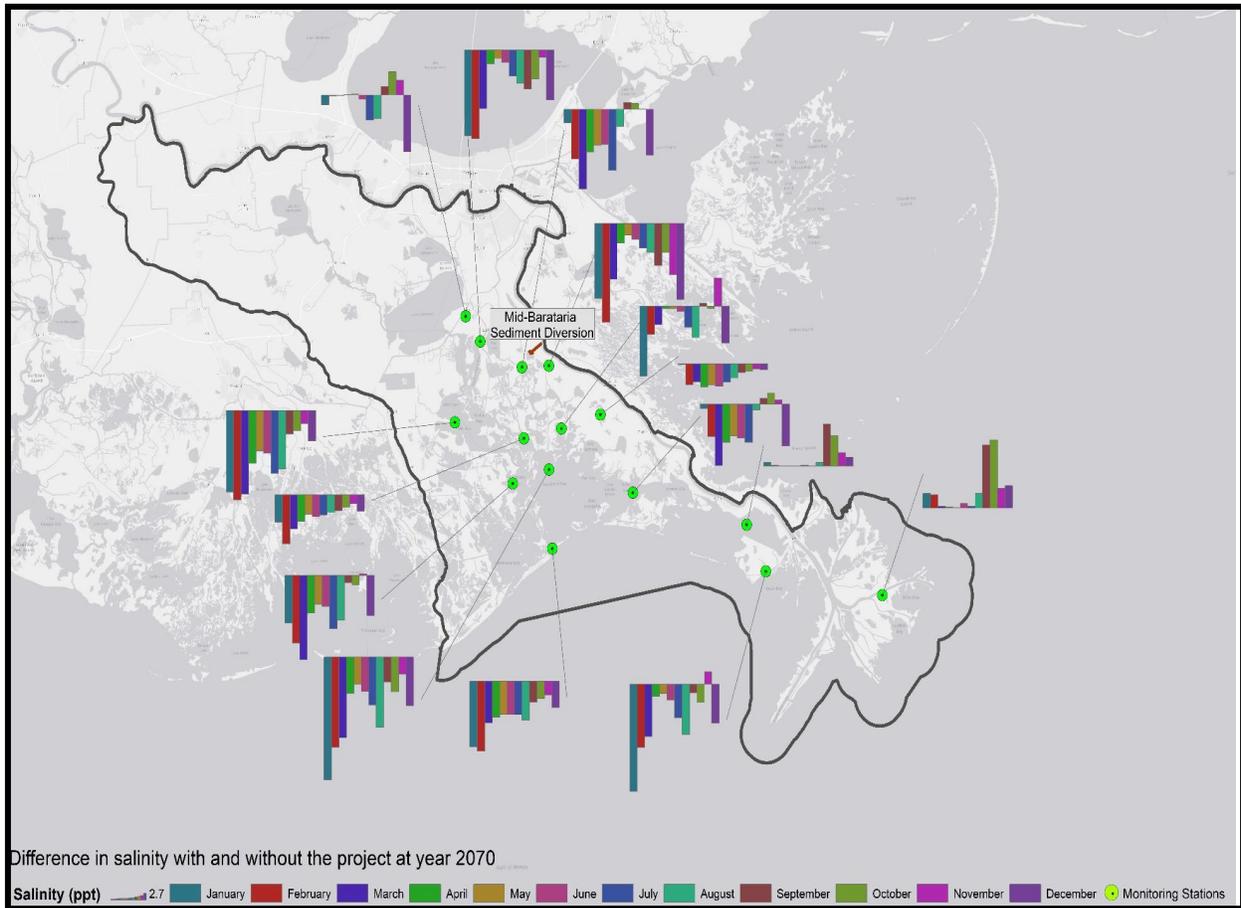


Figure 14. Project Effects on Salinity over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.1-1 in the Project BA)

The largest changes to salinity would occur in the mid-basin region of the Barataria Basin, near the diversion outfall. Changes to salinity as a result of the proposed action are most noticeable during periods of peak river/diversion flow (January – June). The diversion would be adding a new source of freshwater flow into the basin, decreasing salinity substantially (by ≤ 8 ppt² lower than the FWOP, to a minimum of 0 ppt) adjacent to the diversion outfall. The magnitude of salinity changes decreases with increasing distance from the diversion outfall. The second greatest changes to salinity are anticipated to be on the north side of the barrier islands, in South Barataria Bay, during all periods where the diversion is operating above the base flow levels. The barrier islands are an area of mixing of the basin’s estuarine waters and more saline nearshore Gulf waters, but additions of fresh water would likely move the mixing zone slightly south, and decrease salinity substantially (by ≤ 6 ppt lower than the FWOP) just north of the barrier islands during springtime months. However, due to mixing with high salinity Gulf waters, the barrier islands have higher salinity than the rest of Barataria Bay during most of the year; therefore, the lowest monthly salinity predicted at the barrier islands due to the proposed action is estimated to be approximately 1.1 ppt, as compared to a minimum of 3.9 ppt in FWOP in 2070. Salinity conditions south of the barrier islands are primarily driven by nearshore and oceanic processes in the Gulf and the salinity effects of the proposed action are constrained to the immediate vicinity of the barrier islands.

Changes to salinity can have consequences to aquatic plants and animals in the basin, expanding areas available for some species, and restricting suitable areas for others. Project driven changes to salinity have the potential to result in changes to habitats (e.g., species of composition of marsh vegetation) and are predicted to shift marsh areas in the mid-basin from brackish marsh to fresh and intermediate marshes. These are in addition to changes over time in both the FWP and FWOP scenarios where saline marshes in the mid and lower Barataria Basin are predicted to continue to reduce in area, followed by subsequent losses of substantial areas of brackish marsh due to continued sea level rise and coastal erosion. Average salinities throughout the basin with and without the proposed action are described below in Table 7 in increments of ten-year cycles by habitat type. The proposed action would not alter the predominantly fresh upper basin.

Table 7. Predicted Average Salinity in Barataria Basin by Habitat Type

Time Period	Habitat Type	Salinity (psu)	
		FWOP	FWP (75k cfs)
Cycle 0 (2020 - 2029)	Fresh + Intermediate	1.0	0.4
	Brackish	3.8	2.4
	Saline	7.7	9.9*
Cycle 1 (2030 - 2039)	Fresh + Intermediate	1.2	0.4
	Brackish	3.5	2.9
	Saline	8.5	9.0*
Cycle 2(2040 - 2049)	Fresh + Intermediate	1.6	0.3
	Brackish	3.6	3.6
	Saline	8.5	8.1
Cycle 3 (2050 - 2059)	Fresh + Intermediate	1.8	0.5
	Brackish	3.7	2.7
	Saline	7.7	6.5
Cycle 4 (2060 - 2069)	Fresh + Intermediate	1.5	0.2
	Brackish	3.1	2.6
	Saline	NA	NA
Cycle 5 (2070)	Fresh + Intermediate	1.7	0.4
	Brackish	3.8	NA
	Saline	NA	NA

NA = not applicable, no habitat of this type

Source: The Water Institute (2019)

* Note: Salinity calculations are based on the area within each habitat type. In the FWP scenarios, at all time periods, the area that is saline decreases. In some time periods this may cause salinity to appear to increase in saline habitat areas. This is because lower salinity areas in this habitat class shift to brackish habitat in the FWP.

Proposed Action Effects on Water Temperature

In response to global climate change, water temperatures throughout Barataria Basin are anticipated to increase over time, with changes being most pronounced in winter months (up to 3°C increase). The following analysis of effects of the project includes the influence of these predicted conditions, trajectories, and trends, as they would continue to exert their influence.

The proposed action would divert predominantly colder flows from the Mississippi River into the Barataria Basin. Annual river temperature in the Mississippi River ranges from 6.6°C to 30.0°C, while the average water temperature in Barataria Basin ranges from 16°C to 30°C. The temperature differential between the Mississippi River and Barataria Basin is the highest between February and May, with model results predicting a maximum of 6.6°C differential adjacent to the outfall during cycle 2 (2040 to 2049). Over time, the magnitude of seasonal temperature effects are predicted to decrease slightly, but would largely remain the same through the first 50 years, with effects being mostly restricted to the mid-basin region of the Barataria Basin. No temperature effects from the proposed action are anticipated in the southernmost region of the Barataria Basin, along the barrier islands, or in the Birdfoot Delta.

The addition of Mississippi River flow to the mid-basin would change the distribution and timing of temperature-bounded habitats and species in the Barataria Basin. Changes to water temperature can have consequences to aquatic plants and animals in the basin, expanding habitat available for some species, and restricting available habitats for others.

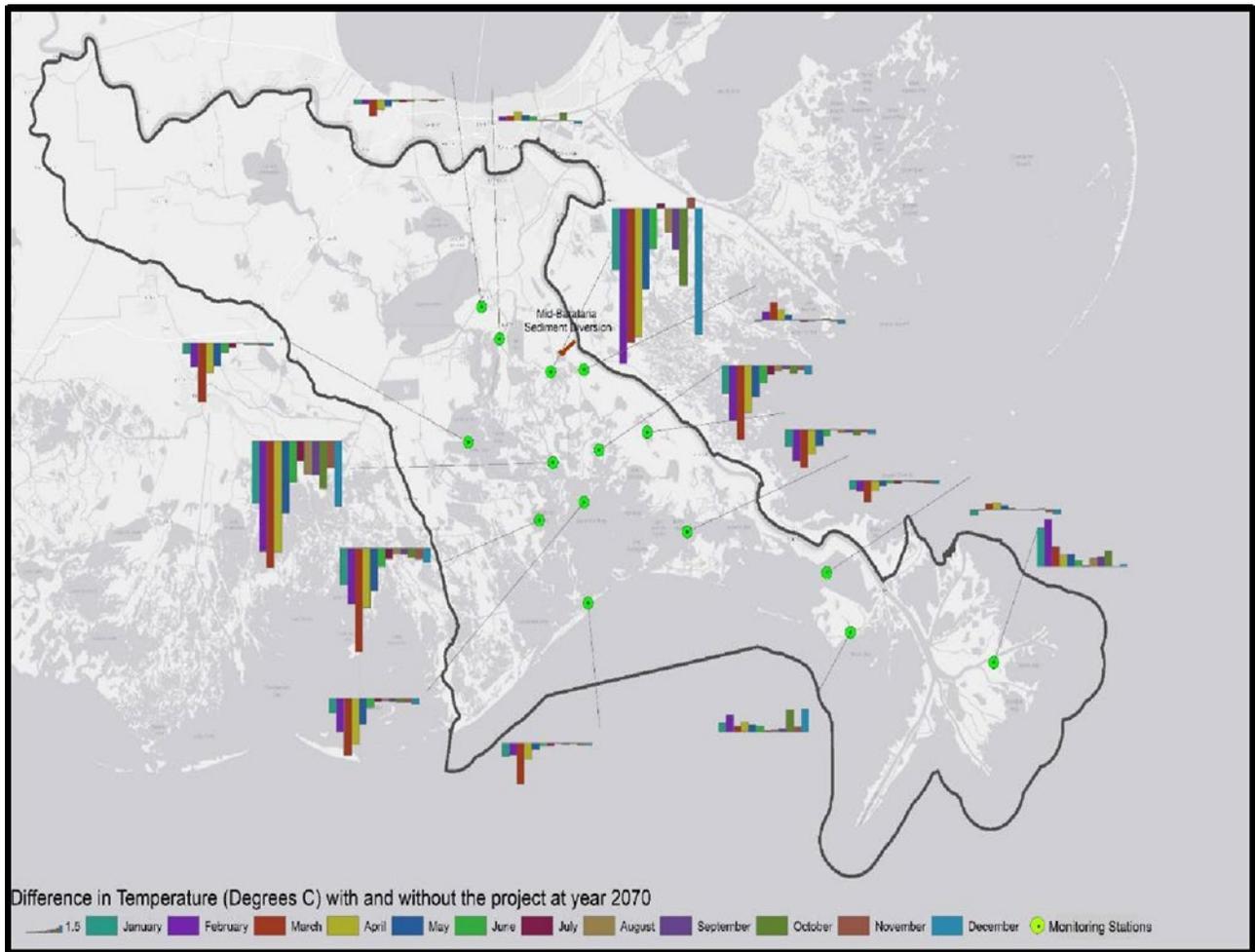


Figure 15. Project Effects on Temperature over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.2-1. in the Project BA)

Proposed Action Effects on Turbidity and Suspended Sediments

In the FWOP, total suspended solids (TSS) is generally low ($<50 \text{ g/m}^3$) year-round throughout the majority of the Barataria Basin (Figure 15). The model also shows periods when TSS is elevated near the barrier islands ($<100 \text{ g/m}^3$). The analysis of the proposed action below includes the influence of predicted conditions in FWOP trajectories and trends in addition to effects of the proposed action, as they will continue to exert their influence.

The proposed action would divert sediment-laden water from the Mississippi River into the mid-basin region of the Barataria Basin (current turbidity and suspended sediment conditions throughout the action area are described in more detail in Section 4.2.5 of the project BA). The purpose of the diversion is to increase sediment deposition in the Barataria Basin in support of land building and marsh maintenance into the future. Project operations would increase the frequency of sediment input into the basin as compared to the FWOP, and would result in changes to the distribution and maintenance of land area and emergent marsh habitats in the basin over time.

The proposed action is anticipated to contribute substantial suspended sediment loads and elevated turbidity at and adjacent to the project outflow and into the northern portion of the lower basin. Turbidity would also be increased by the flow of the outfall itself. During operations, turbidity adjacent to the project outfall is anticipated to increase 50% to 200%, to a maximum of $\leq 375 \text{ g/m}^3$ TSS. TSS are expected to be elevated throughout the mid and lower basin with levels of TSS decreasing in magnitude with distance from the diversion (Figure 16). Along the barrier islands, seasonally elevated TSS is anticipated to increase over time under both the FWOP and FWP scenarios during winter months, up to 50% higher than the existing conditions (up to a maximum of $\leq 150 \text{ g/m}^3$ TSS).

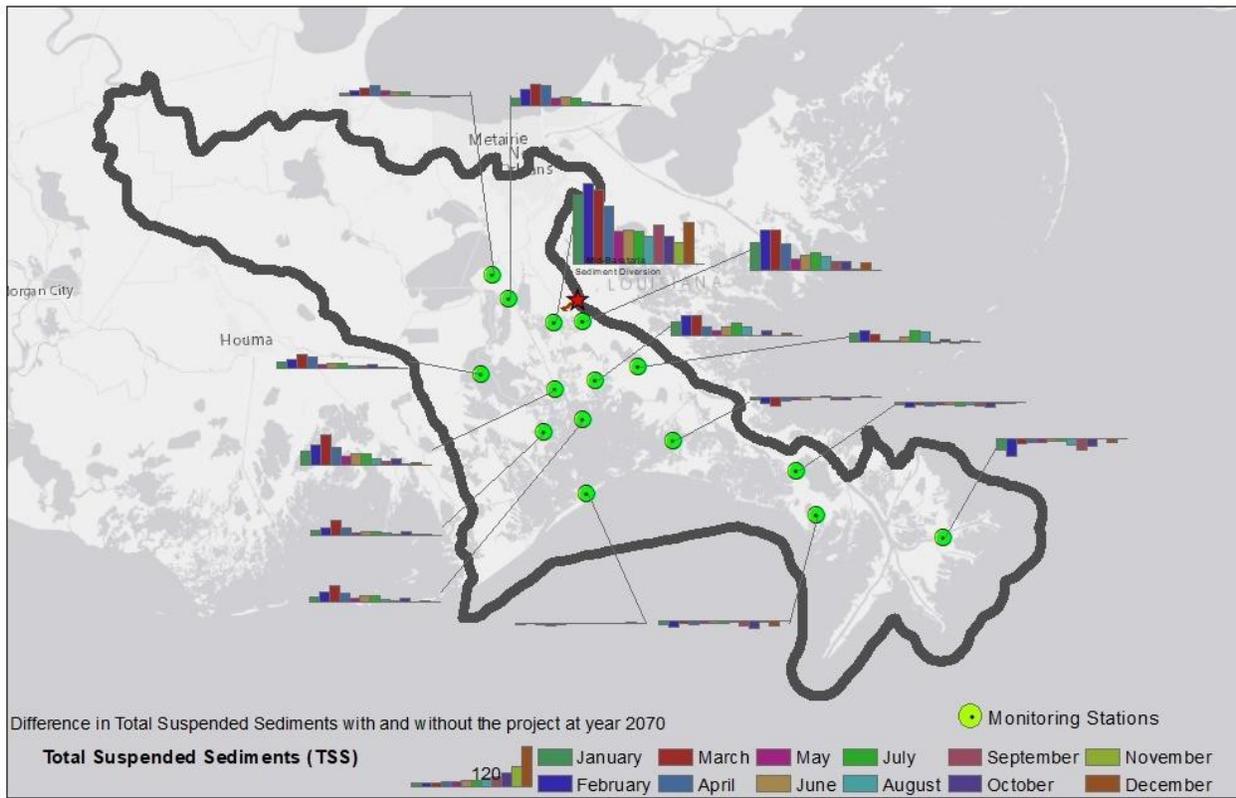


Figure 16. Suspended Sediment over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.3-1. in the Project BA)

Increased turbidity can have consequences to plants and animals present, such as smothering of benthic vegetation and invertebrates, reducing DO levels, and displacing species from highly turbid areas. Increased turbidity may also reduce light transmission into the water column, thereby reducing the water depths where submerged aquatic vegetation (SAV) can thrive. In addition, aquatic vegetation may be buried or growing shoots may be covered with sediment reducing or preventing photosynthesis.

Prolonged exposure to these effects may make habitat unsuitable for vegetation. Increased turbidity and sedimentation can affect normal fish behaviors (including ability to feed, move and/or shelter). Fish can experience injury from sediment abrasion on gill surfaces, and highly turbid waters may diminish the ability of fish to detect prey or predators.

Proposed Action Effects on Water Quality: Nutrients and Dissolved Oxygen

The proposed action would contribute nutrients from the Mississippi River to the Barataria Basin. There are indications that the Barataria Basin may be nutrient limited in areas and/or at certain times of year, suppressing aquatic plant growth (Turner 2017). The addition of nutrients may support primary productivity and lead to decreases in DO resources if eutrophic conditions occur. However, the Barataria Basin waters are shallow and well mixed, allowing surface waters rich in DO to mix throughout the water column; this limits the risk of the occurrence of low DO conditions.

Nutrients

The addition of nutrient-rich Mississippi River waters into the mid-basin as result of the proposed action would seasonally influence nutrient concentrations basin-wide. During spring and summer months, when the diversion system is operating above base flow, total phosphorus (total P) and total nitrogen (total N) are predicted to be elevated immediately adjacent to the diversion outfall (Figures 17 and 18).

Total P concentrations are predicted to be elevated both immediately adjacent to the outfall (maximum 0.18 mg/l higher than FWOP) and slightly south of the diversion outfall (a maximum elevation of 0.16 mg/l compared to FWOP) during months when the diversion system is operating above base flow. At the outfall, elevated levels of total P would be sustained throughout the year, though at lower levels during base flow conditions than when the diversion system is operating above base flow (0.05 mg/L to 0.12 mg/l). Total P concentrations are anticipated to decrease with distance south of the outfall until undetectable in the mid-lower basin. The proposed project is not anticipated to influence total P concentrations north of the project outfall.

Total N concentrations consist of both nitrate (NO₃) and ammonium (NH₄) concentrations. Changes in total N due to the proposed action are predicted to be predominantly driven by changes in nitrate concentrations, but all forms of nitrogen are anticipated to become elevated immediately adjacent to the project outfall. Ammonium concentrations are anticipated to be slightly elevated (a maximum elevation of 0.16 mg/L during cycle 1 [2030-2039] compared to FWOP, which is between 0.00 and 0.01 mg/L) at the project outfall and immediately south, only during months when the diversion system is operating above base flow. At the outfall, elevated nitrate concentrations are predicted to be sustained throughout the year (a maximum elevation of 1.38 mg/L during cycle 1 [2030-2039] compared to FWOP). Southward of the outfall, nitrate concentrations are anticipated to be elevated only during months when the diversion system is operating above base flow, and to decrease with distance from the outfall until undetectable in the mid-lower basin. The proposed action is not anticipated to influence ammonium or nitrate concentrations north of the project outfall.

Changes to aquatic concentrations of nitrogen and phosphorus can have substantial direct and indirect effects on plant growth, DO concentrations, water clarity, and sedimentation rates. Nitrogen's primary role in organisms is protein and DNA synthesis, as well as in photosynthesis. Phosphorus is critical for metabolic processes, which involve the transfer of energy (USEPA 2010). Most effects from nutrient changes are reflected in primary production as discussed below.

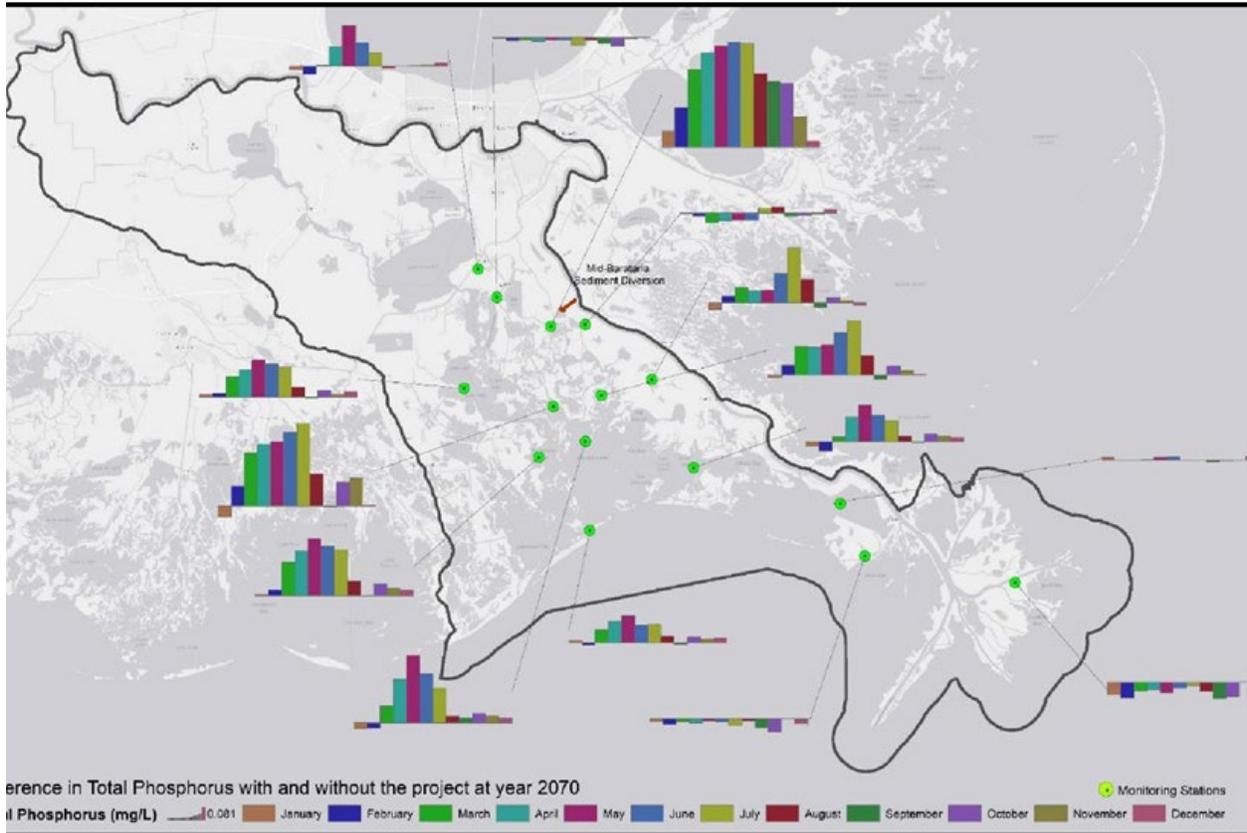


Figure 17. Total Phosphorus over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.5-1. in the Project BA)

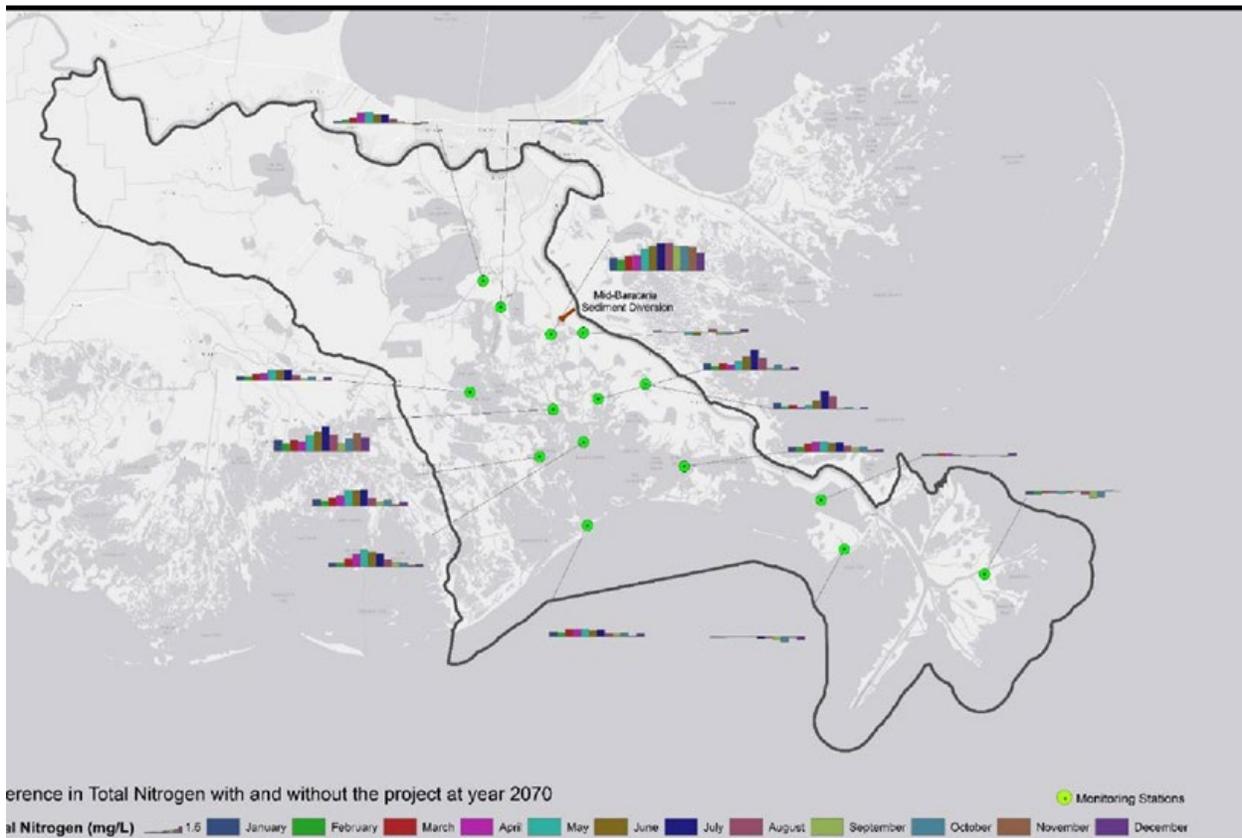


Figure 18. Total Nitrogen over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.5-2. in the Project BA)

Proposed Action Effects on Primary Production (Chlorophyll A)

The proposed action’s addition of sediment and nutrient-rich Mississippi River waters into the mid-basin would seasonally influence chlorophyll A (Chl A) concentrations basin-wide (Figure 19). During spring and summer months, when the diversion system is operating above base flows, Chl A concentrations are anticipated to substantially decrease immediately adjacent to the diversion outfall (up to 66 µg/L below FWOP) due to high turbidity conditions limiting primary production (discussed above in Section 5.3.3). Expanding southward from the diversion outfall, early spring decreases in Chl A concentrations are anticipated in March, with more historical concentrations in April/May. Throughout the mid and into the central-lower basin, Chl A concentrations, in the form of phytoplankton blooms, are predicted to rise throughout the peak growing season’s summer months of May to October (maximum of 74.37 µg/L above FWOP during cycle 2 [2040-2049]) in response to the addition of nutrients from the diversion (discussed above).

Elevated summer phytoplankton blooms above FWOP conditions are predicted to be most dense within the southern-mid and lower basin regions, south of the outflow, beyond the greatest influence of turbidity. Chl A concentrations may be higher in the southern-lower basin in summer months due to localized decreases in mixing provided by the barrier islands (up to 61.2 µg/L above FWOP during cycle 1 [2030-2039]). By 2070, slight increases in Chl A concentrations are anticipated to be seasonally detectable north of the diversion (up to 21.38

µg/L above FWOP). The proposed action is not anticipated to substantially influence Chl A concentrations in the Birdfoot Delta.

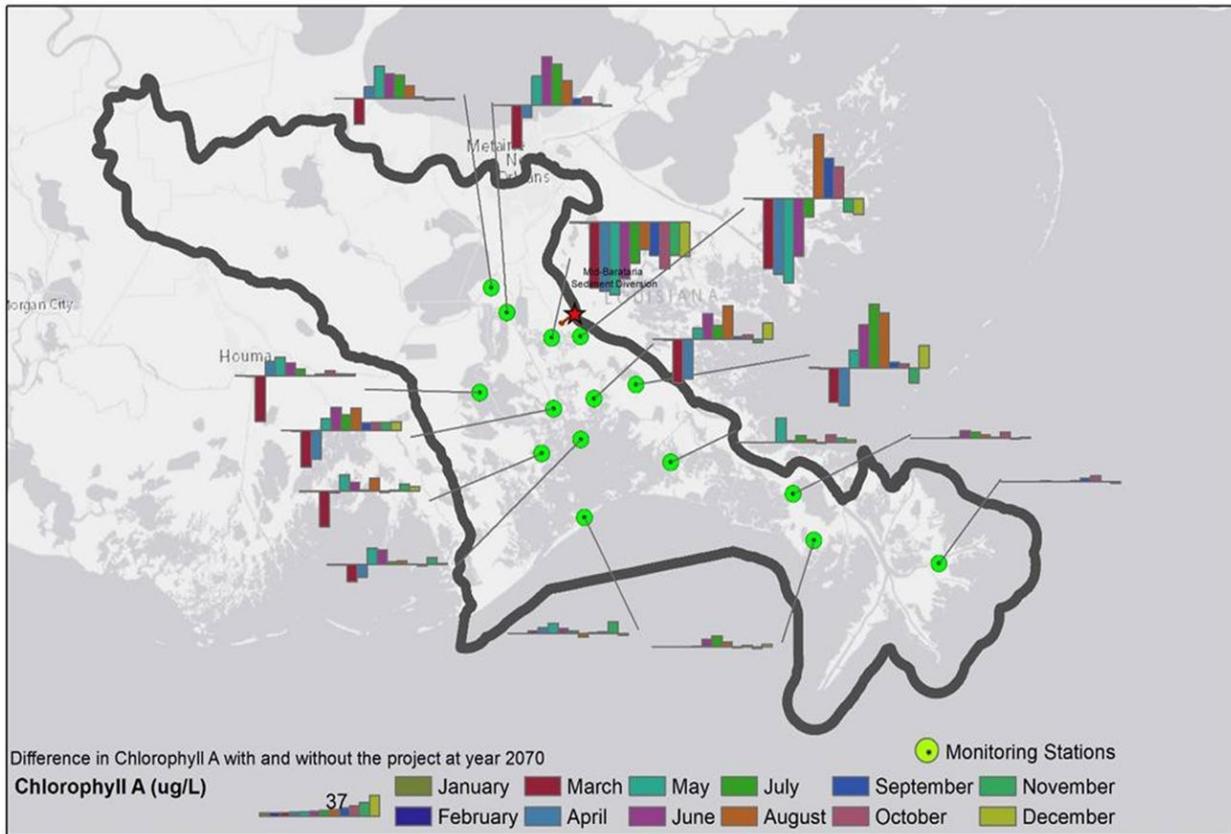


Figure 19. Chlorophyll A over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.5-3. in the Project BA)

Elevated phytoplankton blooms and primary production can only benefit aquatic systems to the threshold where they become eutrophic. Over-enrichment can lead to the development of low oxygen areas, harmful algal blooms, and loss of SAV and bottom habitat. Chl A changes due to nutrient enrichment in Barataria Bay are not anticipated to result in eutrophic conditions, nor are they anticipated to substantially decrease DO concentrations due to strong mixing of the water column; however, phytoplankton and macrophyte communities may be locally and temporally altered.

Sea turtles are susceptible to brevetoxins associated with blooms of *Karenia brevis*, a dinoflagellate responsible for “Florida Red Tide” (Magaña et al. 2003). Sea turtles are exposed to the toxin by eating affected forage items or aerosolized toxins during *K. brevis* blooms. *K. brevis* is present throughout the Gulf of Mexico; however, blooms are typically associated with temperatures between 22°C and 28°C in higher salinity waters along the gulf shelf (Magaña et al. 2003), and no blooms of *K. brevis* have occurred in Louisiana since 1996. That bloom was associated with a special set of conditions where a tropical storm tracked westward during a bloom along the Florida panhandle (Brown et al. 2006). Although the addition of nutrients in Barataria Basin from the Mississippi River has the potential to increase algal blooms in the

Basin, the proposed action is not anticipated to affect the timing or distribution of *K. brevis* blooms, and therefore not expected to contribute to *K. brevis*-related impacts to sea turtles.

Proposed Action Effects on Dissolved Oxygen

Proposed action is anticipated to minimally decrease DO concentrations immediately adjacent to the outfall, correlated with high turbidity, nutrient enrichment, and increased primary productivity at certain times of year.

The proposed action is predicted to have very little effect on DO concentrations north of the diversion (Figure 20). Though the proposed action is anticipated to have varied DO effects throughout the central and lower basin, minimally lowering DO throughout the basin on a seasonal basis, the lowest DO concentrations predicted are approximately 6.0 mg/L, which is within the tolerance range of most organisms.

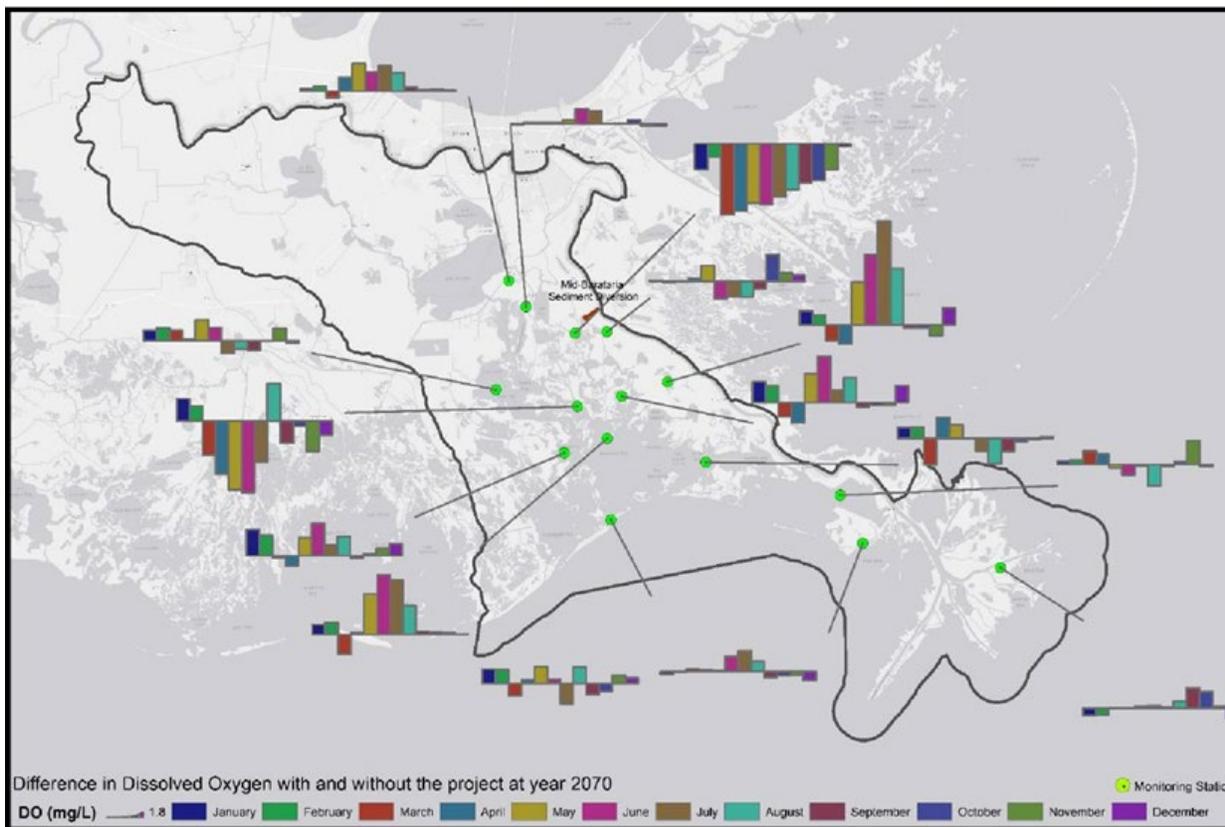


Figure 20. Dissolved Oxygen over Time in Barataria Basin and Birdfoot Delta with and without the Proposed Project (Figure 5.3.5-4. in the Project BA)

Proposed Action Effects on Habitat Area

This section will focus on changes to habitat area resulting from the proposed action, including changes to fresh- and saltwater marshes, wetlands, SAV, and other relevant habitat features for listed species and prey resources. Existing aquatic resources and habitat throughout the action area are described in more detail in Section 4.5 of the project BA.

Marsh Habitat

The FWOP is predicted to lose up to 85% of emergent marsh habitats throughout the action area due to several factors, including climate change and sea level rise. With the project, over 16,500 acres of marsh habitats are anticipated to be maintained or created within Barataria Basin by 2050 as compared to the FWOP (Table 8).

During initial high-flow periods of project operation, initial sediment deposition may temporarily decrease the quality of marsh habitat adjacent to the diversion by inundating vegetation (e.g., SAV) and smothering benthic organisms. After initial high-flow periods, marsh vegetation and invertebrates are anticipated to recover in area and quality (Table 8).

Compared to the FWOP, the proposed action is anticipated to retain or create more vegetation in fresh and intermediate marsh habitats. The largest amount of vegetation would be created and maintained adjacent to the diversion, in areas where land will be created or maintained. Because of the freshwater influence of the diversion, some marsh areas adjacent to the project and in the mid Barataria Basin are expected to shift from brackish communities to fresh- intermediate marsh communities. In the lower basin, small areas of saline-vegetated habitats would initially shift to brackish marsh habitats, but ultimately the same amount of saline-vegetated habitat is predicted to be retained in the FWP and the FWOP.

Many species rely upon marsh habitats across a wide range of salinities and would benefit from the retention of marsh habitat within Barataria Basin. Marsh communities may shift in composition of vegetation and invertebrates due to shifting water quality conditions (e.g., temperature and salinity). These changes may have a diverse array of effects on marsh species and species that rely on specific marsh habitats or prey.

Table 8. Predicted Marsh Habitats within the Action Area

Marsh Habitat Type	Predicted Marsh Habitat (acres)					
	Cycle 0	Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5
	2020-2029	2030-2039	2040-2049	2050-2059	2060-2069	2070
FWOP						
FWOP Fresh + Intermediate	278,081	263,712	228,253	189,589	130,924	66,396
FWOP Brackish	80,969	73,217	55,635	29,069	11,972	6,352
FWOP Saline	70,923	44,900	28,651	16,478	6,967	6,454
Total	429,973	381,829	312,539	235,136	149,863	79,202
FWP						
FWP Fresh + Intermediate	313,995	304,926	273,240	219,914	153,215	79,526
FWP Brackish	68,637	57,918	34,037	20,461	5,804	3,219
FWP Saline	47,367	23,062	16,533	11,308	7,335	6,248
Total	429,999	385,906	323,810	251,683	166,354	88,993
Difference (FWP-FWOP)						
Fresh + Intermediate	35,914	41,214	44,987	30,325	22,291	13,130
Brackish	(12,332)	(15,299)	(21,598)	(8,608)	(6,168)	(3,133)
Saline	(23,556)	(21,838)	(12,118)	(5,170)	368	(206)
Total	26 (+<1%)	4,077 (+1%)	11,271 (+4%)	16,547 (+7%)	16,491 (+11%)	9,791 (+12%)

Proposed Action Effects on Submerged Aquatic Vegetation

Although the project would have the most notable effects on marsh habitats, the proposed action is also anticipated to affect SAV communities within Barataria Basin, such as algae and macroalgae, including *Sargassum*. Most *Sargassum* occurring in the project area is pelagic and development of *Sargassum* mats are likely driven by seasonal, regional wind and current patterns that are not affected by the project. Nutrients carried by the diversion through Barataria Basin may support phytoplankton (Wissel et al. 2005) and nutrient loading may enhance *Sargassum* growth locally (Brooks et al. 2018). Widgeon grass, which may occur in low levels near the barrier islands, may also be minimally affected.

In the FWOP, sea level rise is predicted to decrease SAV throughout the lower basin, with SAV declining with increasing depth and decreasing light availability. In the FWP, as the proposed action creates land and additional shallow water habitat, it is projected to decrease SAV loss. SAV was evaluated using multiple approaches; however, the premise of the SAV Likelihood of Occurrence Model (SLOO) (DeMarco et al. 2018) is believed to be the most representative data for this proposed action. Without the proposed action, SAV is projected to decline from approximately 9% of the basin area to 2% over the 50-year evaluation period. As a result of the proposed action, this model approach indicates the area suitable for SAV is about 2% (1,500 acres) higher in the fresh/intermediate portion of the project area at the end of the project life (USFWS 2020). Operation of the diversion is projected to build new land and will also increase the elevation of existing marshes or sediment beds (Carle et al. 2015).

As the proposed action will seasonally decrease salinities in the mid-basin, species composition of SAV in the mid basin are likely change. Operation of the proposed project would likely result in increased habitat suitability for SAV species in the Barataria Basin that thrive in or tolerate intermediate to fresh water, while decreasing the habitat suitability of those that are adapted to more saline waters. Aquatic vegetation in general is more diverse and abundant in low-salinity habitats (Hillmann et al. 2016), which would likely benefit from the proposed action.

Proposed Action Effects on Prey Base/Food Web

Prey base/food webs within marsh habitats in the mid-basin would experience temporary reductions in quality and biomass with initial peak project operation flows. Peak flows are predicted to change the water quality and sediment delivery within the mid-basin, initially inundating some marsh vegetation adjacent to the diversion and shifting brackish marsh habitats to fresh/intermediate marsh habitats over the course of the first decade of project operations. The shift to intermediate marsh habitat, which is often more productive than brackish marsh habitat, may result in a net benefit to local food webs. Recoveries of both emergent vegetation and invertebrate communities are anticipated rapidly after initial flows, and ultimately the proposed action would substantially increase the amount of marsh habitat within the mid-basin in the FWP as compared to the FWOP.

The main drivers of prey base/food web effects from the proposed action are primary production and salinity. Project operation is anticipated to enhance primary productivity during summer months within the mid and lower basin, in response to nutrient additions from Mississippi River flows (see Section 5.3.5 above). This project-driven enhanced primary productivity is predicted to subsequently increase pelagic and benthic food resources for fishes and invertebrates.

However, the benefits of enhanced productivity are tempered by the mixed effects of reduced salinity throughout the mid-basin. Species tolerant of low salinity, such as blue crab, juvenile Gulf menhaden, red drum, and largemouth bass, would benefit most from the enhanced primary production and are predicted to show positive trends in habitat suitability indices (HSIs) across the basin, potentially resulting in increasing biomass, in the FWP as compared to the FWOP within the mid and lower basin. Higher salinity species such as brown shrimp, spotted seatrout, and oysters may benefit from increased primary production, but primarily within the lower basin during years of high river flows, where salinity is less influenced by project operations. These species are predicted to show lower trends in average basin HSIs, potentially resulting in decreasing biomass, in the FWP as compared to the FWOP. Due to project salinity decreases in the mid-basin, higher salinity species may experience restrictions in available habitat and potentially decreased biomass over time within the mid-basin and concentrated biomass in the lower basin. Conversely, lower salinity species are expected to experience increases in available habitat and potentially increased biomass over time within the mid and lower basins.

Changes in habitat conditions may result in changes in the distribution of prey items. Specifically, changes in salinity are expected to create a southward shift in distribution of species that are sensitive to low salinity conditions. Species affected by low salinity conditions include commercially important species such as brown shrimp. Commercial fisheries are expected to adjust fishing effort and intensity as populations change in the Barataria Basin. Commercially

available brown shrimp populations are predicted to decrease and become concentrated in the lower portions of the Barataria Basin. While fishing effort may or may not decrease in response to these changes over time, it is likely that fishing effort will become more concentrated in lower portions of the Barataria Basin.

5.3 Direct and Indirect Effects on Sea Turtles

Water Temperature

Model results (Sadid et al. 2018) indicate that operation of the project is anticipated to decrease water temperatures within the mid basin during peak flows. During winter months, the project is anticipated to extend the amount of time that temperatures drop below the minimum temperature tolerance for sea turtles (10°C) (Schwartz 1978) adjacent to the outfall, and immediately south of the outfall in the northern mid-basin (i.e. within about 10 kilometers of the outfall). Project operations are predicted to reduce water temperatures by up to 6.5°C in this area, with temperatures staying below 10°C during January and February of each year as a result of the proposed action. Sites farther away from the outfall would experience minimal effects on temperature, typically seeing reductions in winter temperatures of less than 0.5°C.

Cold-shock injury to sea turtles is associated with rapid onset of low temperature conditions. Sea turtle occurrence within the area 10 km from the proposed outfall structure is currently rare, and potentially injurious low temperature conditions caused by the proposed action would occur when sea turtles tend to be at wintering sites and are therefore even less likely to be within this portion of the Barataria Basin. Therefore, the minor seasonal restriction due to low temperatures in the upper portion of sea turtle range in Barataria Basin is not likely to adversely affect sea turtles due to their limited use of this area. Temperatures throughout the basin are not expected to exceed the upper range of sea turtle tolerances (33-34°C) (Valverd and Holzwart 2017) in the FWP or FWOP.

Commercial Fishing Interactions

High numbers of stranded Kemp's ridley and loggerhead sea turtles in the mid-1980s prompted regulations to require turtle excluder devices (TEDs) on shrimping vessels to prevent turtles caught in fishing gear from drowning. In fisheries such as skimmer trawls and push-head trawls, where TEDs have not been historically used, tow time limitations have been used as an alternative conservation measure to reduce the likelihood of drowning turtles. These tow time restrictions specify tow times may not to exceed 55 minutes from April 1 through October 31, and 75 minutes from November 1 through March 31 (50 CFR 223.206(d)(3)(i)(A) and (B)). NOAA published a final rule on December 20, 2019 (84 FR 70048), that requires TEDs on skimmer trawl vessels 40 ft and greater in length effective August 1, 2021; skimmer trawl vessels less than 40 ft in length are required to continue to comply with alternative tow time requirements per 50 CFR 223.206(d)(2)(ii)(A)(3). While these management interventions have significantly reduced the adverse impacts of the shrimp trawl fishery on sea turtles, interactions between turtles and shrimping gear continue to contribute to strandings of sea turtles (Lewison et al. 2003).

As explained in greater detail in past Biological Opinions that analyze the effects of shrimp fisheries on sea turtles, particularly the 2021 Shrimp Opinion, the more abundant sea turtles are

in a given area where and when fishing occurs, and the more fishing effort in that given area, the greater the likelihood and frequency that a sea turtle will be exposed to the gear (NMFS 2021). The proposed project is anticipated to reduce habitat suitability for brown shrimp populations within the Barataria Basin, which is likely to affect commercial fishing activity in the area. Over the past 2 decades, commercial fishing efforts targeting brown shrimp have declined throughout the Basin. The modeled impacts to brown shrimp resulting from the proposed action are expected to continue and likely accelerate these declines in fishing effort in the Basin. While some fishers may choose to stop fishing for brown shrimp in the Basin, others may shift their efforts towards the lower basin or just offshore, where sea turtles are more prevalent. These changes are expected to result in an increase in interactions between fishing gear and sea turtles in the lower basin and nearshore areas. An increase in interactions means there could be an increase in the number of sea turtles involved in such interactions, as well as an increase in the number of times an individual sea turtle is involved in such interactions, because not all interactions are fatal.

Populations of some species of sea turtles have been increasing since conservation measures were instituted in the past several decades. This increases the likelihood of sea turtle interactions with shrimping vessels and resulting strandings (Lewison et al. 2003). The proposed project may contribute to changes in fishing effort and turtle behavior that may concentrate both turtles and shrimp trawling activity in the lower portions of the Barataria Basin. Furthermore, some fishers may venture further to target shrimp populations and may extend fishing to areas offshore. All of this may lead to increased interactions over time. While the current management regulations (TEDs and limited tow times) have a relatively high effectiveness rate for preventing injuries to turtles, an increased number of adverse interactions is reasonably expected to occur.

Given the uncertainties in the reactions of commercial fishers and sea turtles to the changes expected to result from project operations, it is impossible to calculate or detect the expected numbers of increased harmful interactions between sea turtles and shrimp gear that may occur as a result of the proposed action. As noted above, because a sea turtle can have multiple interactions, a single sea turtle stranding does not necessarily represent a single interaction. In the absence of the ability to calculate the number of increased interactions between sea turtles and fishing gear expected to result from the proposed action, we use as a surrogate for estimating these interactions, using a parameter that can be measured and reported on an annual basis.

The Louisiana Department of Wildlife and Fisheries (LDWF 2020) conducts a trip ticket program, which involves the mandatory reporting of commercial seafood landings at the point of first sale where commercial fishermen land and unload their catches. Following the landing of any seafood species in Louisiana, the purchaser records and submits the date of the transaction, the species sold, the volume, and the numerical code of the “area fished”. These trip ticket areas are based on sub-basins identified by the Louisiana Department of Environmental Quality. Figure 21 shows a map of these areas in and around the action area. Area 209 covers the upper Barataria Basin where the greatest impacts on brown shrimp habitat suitability are expected to occur, and area 211 covers most of the lower Barataria Basin and nearshore waters where increased sea turtle interactions resulting from the proposed project operations are most likely to occur.

As explained in greater detail in the 2021 Shrimp Opinion, the likelihood and frequency of sea turtle exposure to shrimp trawls is in large part a function of the fishing effort within an area where sea turtles are located (NMFS 2021). While a sea turtle interaction with fishing gear is a relatively random occurrence, when all other factors remain equal (location, gear type, fishing methods, etc.), we believe the amount of time that nets are in the water, or total fishing effort, is the best indicator of total sea turtle interactions resulting from the proposed project operations. Other measurable parameters, such as total pounds of catch, can vary widely based on many different factors, even with similar fishing effort levels. Therefore, the number of commercial trips conducted each year in Areas 209 and 211 is the best surrogate for sea turtle interactions resulting from the proposed action, because it is an indicator of actual fishing effort.

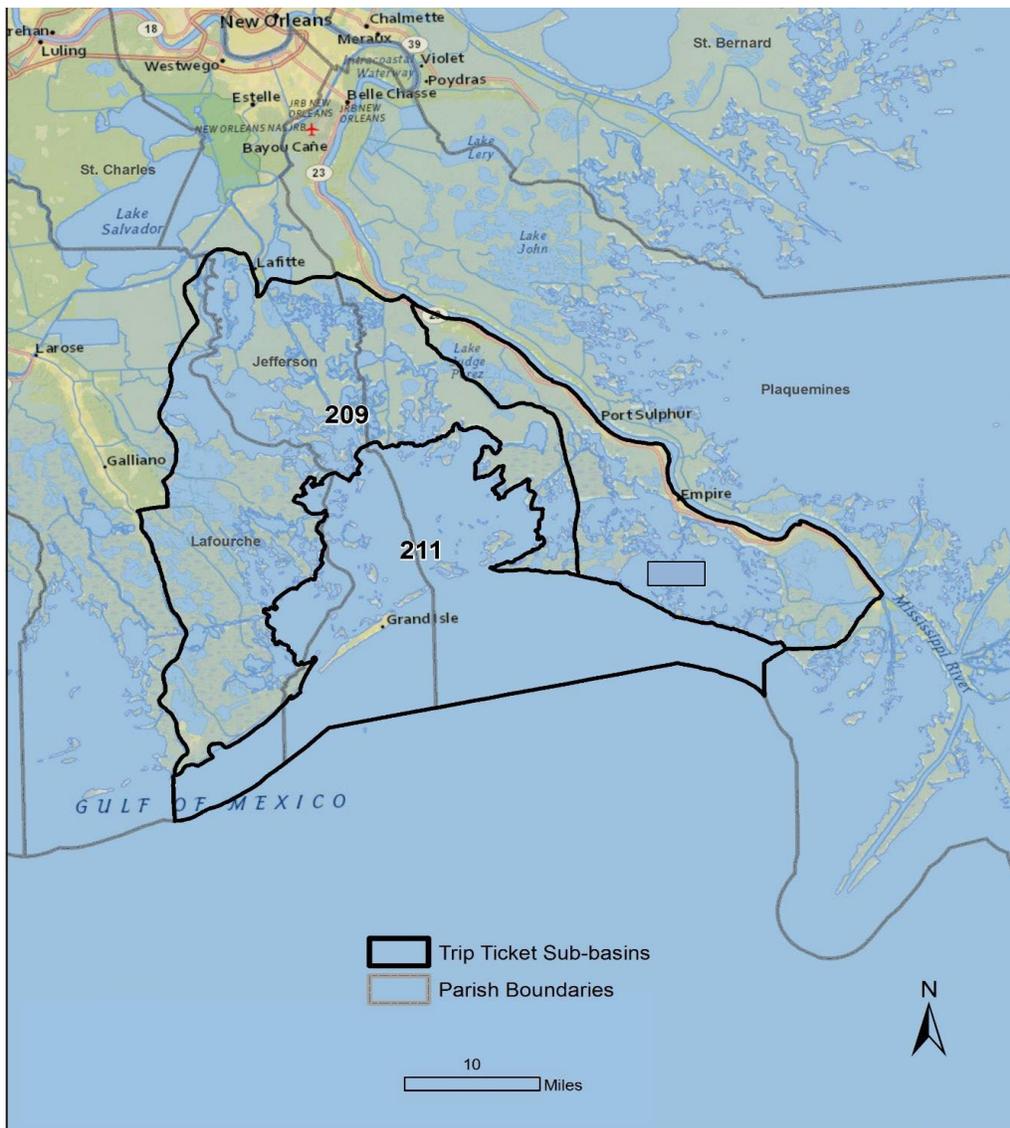


Figure 21. Map of Trip Ticket Reporting Areas Based On Sub-Basins Identified by the Louisiana Department of Environmental Quality (Figure 1 in LDWF (2020))

Table 9 below shows 10 years of brown shrimp trip ticket data from Area 209 from 2008 to 2017 (the most recent years included in the LDWF 2020 report). The average number of trips over

this 10-year period is 745 trips per year. Table 10 shows the same 10 years of brown shrimp trip ticket data from Area 211, with the average number of trips over this 10-year period being 3,385 trips per year. While there is no way to predict the exact shift in fishing effort from the upper basin (Area 209) to the lower basin (Area 211), we will assume as a worst case scenario that all of the brown shrimp fishing effort in Area 209 will shift down to Area 211. This would result in an increase in the average annual trips in Area 211 from 3,385 to 4,130 ($3,385 + 745 = 4,130$), or a 22% increase in brown shrimp fishing effort ($745 \div 3,385 * 100 = 22.0\%$). This number of trips, calculated as a 3-year running average, can be used as a surrogate for the increase in sea turtle take that may result from the proposed action's effects on commercial shrimp fishing.

Table 9. Trip Ticket Commercial Landings Statistics for Brown Shrimp from Area 209 (From Table 23 in LDWF (2020))

Year	Volume (Pounds)	Fishers (Vessels)	Trips	Pounds per Trip
2008	328,764	127	287	1,145.5
2009	106,080	71	119	891.4
2010	994,903	194	555	1,792.6
2011	1,685,146	265	968	1,740.9
2012	882,380	204	686	1,286.3
2013	1,627,610	212	1,129	1,441.6
2014	1,924,416	288	1,273	1,511.7
2015	1,496,018	241	768	1,947.9
2016	1,302,552	191	832	1,565.6
2017	1,250,692	181	836	1,496.0
10-year average	1,159,856	197	745	1,481.95

Table 10. Trip Ticket Commercial Landings Statistics for Brown Shrimp from Area 211 (From Table 7 in LDWF (2020))

Year	Volume (Pounds)	Fishers (Vessels)	Trips	Pounds per Trip
2008	7,451,989	689	3,660	2,036.1
2009	6,145,532	686	3,395	1,810.2
2010	3,155,936	506	1,689	1,868.5
2011	9,340,471	784	4,418	2,114.2
2012	6,205,050	674	4,230	1,466.9
2013	3,039,749	440	2,342	1,297.9
2014	8,227,449	822	4,997	1,646.5
2015	6,107,329	599	3,409	1,791.5
2016	4,547,955	527	2,948	1,542.7
2017	4,753,118	456	2,764	1,719.7
10-year average	5,897,458	618	3,385	1,729

Due to lack of data specific to sea turtle takes associating brown shrimp in these areas, there is no way to directly estimate the numbers of sea turtles that are likely to be taken as a result of this expected shift in fishing effort to the lower Basin. However, we can use other data that is available, namely, the take estimates from NMFS’s recent 2021 Shrimp Opinion (NMFS 2021), along with vessel numbers provided in the Final Environmental Impact Statement for NMFS’s proposed rule to reduce the incidental bycatch and mortality of sea turtles in the Southeastern U.S. Shrimp Fisheries (NMFS 2019) and the Louisiana Shrimp Fishery Management Plan (LDWF 2016). Using these data, we can derive a rough estimate of sea turtle takes that may result from the expected shift in fishing effort to the lower Basin. The total estimated 10-year incidental take (non-lethal and lethal) of Kemp’s ridley, loggerhead and green sea turtle for the Southeast U.S. shrimp fisheries is summarized in Table 11 below (NMFS 2021).

Table 11. Estimates of Total Sea Turtle Take in the Southeast U.S. Shrimp Fisheries Over the Next 10 Years (NMFS 2021)

Species	Captures	Mortalities
Kemp’s Ridley Sea Turtle	168,990	17,010
Loggerhead Sea Turtle	145,340	4,300
Green Sea Turtle ⁵	42,428	3,400
NA DPS (96%)	40,730	3,264
SA DPS (4%)	1,698	136

We start by dividing the 10-year capture and mortality numbers in Table 11 above by 10, to determine the annual take estimates. Dividing the annual take estimates by 9,000 (the approximate number of vessels in the Southeast U.S. shrimp fisheries (NMFS 2019; LDWF 2016) gives us an estimate of the annual take per vessel. We then multiply the annual take per vessel by the 197 vessels (Table 9) expected to move from the upper basin (Area 209), where sea turtles are extremely rare, to the lower basin (Area 211), where sea turtles are more prevalent, to provide an estimate of the average annual take levels expected to result from the proposed action (Table 12; fractional numbers are rounded up to the nearest whole number to be conservative towards the species). This analysis produces an average annual take estimate of 370 captures and 38 mortalities of Kemp’s ridley sea turtles; 319 captures and 10 mortalities of loggerhead sea turtles; and 93 captures and 8 mortalities of green sea turtles. Breaking down the take estimate for green sea turtles into the North Atlantic DPS and South Atlantic DPS, we estimate 90 of the captures and 8 of the mortalities will be from the NA DPS and 4 captures and 1 mortality will be from the SA DPS (Table 12).

⁵ For the green sea turtle, the capture and mortality estimates take into consideration anticipated 7.6% population growth over the next 10 years. See Table 36 in the 2021 Shrimp Opinion (NMFS 2021).

Table 12. Estimates of Annual Average Sea Turtle Takes Resulting from Fisheries Interactions Related to the Proposed Action

Species	Captures over 10 years	Mortalities over 10 years	Annual Captures	Annual Mortalities	Annual Captures per vessel	Annual Mortalities per vessel	Annual Captures from 197 Vessels	Annual Mortalities from 197 Vessels
Kemp's Ridley Sea Turtle	168,990	17,010	16,899	1,701	1.878	0.189	370	38
Loggerhead Sea Turtle	145,340	4,300	14,534	430	1.604	0.048	319	10
Green Sea Turtle	42,428	3,400	4,243	340	0.471	0.038	93	8
NA DPS (96%)	40,730	3,264	4,073	326.4	0.453	0.036	90	8
SA DPS (4%)	1,698	138	170	14	0.012	0.0015	4	1

Salinity Effects

Sea turtles obtain water by drinking salt water and use salt glands to excrete excess salts (Kooistra and Evans 1976). When sea turtles are exposed to freshwater, the rate of water consumption increases causing a reduction in plasma osmolality and electrolytes in the blood (Ortiz et al. 2000). While acute short-term exposure to freshwater (~4 days or less) does not appear to create a stress response, prolonged exposure to freshwater diminishes turtle osmoregulatory capacity (Ortiz et al. 2000). The proposed action is expected to reduce salinities throughout a large portion of the Barataria Basin, with extended periods of reductions occurring during peak Mississippi River and diversion flow, typically between December and July of each year. While sea turtles may occasionally use low salinity areas for foraging or predator refuge, we expect that they will be forced to avoid these areas during the low salinity periods in general, and may concentrate their activity in the lowest portions of the Basin, where diversion flows are expected to have less influence on salinity levels.

Due to the scarcity of information on sea turtle presence and usage of the Barataria Basin, there is no practicable method to calculate how many turtles may be harmed, or the extent to which they may be harmed, by the seasonal loss of access to the habitats that will become too fresh to be suitable for sea turtles. Therefore, we use the salinity levels themselves as a surrogate to estimate the duration and amount of habitat that will be rendered unsuitable for sea turtles, and the level of harm that loss of habitat functions may cause to those turtles.

The Delft3D project modeling provides estimates of projected salinity conditions at various locations throughout the basin, in each month of the year, under varying Mississippi River flow/ Project operational conditions. We can use stations USGS Barataria Pass at Grand Isle (USGS 73802516), USGA Barataria Bay near Grand Terre Island (USGS 291929089562600), and the USGS Barataria Bay North of Grand Isle (USGS 7380251) (Figure 22), located across the lower basin, where sea turtles are currently most prevalent, to determine the amount of time, on average, that project operations are projected to result in freshwater conditions at these stations (salinity range from 0-5 ppt). These 3 stations are situated on a generally north to south axis through the lower section of the basin (Figure 22), with the northernmost station (USGS

7380251) having more fresh water conditions, and the southernmost station (USGS73802516) having more saline conditions (Figure 22). We examined the projected salinity conditions at these 3 stations under 3 different representative historical hydrographs. The first hydrograph (2011; “wet”) represents high river flow conditions with extended spring flooding; the second hydrograph (1970; “normal”) represents more typical flows and hydrograph shape; the third hydrograph (2006; “dry”) represents low river flows with multiple spring flow fluctuations.

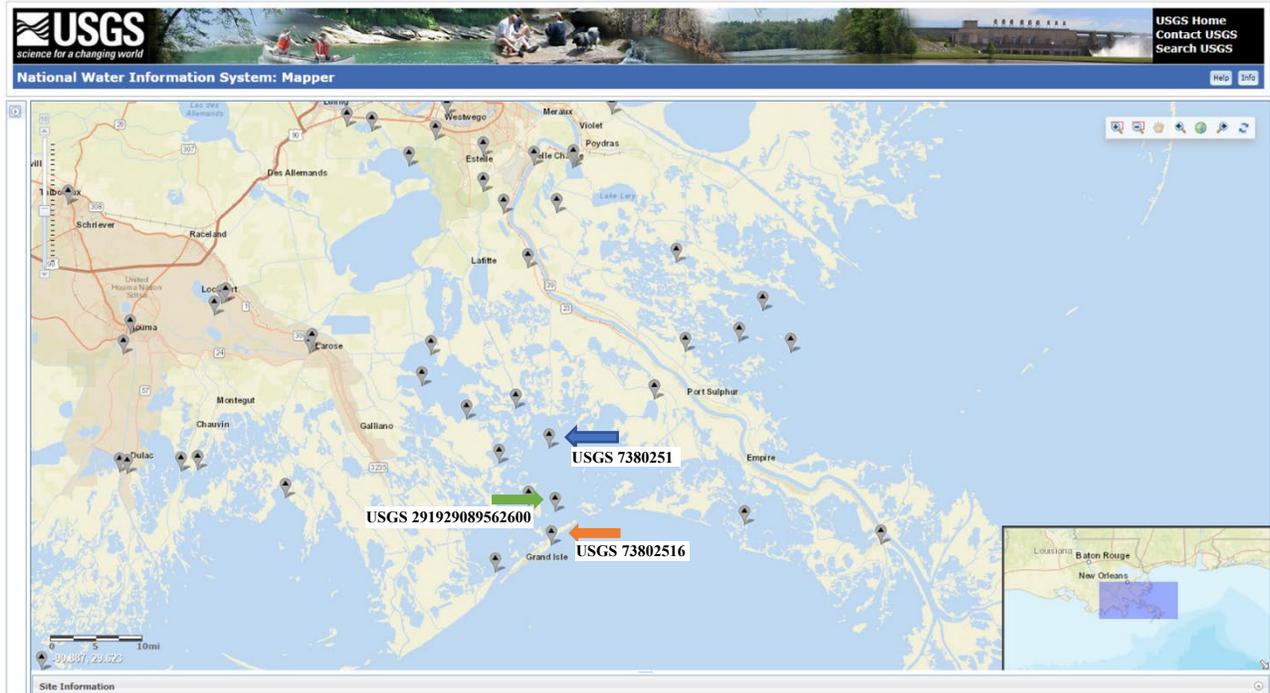


Figure 22. Location of 3 USGS Monitoring Stations Forming a North-South Transect Across Lower Barataria Bay, Used in the Analysis of Modeled Salinity Conditions (Figure 1. In Supplemental BA Materials (11/3/21))

During the cycle 0 (2020-2029), the Delft3D modeling projects that Station USGS 7380251 will experience fresh water conditions (<5 ppt) more than 330 days of the year (>90%) under all 3 representative hydrographs. This represents an average increase of 59 additional days of fresh water conditions, above what is projected under FWOP conditions, or an average 21.5% increase over FWOP, across all three hydrologic scenarios (Table 13; Figure 23).

Table 13. Station USGS 7380251 (northern), Salinity Modeling Analysis for 3 Representative Hydrographs (Figure 10. in Supplemental BA Materials (11/3/21))

Station: USGS 7380251								
Season		FWP 2006 (Dry)	FWP 1970 (normal)	FWP 2011 (wet)		FWOP 2006 (Dry)	FWOP 1970 (normal)	FWOP 2011 (wet)
Winter	Days below 5 ppt	79	81	70		55	58	55
	% below 5 ppt	90.8%	93.1%	80.5%		63.2%	66.7%	63.2%
Spring	Days below 5 ppt	90	91	91		83	80	79
	% below 5 ppt	98.9%	100%	100%		91.2%	87.9%	86.8%
Summer	Days below 5 ppt	87	85	90		82	84	88
	% below 5 ppt	94.6%	92.4%	97.8%		89.1%	91.3%	95.7%
Fall	Days below 5 ppt	76	77	80		56	53	48
	% below 5 ppt	82.6%	83.7%	87.0%		60.9%	57.6%	52.2%
Annual	Total Days	332	334	331		276	275	270
Annual	Percent of Year	91.0%	91.5%	90.7%		75.6%	75.3%	74.0%
	Days above FWOP	56	59	61				
	% increase above FWOP	20.3%	21.5%	22.6%				

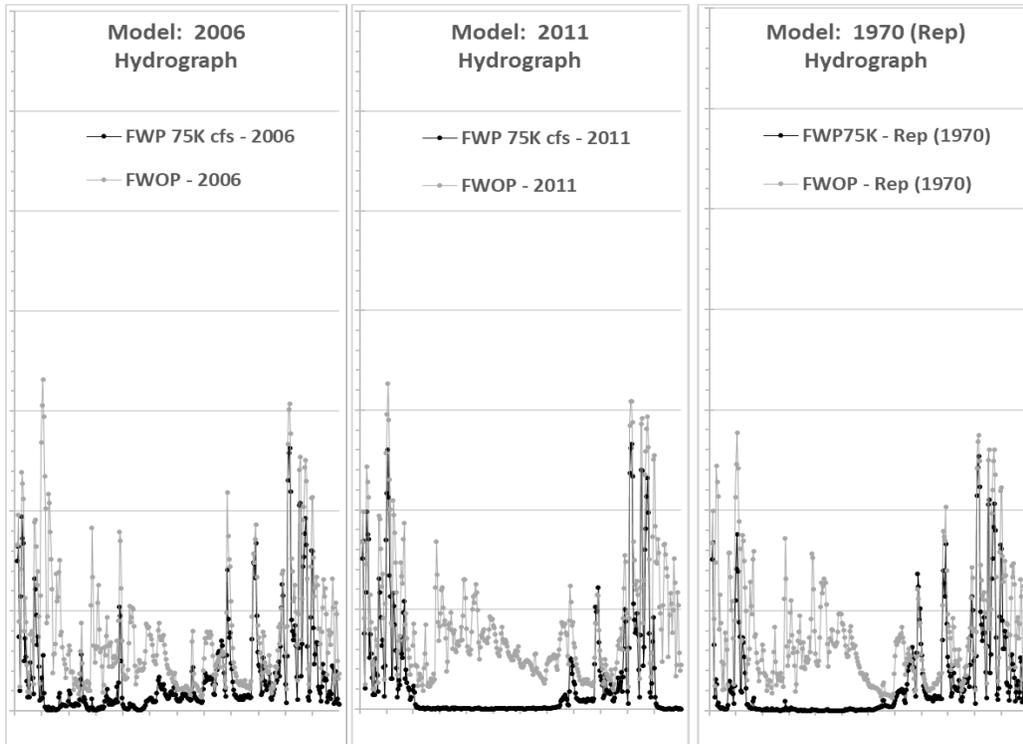


Figure 23. Station USGS 7380251 (northern), Modeled Salinity Profiles for 3 Representative Hydrographs (Figure 7. in Supplemental BA Materials (11/3/21))

For Station USGS 291929089562600, the with-project modeling projects 48 days of fresh water conditions under the dry conditions scenario (2006 hydrograph). This is compared to a projected 0 days of fresh water conditions at this station under the FWOP. Under the normal hydrology scenario (1970 hydrograph), the with-project modeling projects 167 days of fresh water conditions at this station. This is compared to 22 days under the FWOP, or a 659% increase in fresh water conditions. Under the wet hydrology scenario (2011 hydrograph), the with-project modeling projects 121 days of fresh water conditions at this station. This is compared to 7 days under the FWOP, or a 1,729% increase in fresh water conditions (Table 14; Figure 24).

Table 14. Station USGS 291929089562600 (central), Salinity Modeling Analysis for 3 Representative Hydrographs (Figure 11. in Supplemental BA Materials (11/3/21))

Station: USGS 291929089562600								
Season		FWP 2006 (Dry)	FWP 1970 (normal)	FWP 2011 (wet)		FWOP 2006 (Dry)	FWOP 1970 (normal)	FWOP 2011 (wet)
Winter	Days below 5 ppt	12	35	25		0	0	0
	% below 5 ppt	13.8%	40.2%	28.7%		0.0%	0.0%	0
Spring	Days below 5 ppt	36	89	91		0	7	21
	% below 5 ppt	39.6%	97.8%	100%		0.0%	7.7%	23.1%
Summer	Days below 5 ppt	0	4	30		0	0	1
	% below 5 ppt	0.0%	4.3%	32.6%		0.0%	0.0%	1.1%
Fall	Days below 5 ppt	0	0	21		0	0	0
	% below 5 ppt	0.0%	0.0%	22.8%		0.0%	0.0%	0.0%
Annual	Total Days	48	128	167		0	7	22
Annual	Percent of Year	13.2%	35.1%	45.8%		0%	1.9%	6.0%
	Days above FWOP	48	121	145				
	% increase above FWOP	NA	1,728.6%	659.1%				

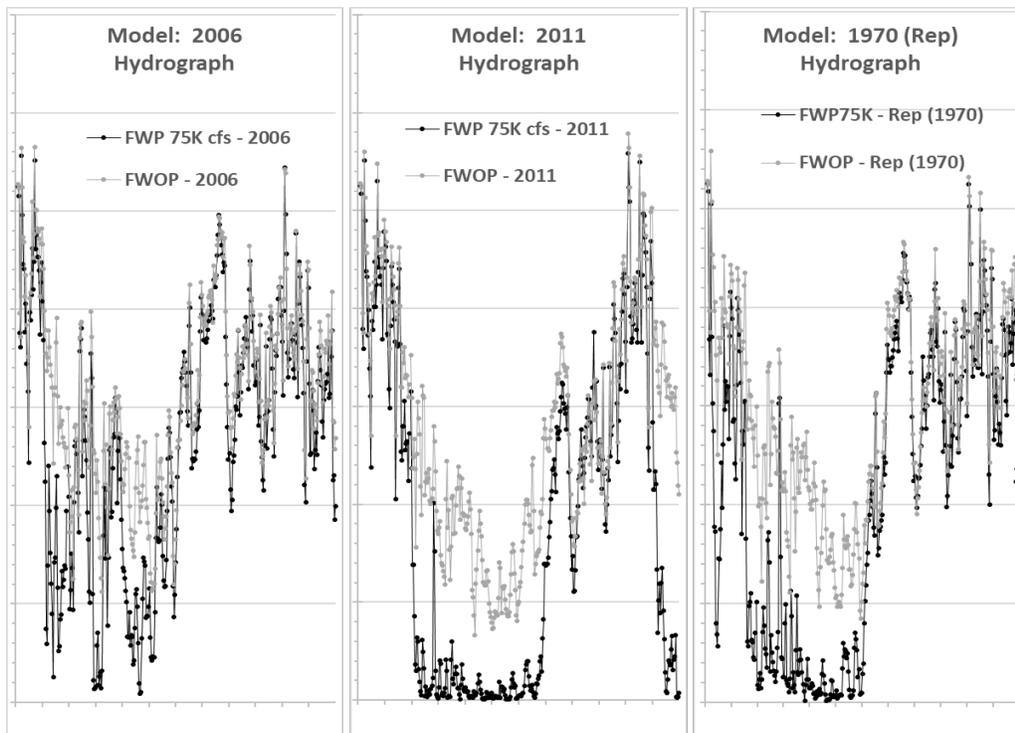


Figure 24. Station USGS 291929089562600 (central), Modeled Salinity Profiles for 3 Representative Hydrographs (Figure 8 in Supplemental BA Materials (11/3/21))

For Station USGS 73802516, the with-project modeling projects 9 days of fresh water conditions under the dry conditions scenario. This is compared to a projected 0 days of fresh water conditions at this station under the FWOP. Under the normal hydrology scenario, the with-project modeling projects 104 days of fresh water conditions at this station. This is compared to 6 days under the FWOP, or a 1,633% increase in fresh water conditions. Under the wet hydrology scenario, the with-project modeling projects 52 days of fresh water conditions at this station. This is compared to a projected 0 days of fresh water conditions at this station under the FWOP (Table 15; Figure 25).

Table 15. Station USGS 73802516, (southern), Salinity Modeling Analysis for 3 Representative Hydrographs (Figure 12. in Supplemental BA Materials (11/3/21))

Station: USGS 73802516								
Season		FWP 2006 (Dry)	FWP 1970 (normal)	FWP 2011 (wet)		FWOP 2006 (Dry)	FWOP 1970 (normal)	FWOP 2011 (wet)
Winter	Days below 5 ppt	2	4	11		0	0	0
	% below 5 ppt	2.3%	4.6%	12.6%		0	0	0
Spring	Days below 5 ppt	7	47	76		0	0	6
	% below 5 ppt	7.7%	51.6%	83.5%		0	0	6.6%
Summer	Days below 5 ppt	0	1	13		0	0	0
	% below 5 ppt	0.0%	1.1%	14.1%		0	0	0
Fall	Days below 5 ppt	0	0	4		0	0	0
	% below 5 ppt	0.0%	0.0%	4.3%		0	0	0
Annual	Total Days	9	52	104		0	0	6
Annual	Percent of Year	2.5%	14.3%	28.5%		0	0	1.6%
	Days above FWOP	9	52	98				
	% increase above FWOP	NA	NA	1,633%				

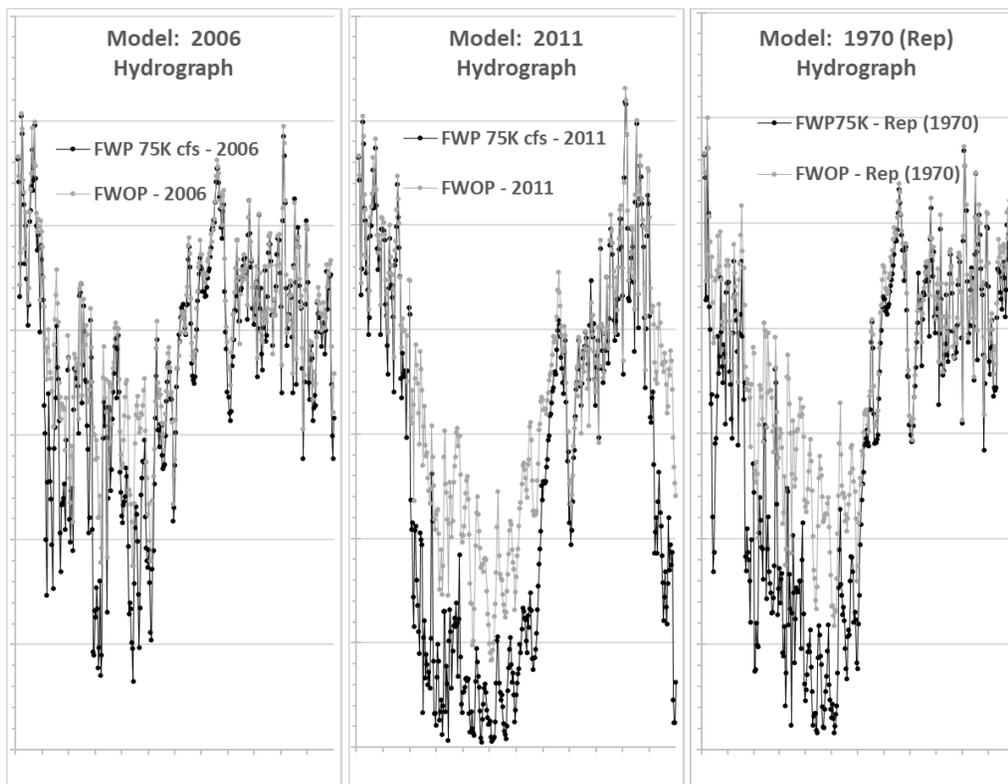


Figure 25. Station USGS 73802516 (southern), Modeled Salinity Profiles for 3 Representative Hydrographs (Figure 9. in Supplemental BA Materials (11/3/21))

These modeled low-salinity time periods can be considered as a general estimate of the magnitude of project effects, indicating the projected level of harm to sea turtles, due to loss of habitat function and seasonal distribution expected to be caused by the proposed action. However, no two water years are ever exactly alike, and modeled projections will very rarely match actual conditions on the ground. In addition, these modeled projections cannot account for localized rainfall patterns, wind patterns, and other factors that may influence salinity conditions in real time at these locations. Due to these inherent discrepancies between modeled projections and actual measured conditions, it will take a sophisticated monitoring and data analysis plan design to determine if seasonal salinity conditions under actual project operations are within the expected range projected by the model, and analyzed in this Opinion.

Such a monitoring plan (described further in the Terms and Conditions section below) will be jointly developed in coordination between NMFS (SERO and SEFSC) and CPRA. Once the monitoring plan design has been fully developed, it will be integrated into the existing Monitoring and Adaptive Management Plan for the Proposed Project.

5.4 Summary

One of the primary effects of the proposed action on sea turtles will be the loss of suitable habitat conditions throughout a significant proportion of the Baratavia Basin as a result of reduced salinity and other factors (turbidity, vegetation, water temperature, etc.) that may adversely affect the prey species and other habitat features that sea turtles depend on within the Basin. The other

potential source of adverse effects is the likely concentration of commercial shrimp fishing activities and sea turtles in the lower Basin, and just outside of the barrier islands, which could result in an increase in adverse interactions between sea turtles and shrimp fishing gear. Based on the best available information (presented above), we do not have the specific details necessary to allow a quantitative estimate of the numbers of each species of sea turtle that may be adversely affected by the proposed action. We will therefore present a qualitative analysis of the expected level of effects to these species, based on surrogates related to the factors that would cause those effects, which can be measured and monitored before and during project operations. This analysis is presented in the Integration and Synthesis of Effects section below.

6 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the action area. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA and 50 CFR 402.14. Actions that are reasonably certain to occur include actions that have some demonstrable commitment to their implementation, such as funding, contracts, agreements or plans.

Cumulative effects from non-federal actions reasonably certain to occur within the action area may affect sea turtles. Stranding data indicate sea turtles in the action area are impacted by various natural causes, including cold stunning and hurricanes, as well as human activities, such as incidental capture in state fisheries, ingestion of and/or entanglement in debris, vessel strikes, and degradation of habitat through industrial development (oil and gas, and other industry) within the Basin.

These cumulative effects are expected to continue at current levels into the foreseeable future, concurrent with the proposed action. The past and present impacts of these activities have been discussed in Sections 3 and 4 (Status of Species and Environmental Baseline) of this Opinion. We are not aware of any proposed or anticipated changes in these activities that would substantially change the impacts they have on sea turtles covered by this Opinion.

As discussed in Section 3 and, more specifically, Section 4.4, we expect climate change will continue to affect sea turtles and their habitats, in a variety of ways. These changes, however, are difficult to precisely predict and are expected to develop slowly over a long period (i.e., multiple decades or longer). We have used a 50-year time frame for the proposed action in this Opinion because that the duration of the project operations plan. We are not aware of any other information about non-federal actions within the action area beyond what has been described in Sections 3 and 4 of this Opinion, most of which we expect will continue into the future. The amount and intensity of commercial shrimp fishing within the action area has been steadily declining over the past 20 years, and continued declines are considered reasonably certain to occur (partially due to the effects of the proposed action) (USACE 2021). Other impacts, such as those associated with climate change, pollution, aquaculture, vessel strikes, and anthropogenic noise are likely to continue to increase in the future, although any increase in effect may be somewhat countered by an increase in conservation and management activities. We will continue to work with states to develop ESA Section 6 agreements and with researchers on Section 10

permits to enhance programs to quantify and mitigate these effects. Therefore, we expect that the overall level of impacts on sea turtles from these factors will continue at relatively similar levels into the foreseeable future, and therefore, are reflected in the anticipated trends described in Sections 3 and 4.

7 INTEGRATION AND SYNTHESIS OF EFFECTS

The analyses conducted in the previous sections of this Opinion provide the basis on which we determine whether the proposed action is likely to jeopardize the continued existence of Kemp's ridley, green (NA and SA DPSs), and loggerhead (NWA DPS) sea turtles. In Section 5, we outlined how the proposed action is likely to adversely affect these species to the extent possible, with the best available data. Now we assess each of these species' response to the effects of the proposed action in terms of overall population effects, and whether those effects are likely to jeopardize their continued existence in the wild, in the context of the Status of the Species (Section 3), the Environmental Baseline (Section 4), and the Cumulative Effects (Section 6). In Section 3 (Status of Species), we present the status of the species, outline threats, and discuss information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In Section 4 (Environmental Baseline), we outline 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 these species. Section 6 (Cumulative Effects) discusses the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area. These effects are in addition to the other ongoing effects to the species, such as bycatch in other fisheries, effects from other federal actions, and the potential effects of climate change, all of which are discussed in detail in the preceding sections of this biological opinion. All of these previously discussed effects are part of the baseline upon which this analysis is based, and the associated population level implications for the species are reflected in the species current population trends.

It is the responsibility of the action agency to “insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species...” (ESA Section 7(a)(2)). Action agencies must consult with and seek assistance from the NMFS to meet this responsibility. NMFS must ultimately determine in a Biological Opinion whether the action jeopardizes listed species. To “jeopardize the continued existence of” means “to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species” (50 CFR 402.02). Thus, in making this determination for each species, we must look at whether the proposed action directly or indirectly reduces the reproduction, numbers, or distribution of a listed species. Then, if there is a reduction in one or more of these elements, we evaluate whether any such reduction is expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species in the wild.

The ESA Section 7 Consultation Handbook (USFWS and NMFS 1998) defines survival and recovery, as they apply to the ESA's jeopardy standard. Survival means “the species' persistence...beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment.” Survival is the condition in which a species continues to

exist into the future while retaining the potential for recovery. This condition is characterized by a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. The Consultation Handbook defines recovery as "improvement in the status of a listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities. Therefore, we also evaluate in the context of the recovery plans for each species.

Recovery plans include criteria, which, when met, would result downlisting the species from endangered to threatened or delisting the species from the List of Endangered and Threatened Wildlife. Recovery criteria can be viewed as targets, or values, by which progress toward achievement of recovery objectives can be measured. Recovery criteria may include such things as population numbers and sizes, management or elimination of threats by specific mechanisms, and specific habitat conditions. We evaluate each species in the context of the criteria and objectives in its recovery plan.

As previously stated, we do not expect any individual sea turtle to spent its entire life, or even an entire year within the action area. Additionally, there is no practical method to reasonably estimate how many turtles might be present within the action area and exposed to the effects of the proposed action at any one time or throughout the year.

The status of each listed species or DPS likely to be adversely affected by the proposed action is reviewed in Section 3. For any species listed globally, our jeopardy determination must find the proposed action will appreciably reduce the likelihood of survival and recovery at the global species range. For any species listed as DPSs, a jeopardy determination must find the proposed action will appreciably reduce the likelihood of survival and recovery of that DPS. Below, we re-evaluate the responses of Kemp's ridley, green (NA and SA DPSs), and loggerhead (NWA DPS) sea turtles to the effects of the action.

7.1 Kemp's Ridley Sea Turtle

Kemp's ridley sea turtles are likely to experience the greatest adverse effects from the proposed action, as their primary range is within the Gulf of Mexico, and they are the most common sea turtle in stranding records within and near the Barataria Basin, representing at least 47 of the 55 sea turtles observed between 1998 and 2019 (NOAA 2019). Coleman et al. (2016) monitored movements of juvenile Kemp's ridley sea turtles and identified the lower portion of the Barataria Basin including most of Barataria Bay as "core use habitats" for this species. While Mississippi Sound on the east side of the Mississippi River delta appears to be the primary wintering area for juvenile Kemp's ridley sea turtles, they were observed to move into the Barataria Basin in the spring (March-May) and appear to forage in the Mississippi River delta and offshore of the barrier islands throughout the year (Coleman et al. 2016).

As discussed in Section 5, the proposed action is expected to cause a reduction in the total number of Kemp's ridley sea turtles and the area of suitable habitat available to the species, as compared to those that would have been present in the absence of the proposed action, assuming all other variables remained the same. The proposed action is expected to result in an increase in fishing effort in one small area (lower Barataria Basin) covered by the Southeast U.S. shrimp fishery, which may be offset by reductions in effort throughout the basin due to project impacts to brown shrimp. Our best estimate reflected in Table 12 is that the proposed action is likely to result in 370 captures, including 38 mortalities of Kemp's ridley sea turtles per year resulting from interactions with shrimp fishing gear. In addition, the seasonal conversion of saline and brackish habitat to fresh and intermediate habitat will likely result in seasonal impacts to foraging and sheltering behavior, and seasonal reductions in the distribution of the species.

7.1.1 Survival

Whether the reductions in numbers that are likely to result from increased fisheries interactions and habitat loss, and the reduction in distribution (due to the seasonal fluctuations in salinity levels within the Basin) will appreciably reduce Kemp's ridleys likelihood of survival depends on the effect these reductions in numbers and distribution will have relative to current population sizes and trends.

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with other sea turtles species, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. Nevertheless, the nesting data provides valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid, and represents the best proxy for estimating population changes.

Following a significant, unexplained 1-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database, unpublished data). In 2013 and 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 nests, and in 2016 overall numbers increased to 18,354 recorded nests. There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm. to NMFS SERO PRD, August 31, 2017 as cited in NMFS 2020b) and decreases observed in 2018 and again in 2019. In 2019, there were 11,140 documented nests in Mexico. It is unknown whether this decline is related to resource fluctuation, natural population variability, effects of catastrophic events like the DWH oil spill event affecting the nesting cohort, or some other factor(s). A small nesting population is also emerging in the United States, primarily in Texas. From 1980-1989, there were an average of 0.2 nests/year at the Padre Island National Seashore, rising to 3.4 nests/year from 1990-1999, 44 nests/year from 2000-2009, and 110 nests per year from 2010-2019. There was a record high of 353 nests in 2017 (NPS 2020). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017 (NMFS 2020b) and decreases in nesting in 2018 and 2019 (NPS 2020). Nesting has also been documented in Alabama, Florida, Georgia, the Carolinas, and Virginia (USFWS 2017). There are no records of Kemp's ridley sea turtles nesting within the proposed action area. The closest recorded nesting beaches are found over 200 kilometers away in Alabama and Texas.

Additionally, genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). Additional analysis of the mitochondrial DNA (mtDNA) taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (NMFS and USFWS 2015; TEWG 2000). Galloway et al. (2016) developed a stock assessment model for Kemp's ridley to evaluate the relative contributions of conservation efforts and other factors toward this species' recovery. Population estimates for 2012 suggest that the population size of females ages 2+ was 152,357 (Standard Deviation = 25,015).

The nonlethal capture of 332 Kemp's ridley sea turtles per year (370 captures - 38 mortalities) over the next 50 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. Nonlethal captures will not result in a reduction in numbers of the species, as we anticipate these nonlethal captures to fully recover such that no reductions in reproduction or numbers of this species are anticipated.

Based on the population estimates of Kemp's ridleys 2+ years of age from Galloway et al. (2016), the mortality of 38 Kemp's ridleys sea turtles per year over the next 50 years is a relatively small reduction in the overall numbers for this species. The loss of 38 individuals would equal approximately 0.025% of the population per year ($38 \div 152,357 \times 100 = 0.025\%$). Moreover, the average size of captured Kemp's ridleys documented by fishery observers in the shrimp fisheries reveals that a significant portion of these turtles are small, sexually-immature juvenile sea turtles, many of which would not have survived to reach maturity and reproduce even without the lethal capture.

The proposed action could also result in a potential reduction in future reproduction, assuming at least some of these individuals would be female and would have otherwise survived to reproduce in the future. The annual loss of adult females could preclude the production of thousands of eggs and hatchlings, of which a small percentage would be expected to survive to sexual maturity. Thus, the death of any females that would otherwise have survived to sexual maturity will eliminate their contribution to future generations, and result in a reduction in Kemp's ridley sea turtle reproduction.

Regarding the seasonal reduction in the distribution of the species resulting from the seasonal conversion of saline and brackish habitat, the area affected is considered a core use habitat area for the species, but it is a relatively small area when compared to the thousands of miles of near-shore coastal habitat available throughout the species range. The conversion of saline to fresh habitat is also expected to be somewhat offset by an increase in saline conditions around the Birdfoot Delta of the Mississippi River, caused by the proposed action. It is also likely that the long-term effects of climate change and sea level rise will result in saline intrusion and erosion of the coastal freshwater and intermediate marsh habitat throughout the northern Gulf, creating large areas with habitat conditions similar to those currently found in Barataria Bay. In addition, the species' limited range and low global abundance makes it particularly vulnerable to new

sources of mortality as well as demographic and environmental stochasticity, which are often difficult to predict with any certainty.

It is likely that the Kemp's ridley was the sea turtle species most affected by the DWH oil spill event on a population level. In addition, sea turtle strandings documented from 2010 to present in Alabama, Louisiana, and Mississippi primarily involved Kemp's ridley sea turtles. Necropsy results indicated that a significant proportion of Kemp's ridley sea turtle mortality was caused by forced submergence, which is commonly associated with fishery interactions (77 FR 27413, May 10, 2012). As described in Section 4 (Environmental Baseline), regulatory actions have been taken to reduce anthropogenic effects to Kemp's ridley sea turtles. These include measures implemented to reduce the number and severity of Kemp's ridley sea turtle interactions in the South Atlantic U.S. shrimp, Mid-Atlantic large mesh gillnet, Mid-Atlantic summer flounder, Mid-Atlantic scallop dredge, and the Virginia pound net fisheries. In 2021, TED requirements in a portion of the skimmer trawl sector of the shrimp fisheries became effective, further reducing impacts to sea turtles.

It is likely that the greatest new source of mortality for Kemp's ridley sea turtles will be the highly uncertain potential future impacts associated with climate change. As mentioned in previous sections, some of the likely effects commonly associated with climate change are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The potential effects, and the expected related effects to ESA-listed species (e.g., impacts to sea turtle nesting beaches, hatchling sex ratios, estuarine habitats and prey species, etc.) stemming from climate change are the result of a slow and steady shift over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. As previously discussed, we have elected to view the effects of climate change on affected species over a more manageable and predictable 10-year time period due to this reality. Within this 10-year time period, we do not expect the effects of climate change will present a risk to the Kemp's ridley sea turtle population. Furthermore, the 370 captures, including 38 mortalities of Kemp's ridley sea turtles per year resulting from interactions with shrimp fishing gear, along with the seasonal reduction in suitable saline habitat resulting in impacts to foraging and sheltering behavior, and seasonal reductions in the distribution of the species are not likely to appreciably reduce overall population numbers over time due to current population size, expected recruitment, and the implementation of additional conservation actions and requirements in the shrimp trawl fisheries.

It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population increase in Kemp's ridleys. With the recent nesting data, the population trend has become less clear. Nonetheless, data from 1990 to present continue to support that Kemp's ridley sea turtles have shown a generally increasing nesting trend. Even with reported biennial fluctuations in nesting numbers from Mexican beaches, all years since 2006 have reported over 10,000 nests per year, indicating an increasing population over the previous decades. We believe this long-term trend in nesting is likely evidence of a generally increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. These nesting data are indicative of a species with a high number of sexually mature individuals. All of those positive population trends have occurred while the shrimp fisheries have

been operating and adversely affecting the species along with all the other adverse effects included in the baseline.

Based on the foregoing, we conclude that the loss of 38 Kemp's ridleys per year over the next 50 years, along with a potential reduction in the seasonal distribution of the species is not expected to change the trend in nesting or the reproduction of Kemp's ridley sea turtles. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of this species in the wild.

7.1.2 Recovery

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

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

With respect to the demographic recovery objective, the nesting numbers in the most recent three years for which we have complete data indicate there were 24,570 nests in 2017, 17,945 in 2018, and 11,090 in 2019 on the main nesting beaches in Mexico. Based on 2.5 clutches/female/season, these numbers represent approximately 9,828 (2017), 7,178 (2018), and 4,436 (2019) nesting females in each season. The number of nests reported annually from 2010 to 2014 declined overall; however, they rebounded in 2015 through 2017, and declined again in 2018 and 2019. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of nesting females is still below the number of 10,000 nesting females per season required for downlisting (NMFS and USFWS 2015). Since we concluded that the potential loss of up to 38 Kemp's ridley sea turtles per year is not likely to have any detectable effect on nesting trends, we do not believe the proposed action will impede progress toward achieving this recovery objective. The anticipated 332 nonlethal captures of these sea turtles per year would not affect the adult female nesting population or number of nests per nesting season.

In regards to the listing factor recovery criterion, the recovery plan states, "the highest priority needs for Kemp's ridley recovery are to maintain and strengthen the conservation efforts that have proven successful. . . . In the water, successful conservation efforts include maintaining the use of [TEDs] in fisheries currently required to use them, expanding TED-use to all trawl fisheries of concern, and reducing mortality in gillnet fisheries. Adequate enforcement in both the terrestrial and marine environment is also noted as essential to meeting recovery goals" (NMFS et al. 2011).

As discussed above in Section 4, we have recently expanded the TED requirements in the skimmer trawl sector of the shrimp fisheries, which should aid in the recovery of the species.

Kemp's ridleys mature and nest at an age of 7-15 years, which is earlier than other sea turtles. A younger age at maturity may be a factor in the response of this species to recovery actions and other improved conditions. The use of TEDs in shrimp trawls in the United States required by the sea turtle conservation regulations and in Mexican waters required by Mexican government regulations has had a dramatic effect on the recovery of Kemp's ridley sea turtles. There has also been a decrease in the amount of overall shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and USFWS 2015). As a result, Kemp's ridley sea turtles total mortality (all sources) declined by about one-third with the early implementation of TEDs, and it has been estimated that after 1996 mortality declined by almost 60% compared to pre-TED levels.

Because the primary cause of Kemp's ridley sea turtle mortalities resulting from the proposed action is from interactions with shrimp fishing gear, we believe these regulations will also help to minimize such mortalities. Based on this information, and the population numbers and trends discussed above, we conclude the proposed action is not likely to cause an appreciable reduction in the likelihood of the recovery of Kemp's ridley sea turtles in the wild.

In summary, in light of the long term nesting trend, the overall population size, and ongoing and future conservation measures (e.g., expanded TED regulations in the shrimp trawl fishery) that have proven successful in reducing the number of Kemp's ridley sea turtles injured or killed, we conclude that the loss of up to an additional 38 Kemp's ridley sea turtles per year, along with the expected seasonal reduction in habitat function caused by salinity effects of the proposed action are not likely to appreciably reduce the likelihood of survival and recovery for Kemp's ridley sea turtles, even with other ongoing threats to the species, including bycatch mortality from other fisheries, other federal actions (i.e., anticipated take issued in other Opinions), and/or the potential effects of climate change that are likely to continue.

7.2 Green Sea Turtle

As noted in Section 3, information suggests that the vast majority of the anticipated green sea turtles in the Gulf of Mexico and South Atlantic regions are likely to come from the North Atlantic DPS. However, it is possible that animals from the South Atlantic DPS could be affected by the proposed action. Based on Foley et al. (2007), we anticipate 96% of green sea turtles within the action area affected by the proposed action will consist of individuals from the NA DPS and 4% of the green sea turtles affected by the proposed action will be from the SA DPS. We provide separate jeopardy analyses for each DPS below based on this DPS percentage split.

7.2.1 Green Sea Turtle NA DPS

Green sea turtles are considered rare in the action area, with no documented captures and only 3 documented strandings in the area, along with some anecdotal sightings by research scientists in the lower Basin near the barrier islands (K. Hart USGS research scientist, personal communication 2019). As a result, we do not anticipate the seasonal conversion of saline and brackish habitat within Barataria Bay to fresh and intermediate habitat to result in a seasonal reduction in the distribution of green sea turtles from either the NA DPS or the SA DPS.

Based on our analysis in Section 5 (Table 12), we estimate that the proposed action will result in a total of 93 captures that will result in up to 8 mortalities of green sea turtles per year. We assume 96% of the green sea turtles involved in these captures will be from the NA DPS. Thus, our best estimate is that the proposed action is likely to result in 90 captures ($93 \times .96 = 89.3$), resulting in 8 mortalities ($8 \times 0.96 = 7.7$) of green sea turtles from the NA DPS per year. We round partial numbers up to the nearest whole number to be conservative towards the species.

7.2.1.1 Survival

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. The nonlethal capture of 82 green sea turtles from the NA DPS per year (90 captures - 8 mortalities) is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. Nonlethal captures will not result in a reduction in numbers of the species, as we anticipate these nonlethal captures to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since this species has only been documented along the outer edges of the action area, where salinity impacts are expected to be minimal, we anticipate no change in the distribution of NA DPS green sea turtles resulting from the seasonal conversion of saline and brackish habitat. Furthermore, the mortality of 8 green sea turtles from the NA DPS per year over the next 50 years is a small reduction in the overall numbers for this DPS. These mortalities could result in a potential reduction in future reproduction, assuming some individuals would be female and would have otherwise survived to reproduce in the future. For example, an adult green sea turtle can lay 3-4 clutches of eggs every 2-4 years, with approximately 110-115 eggs/nest, of which a small percentage would be expected to survive to sexual maturity.

Seminoff et al. (2015) estimate that there are greater than 167,000 nesting green sea turtle females in the NA DPS. The nesting at Tortuguero, Costa Rica, accounts for approximately 79% of that estimate (approximately 131,000 nesters), with Quintana Roo, Mexico (approximately 18,250 nesters; 11%), and Florida, U.S. (approximately 8,400 nesters; 5%), also accounting for a large portion of the overall nesting (Seminoff et al. 2015). At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2010 increased, despite substantial human impacts to the population at the nesting beach and at foraging areas (Campbell and Lagueux 2005; Troëng and Rankin 2005). Nesting locations in Mexico along the Yucatan Peninsula also indicate the number of nests laid each year has deposited, but by 2000 this increased to over 1,500 nests/year (NMFS and USFWS 2007a). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, *El Centro De Investigaciones De Quintana Roo*, unpublished data, 2013, in Seminoff et al. 2015). In Florida, most nesting occurs along the eastern central Atlantic coast, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, FWC, pers. comm., 2013). As described in Section 3 of this Opinion, nesting has increased substantially over the last 20 years and peaked in 2017 with 53,102 nests statewide in Florida, though the number of nests dropped again in 2018 as part of the regular biennial fluctuation.

Although the anticipated 8 annual mortalities would result in an instantaneous reduction in absolute population numbers, the U.S. populations of green sea turtles from the NA DPS would not be appreciably affected. For a population to remain stable, sea turtles must replace

themselves through successful reproduction at least once over the course of their reproductive lives, and at least one offspring must survive to reproduce itself. If the hatchling survival rate to maturity is greater than the mortality rate of the population, the loss of breeding individuals would be exceeded through recruitment of new breeding individuals. Since the abundance trend information for green sea turtles is clearly increasing while mortalities have been occurring, we believe the mortalities attributed to the proposed action will not have any measurable effect on that trend. In addition, 8 green sea turtles per year represents a very small fraction (~0.005% annually) of the overall NA DPS female nesting population estimated by Seminoff et al. (2015). As described in Section 4, although the DWH oil spill event is expected to have resulted in adverse impacts to green sea turtles, there is no information to indicate, or basis to believe, that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected mortalities from the proposed action would result in a detectable change in the population status of green sea turtles in the North Atlantic. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action could be seen as reducing the likelihood of survival and recovery of the species.

As mentioned in previous sections, some of the likely effects commonly associated with climate change are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The potential effects, and the expected related effects to ESA-listed species (e.g., impacts to sea turtle nesting beaches and hatchling sex ratios, associated effects to prey species, etc.) stemming from climate change are the result of a slow and steady shift over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. As previously discussed, we have elected to view the effects of climate change on affected species over a more manageable and predictable 10-year time period due to this reality. Within this 10-year time period, we do not expect the effects of climate change will present a risk to the NA DPS green sea turtle population.

In summary, green sea turtle nesting at the primary nesting beaches within the range of the NA DPS has been increasing over the past 2 decades, against the background of the past and ongoing human and natural factors (i.e., the environmental baseline) that have contributed to the current status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for NA DPS green sea turtles is increasing, we believe 82 nonlethal captures and 8 mortalities of NA DPS green sea turtles per year, along with the expected seasonal reductions in habitat function caused by salinity effects considered by this Opinion, will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle NA DPS in the wild.

As described in Section 4 (Environmental Baseline), regulatory actions have been taken to reduce anthropogenic effects to green sea turtles in the Gulf of Mexico. These include measures to reduce the number and severity of green sea turtle interactions in fisheries, such as the Southeast U.S. shrimp, Mid-Atlantic large mesh gillnet, Mid-Atlantic sea scallop dredge, summer flounder trawl, and the Virginia pound net fisheries—all of which are causes of green

sea turtle mortality. Since most of these regulatory measures have been in place for several years now, it is likely that current nesting trends reflect the benefit of these measures to North Atlantic green sea turtles. Therefore, the current nesting trends for green sea turtles in the North Atlantic are likely to continue to improve as a result of the regulatory actions taken for these and other fisheries.

Based on the foregoing, we conclude the loss of 8 green sea turtles per year over the next 50 years, along with the expected seasonal reductions in habitat function caused by salinity effects of the proposed action, even with other ongoing threats to the species including bycatch mortality from other fisheries, other federal actions (i.e., anticipated take issued in other Opinions), and/or and the potential effects of climate change, will not appreciably reduce the likelihood of survival for the NA DPS of green sea turtles. This conclusion is based on the above findings where we demonstrated the estimated mortalities and habitat impacts are not expected to measurably affect the increasing nesting trend in Florida, that the population size is relatively large, and that we have implemented other conservation measures to reduce the number of green sea turtle mortalities, which should result in increases to the numbers of NA DPS green sea turtles that would otherwise not have occurred in the absence of those regulatory measures.

7.2.1.2 Recovery

The NA DPS of green sea turtles does not have a separate recovery plan at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991) does exist. Since the animals within the NA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the NA DPS, is developed. The Atlantic Recovery Plan lists the following recovery objectives, which are relevant to the proposed action in this Opinion, and must be met over a period of 25 continuous years:

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

Along the Atlantic coast of eastern central Florida, a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, FWC, pers. comm., 2013, as cited in Seminoff et al. 2015). Nesting has increased substantially over the last 20 years and peaked in 2011 with 15,352 nests statewide (Chaloupka et al. 2007; B. Witherington, FWC, pers. comm., 2013 as cited in Seminoff et al. 2015). The status review estimated total nester abundance for Florida at 8,426 turtles (Seminoff et al. 2015). As described above, sea turtle nesting in Florida is increasing. For the most recent 6-year period of statewide nesting beach survey data, there were 5,895 nests in 2014, 37,341 in 2015, 5,393 in 2016, 53,102 in 2017, 4,545 in 2018, and 53,011 in 2019 (see <https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). Thus, this recovery criterion continues to be met.

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

Because the proposed action is not expected to measurably affect nesting trends, we conclude that it will not appreciably reduce the likelihood of recovery of NA DPS green sea turtles.

Therefore, we conclude the proposed action considered in this Opinion is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NA DPS of green sea turtles in the wild.

7.2.2 Green Sea Turtle SA DPS

Based on our analysis in Section 5 (Table 12), we estimate that the proposed action will result in a total of 93 captures that will result in up to 8 mortalities of green sea turtles per year. We assume 4% of the green sea turtles involved in these captures will be from the SA DPS. Thus, our best estimate is that the proposed action is likely to result in a total of 4 captures ($93 \times .04 = 3.72$), that will result in up to 1 mortality ($8 \times 0.04 = 0.32$) of an SA DPS green sea turtles per year. We round partial numbers up to the nearest whole number to be conservative towards the species.

7.2.2.1 Survival

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. The nonlethal capture of 3 green sea turtle (4 captures – 1 mortality) each year from the SA DPS over the next 50 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of this DPS. Nonlethal captures will not result in a reduction in numbers of the species, as we anticipate these nonlethal captures to fully recover such that no reductions in reproduction or numbers of this species are anticipated. The mortality of up to 1 green sea turtle per year from the SA DPS over the next 50 years is an obvious reduction in numbers. As discussed in Section 7.2.1, these

mortalities could also result in a potential reduction in future reproduction, assuming some individuals would be female and would have survived to reproduce in the future.

The SA DPS is large, estimated at over 63,000 nesting females, but data availability is poor with 37 of the 51 identified nesting sites not having sufficient data to estimate number of nesters or trends (Seminoff et al. 2015). While the lack of data was a concern due to increased uncertainty, the overall trend of the SA DPS was not considered to be a major concern. Some of the largest nesting beaches such as Ascension and Aves Islands in Venezuela and Galibi in Suriname appear to be increasing, with others (e.g., Trindade and Atol das Rocas, Brazil; Poilão and the rest of Guinea-Bissau) appearing to be stable. In the U.S., nesting of SA DPS green sea turtles occurs in the SA DPS on beaches of the U.S. Virgin Islands, primarily on Buck Island and Sandy Beach, St. Croix, although there are not enough data to establish a trend. Although the potential mortality of up to 1 sea turtle per year from this DPS over a 50-year period may occur as a result of the proposed action and would result in a reduction in absolute population numbers, the population of green sea turtles in the SA DPS would not be appreciably affected. Likewise, the reduction in reproduction that could occur due to these mortalities would not appreciably affect reproduction output in the South Atlantic.

As mentioned in previous sections, some of the likely effects commonly associated with climate change are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The potential effects, and the expected related effects to ESA-listed species (e.g., impacts to sea turtle nesting beaches and hatchling sex ratios, associated effects to prey species, etc.) stemming from climate change are the result of a slow and steady shift over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. As previously discussed, we have elected to view the effects of climate change on affected species over a more manageable and predictable 10-year time period due to this reality. Within this 10-year time period, we do not expect the effects of climate change will present a risk to the SA DPS green sea turtle population.

The potential for 1 green sea turtle mortality per year from the SA DPS over the next 50 years will result in a reduction in numbers when they occur, but it is unlikely to have any detectable influence on the trends noted above, even when considered in context with the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of green sea turtles from the SA DPS in the wild.

7.2.2.2 Recovery

As with the NA DPS, the SA DPS of green sea turtles does not have a separate recovery plan at this time. Since the animals within the SA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in the Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991) does exist. We believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the SA DPS, is developed. In our analysis for the NA DPS, we stated that the Atlantic Recovery Plan lists the following recovery objectives, which are relevant to the proposed action in this Opinion, and must be met over a period of 25 continuous years:

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

The nesting recovery objective is specific to the NA DPS, but demonstrates the importance of increases in nesting to recovery. As previously stated, nesting at the primary SA DPS nesting beaches has been increasing over the past 3 decades. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting and in-water abundance, however, it is likely that numbers on foraging grounds have increased.

Because the nonlethal capture of three green sea turtles per year from the SA DPS is not expected to have any detectable influence on the recovery objectives, we conclude that the proposed action will not appreciably reduce the likelihood of recovery of SA DPS green sea turtles.

Therefore, we conclude the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the SA DPS of green sea turtles in the wild,

7.3 Loggerhead Sea Turtle NWA DPS

Based on our analysis in Section 5 (Table 5), we estimate that the proposed action will result in a total of 319 captures that will result in up to 10 mortalities of NWA DPS loggerhead sea turtles per year. We also estimate that the seasonal conversion of saline and brackish habitat within Barataria Bay to fresh and intermediate habitat will likely result in a seasonal reduction in the distribution of the NWA DPS loggerhead sea turtles.

7.3.1 Survival

Whether the expected reductions in loggerhead sea turtle numbers, reproduction, and distribution as a result of the proposed action would appreciably reduce the likelihood of survival for the DPS depends on what effect these reductions in numbers and reproduction would have on overall population sizes and trends. The nonlethal capture of 309 loggerhead sea turtles from the NWA DPS per year (319 capture – 10 mortalities) over the next 50 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. Nonlethal captures will not result in a reduction in numbers of the species, as we anticipate these nonlethal captures to fully recover such that no reductions in reproduction or numbers of this species are anticipated.

The mortality of 10 loggerhead sea turtles per year from the NWA DPS due to the proposed action occurring over a 50-year period will reduce the number of loggerhead sea turtles compared to the number that would have been present in the absence of the proposed actions (assuming all other variables remained the same). These lethal interactions may also result in a future reduction in reproduction due to lost reproductive potential, if some of these individuals were females who would have reproduced in the future, thus eliminating each female individual's contribution to future generations. For example, an adult female loggerhead sea

turtle in the NWA DPS can lay 3 or 4 clutches of eggs every 2 to 4 years, with 100 to 126 eggs per clutch (NMFS and USFWS 2008). The potential annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity.

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

NMFS (2009f) estimated the minimum adult female population size for the NWA DPS⁶ in the 2004-2008 time frame to likely be between approximately 20,000-40,000 individuals (median 30,050), with a low likelihood of being as many as 70,000 individuals. Another estimate for the entire NWA DPS was a mean of 38,334 adult females using data from 2001-2010 (Richards et al. 2011). A much less robust estimate for total benthic females in the NWA DPS was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1,000,000. NMFS (2011a) preliminarily estimated the loggerhead population in the NWA DPS along the continental shelf of the Eastern Seaboard during the summer of 2010 at 588,439 individuals (estimate ranged from 381,941 to 817,023) based on positively identified individuals. Our Northeast Fisheries Science Center's point estimate increased to approximately 801,000 individuals when including data on unidentified sea turtles that were likely loggerheads. NMFS (2011a) underestimates the total population of loggerheads since it did not include Florida's east coast south of Cape Canaveral or the Gulf of Mexico, which are areas where large numbers of loggerheads can also be found. In other words, it provides an estimate of a subset of the entire population. These numbers were derived prior to additional years of increased nesting.

Florida accounts for more than 90% of U.S. loggerhead nesting. 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 from 2012-2016 resulting in widening confidence intervals. Nesting at the core index beaches declined in 2017 to 48,033, and rose slightly again to 48,983 in 2018, which is still the fourth highest total since 2001. However, it is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.), it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani et al. 2019).

⁶ We refer to the NWA DPS, even when discussing information in references published prior to the 2011 DPS listing, for consistency and ease of interpretation in this analysis.

We have not previously conducted a population viability analysis (PVA) for the NWA DPS of loggerhead sea turtles in the southeast U.S., and opted again not to conduct one for this Opinion. While we have utilized a PVA for loggerheads in some capacity for other fisheries (e.g., the Atlantic sea scallop fishery, though that analysis did not model the viability of the entire loggerhead population), we ultimately decided not to pursue a PVA for this action as a PVA for the NWA DPS of loggerheads, or any other DPS for that matter, has not been constructed since there are no estimates of the number of mature males, immature males, and immature females in the population and the age structure of the population is unknown. The approach employed in this Opinion is consistent with past analyses conducted on this and other fisheries in the southeast U.S., and we believe its conclusions are sound and accurate.

In summary, abundance estimates accounting for only a subset of the entire loggerhead sea turtle population in the NWA DPS indicate the population is large (i.e., several hundred thousand individuals). Furthermore, overall long-term nesting trends have been level or increasing over the years.

The proposed action could remove up to 10 individuals per year over a 50-year period. These removed individuals represent approximately 0.0026% annually on the low end of the NMFS (2011a) estimate of 381,941 loggerheads within the Northwest Atlantic continental shelf (as opposed to pelagic juveniles on the open ocean). As noted above, this estimate reflects a subset of the entire population for the NWA DPS of loggerhead sea turtles, and thus these individuals represent an even smaller proportion of the population removed. While the loss of 10 individuals per year over 50 years is an impact to the population, in the context of the overall population's size and current trend, we do not expect it to result in a detectable change to the population numbers or trend. The amount of loss is certainly smaller than the error associated with estimating (through extrapolation) the overall population in the 2011 report. Consequently, we expect the population within the NWA DPS to remain large (i.e., hundreds of thousands of individuals) and to retain the potential for recovery. We also expect the habitat impacts from the proposed action will not cause the population to lose genetic heterogeneity, broad demographic representation, or successful reproduction, nor affect loggerheads' ability to meet their lifecycle requirements, including reproduction, sustenance, and shelter. Therefore, we conclude the proposed action is not likely to appreciably reduce the likelihood of the NWA DPS of loggerhead sea turtles' survival in the wild.

As described in Section 4, we believe that the DWH oil spill event had an adverse impact on loggerhead sea turtles, and resulted in mortalities to an unquantified number of individuals, along with unknown lingering impacts resulting from nest relocations, nonlethal exposure, and foraging resource impacts. However, there is no information to indicate, or basis to believe, that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected impacts from the proposed action would result in a detectable change in the population status of the NWA DPS of loggerhead turtles. This is especially true given the size of the population and that, unlike Kemp's ridleys, the NWA DPS is proportionally much less intrinsically linked with the Gulf of Mexico. It is possible that the DWH oil release event reduced that survival rate of all age classes to varying degrees, and may continue to do so for some undetermined time into the future. However, there is no information at this time that it has, or should be expected to have, substantially altered the long-term survival rates in a manner that

would significantly change the population dynamics compared to the conservative estimates used in this Opinion.

As mentioned in previous sections, some of the likely effects commonly associated with climate change are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The potential effects, and the expected related effects to ESA-listed species (e.g., impacts to sea turtle nesting beaches and hatchling sex ratios, associated effects to prey species, etc.) stemming from climate change are the result of a slow and steady shift over a long time-period, and forecasting any specific critical threshold that may occur at some point in the future (e.g., several decades) is fraught with uncertainty. In some instances, species' behavioral changes may mitigate some of the impacts, including shifting breeding season and location to avoid warmer temperatures. For example, the start of the nesting season for loggerheads has already shifted as the climate has warmed (Weishampel et al. 2004). As previously discussed, we have elected to view the effects of climate change on affected species over a more manageable and predictable 10-year time period due to this reality. Within this 10-year time period, we do not expect the effects of climate change will present a risk to the NWA DPS loggerhead sea turtle population.

Regarding the seasonal reduction in the distribution of the species resulting from the seasonal conversion of saline and brackish habitat within Barataria Bay to fresh and intermediate habitat, the area affected is relatively small when compared to the thousands of miles of near-shore coastal habitat available throughout the range of this DPS. The conversion of saline to fresh habitat is also expected to be somewhat offset by an increase in saline conditions around the Birdfoot Delta of the Mississippi River, caused by the proposed operations. It is also likely that the long-term effects of climate change and sea level rise will result in saline intrusion and erosion of the coastal freshwater and intermediate marsh habitat throughout the northern Gulf, creating large areas with habitat conditions similar to those currently found in Barataria Bay.

Based on the foregoing, we conclude that the loss of 10 loggerhead sea turtles per year over the next 50 years, along with a potential reduction in the seasonal distribution of the species is not expected to change the trend in nesting or the reproduction of loggerhead sea turtles. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of this species in the wild.

7.3.2 Recovery

The recovery plan for the Northwest Atlantic population of loggerhead sea turtles (NMFS and USFWS 2008) was written prior to the loggerhead sea turtle DPS listings. However, this plan deals with the populations that comprise the current NWA DPS and is, therefore, the best information on recovery criteria and goals for the DPS. The plan's recovery goal for loggerhead sea turtles is "to ensure that each recovery unit meets its Recovery Criteria alleviating threats to the species so that protection under the ESA is no longer necessary" (NMFS and USFWS 2008). The plan then identifies 13 recovery objectives needed to achieve that goal.

The plan lists the following recovery objectives that are relevant to the effects of the proposed action:

- 1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
- 2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
- 10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
- 11. Minimize trophic changes from fishery harvest and habitat alteration.

The recovery plan anticipates that, with implementation of the plan, the NWA DPS will recover within 50-150 years, but notes that reaching recovery in only 50 years would require a rapid reversal of the then-declining trends of the NRU, PFRU, and NGMRU. 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.

Ensuring that the number of nests in each recovery unit is increasing is the recovery plan's first recovery objective and, the plan's overarching objective with associated demographic criteria. Nesting trends in most recovery units have been stable or increasing over the past couple of decades. The potential lethal take of up to 10 loggerhead sea turtles per year over a 50-year period is so small in relation to the overall population on the continental shelf (which does not include the large, but unknown pelagic population numbers), that it would be hardly detectable. For these reasons, we do not believe the proposed action will impede achieving this recovery objective.

The proposed action also does not conflict with Recovery Objectives 2 and 10. While bycatch of neritic juveniles may still occur during the proposed action, bycatch minimization measures are in place in these fisheries that avoid or minimize lethal bycatch. Further, the expansion of the TED requirements to the skimmer trawl fisheries further supports these recovery objectives. For these reasons, we do not believe the proposed action will impede achieving these recovery objectives. Likewise, we do not believe the proposed action conflicts with Recovery Objective 11, as there is no indication the impacts analyzed in this Opinion might cause any trophic changes that would affect the NWA DPS of loggerhead sea turtles. For these reasons, we do not believe the proposed action will impede achieving this recovery objective.

The potential for 10 loggerhead sea turtle mortalities from the NWA DPS per year over the next 50 years will result in a reduction in numbers when they occur, but it is unlikely to have any detectable influence on the trends noted above, even when considered in context with information in Sections 3 (Status of the Species), 4 (Environmental Baseline), and 6 (Cumulative Effects) discussed in this Opinion. Similarly, we do not expect the seasonal reductions in habitat suitability or the nonlethal capture of up to 309 loggerhead sea turtles from the NWA DPS to have any detectable influence on the recovery objectives.

Therefore, we conclude the proposed action, even with other ongoing threats to the species including bycatch mortality from other fisheries, other federal actions (i.e., anticipated take issued in other Opinions), and/or and the potential effects of climate change, is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NWA DPS of loggerhead sea turtles in the wild.

8 INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that would otherwise be considered prohibited under Section 9 or Section 4(d), but which is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the RPMs and the terms and conditions of the ITS of the Opinion. NMFS must estimate the extent of take expected to occur from implementation of the proposed action to frame the limits of the take exemption provided in the ITS. These limits set thresholds that, if exceeded, would be the basis for reinitiating consultation. The following section describes the extent of take that NMFS anticipates will occur as a result of the proposed action

8.1 Anticipated Incidental Take

NMFS anticipates the average per year take over the next 50 years as a result of the proposed action will consist of up to 370 Kemp's ridley sea turtles (which includes up to 38 mortalities), 319 loggerhead sea turtles (NWA DPS) (which includes up to 10 mortalities), 90 green sea turtles (NA DPS) (which includes up to 8 mortalities), 4 green sea turtles (SA DPS) (which includes up to 1 mortality). As discussed in section 5 above, it would be very difficult to monitor fisheries-related turtle takes on a real-time basis, and impossible to determine which of those takes might be the result of altered fishing practices stemming from the indirect effects of the proposed action. Because one of the purposes of an ITS is to clearly define any reinitiation triggers that provide clear signals that the level of anticipated take has been exceeded and, therefore, would require reexamination of the proposed action through a reinitiated consultation, we have concluded that the most meaningful way to monitor fisheries-related take caused by the proposed action is through monitoring the level of fishing effort (number of fishing trips) that is occurring in the area most affected by the proposed action, as a surrogate for the level of sea turtle interactions occurring in that area. By measuring increases in fishing activity in this area, we can indirectly measure increases in fishery-related sea turtle takes occurring in the area.

As can be seen in Table 10, the level of fishing effort (represented by the number of trips) is somewhat variable from year to year. Fishing effort levels can be influenced by sea temperatures, species abundances, and many other factors that are difficult to predict. For these reasons, and based on our experience monitoring fisheries, we believe a 3-year running average of annual trips is the best metric to determine if real, sustained increases in fishing effort are occurring in the area. The average number of brown shrimp fishing trips in area 211 (based on 10 years of data from 2008 to 2017) is 3,385 trips per year (Table 10). We predict that all trips currently occurring in area 209 (in the upper basin, north of area 211) will move down into area 211 as a result of the proposed action, so the total number of trips expected to occur once the project is fully operational would be 4,130 over a 3-year average ($3,385 + 745 = 4,130$). This number of trips, calculated as a 3-year running average, is the surrogate for the level of sea turtle take expected to result from the proposed action's effects on commercial shrimp fishing. The project proponent will need to monitor the annual trip ticket data for area 211 and report to NMFS (as described below) the 3-year running average of brown shrimp fishing trips, in order to ensure the

anticipated level of fishery-related take is not exceeded. The exceedance of 4,130 brown shrimp fishing trips in area 211 over a 3-year running average at any time during the 50-year life of project operations will require reinitiation of the consultation.

The loss of habitat function expected to result from the conversion of saline and brackish areas to fresh and intermediate conditions may result in harm to sea turtles by reducing their ability to perform essential behaviors such as feeding, breeding and sheltering within the affected areas. Due to the scarcity of information on sea turtle activity and use of the action area, and the complete lack of sea turtle monitoring within the area, it is impossible to directly quantify the actual level of take (harm) that may occur to sea turtles from these ecosystem-level impacts expected to result from project operations. For these reasons, we have determined that the most meaningful way to monitor the level of salinity-related take that may be caused by the proposed action is through monitoring the actual salinity levels occurring in the action area under project operations, and using these salinity levels as a surrogate for the level of sea turtle exclusion and harm occurring in the action area.

The Delft3D project modeling provides estimates of projected salinity conditions at various locations throughout the basin, in each month of the year, under varying Mississippi River flow/Project operational conditions. We can use stations USGS Barataria Pass at Grand Isle (USGS 73802516), USGA Barataria Bay near Grand Terre Island (USGS 291929089562600), and the USGS Barataria Bay North of Grand Isle (USGS 7380251) (Figure 22), located across the lower basin, where sea turtles are currently most prevalent, to determine the amount of time, on average, that project operations are projected to result in freshwater conditions (salinity range from 0-5 ppt) at these stations. These 3 stations are situated on a generally north to south axis through the lower section of the basin (Figure 22), with the northernmost station (USGS 7380251) having more fresh water conditions, and the southernmost station (USGS73802516) having more saline conditions. The Delft3D modeling indicates that these 3 stations are projected to be below 5 ppt salinity for 331 days (northern station); 145 days (central station); and 104 days (southern station) of the year in “wet” years (represented by the 2011 hydrograph in the modeling; Tables 12, 13 & 14). In “normal” years (represented by the 1970 hydrograph in the modeling), these 3 stations are projected to be below 5 ppt salinity for 334 days (northern station); 121 days (central station); and 52 days (southern station) of the year (Tables 12, 13 & 14). In “dry” years (represented by the 2006 hydrograph in the modeling), these 3 stations are projected to be below 5 ppt salinity for 332 days (northern station); 48 days (central station); and 9 days (southern station) of the year (Tables 12, 13 & 14). These modeled low-salinity time periods can be considered as a general estimate of the magnitude of project effects, indicating the projected level of harm to sea turtles, due to loss of habitat function and seasonal distribution expected to be caused by the proposed action.

Due to the inherent discrepancies between modeled projections and actual measured conditions (described in Section 5.3), it will take a sophisticated monitoring and data analysis plan design to determine if seasonal salinity conditions under actual project operations are exceeding the expected range projected by the model, and thus exceeding the level of take analyzed and authorized in this Opinion (which would require reinitiation of the consultation). Therefore, the project proponent will be required to develop and implement such a monitoring plan/analysis in coordination with NMFS (SERO and SEFSC). Data output produced under this monitoring plan

shall be reported to NMFS (as described below), in order to determine if the anticipated level of salinity-related take is being exceeded.

8.2 Effect(s) of the Take

We have determined that the anticipated take specified in Section 8.1 is not likely to jeopardize the continued existence of Kemp's ridley, green (NA and SA DPSs), or loggerhead (NWA DPS), sea turtles, as result of the proposed action.

8.3 Reasonable and Prudent Measures (RPMs)

Section 7(b)(4) of the ESA requires us to issue a statement specifying the impact of any incidental take on listed species, which results from an agency action otherwise found to comply with Section 7(a)(2) of the ESA. It also states that Reasonable and Prudent Measures (RPMs) necessary to monitor and minimize the impacts of take and the terms and conditions (T&Cs) to implement those measures, must be provided and followed to minimize those impacts. Only incidental taking that complies with the specified terms and conditions is authorized. The RPMs and terms and conditions are specified as required, per 50 CFR 402.14 (i)(1)(ii) and (iv), to document the incidental take caused by the proposed action and to minimize the impact of that take on ESA-listed species. These measures and terms and conditions are non-discretionary, and must be implemented for the protection of Section 7(o)(2) to apply.

We have determined that the following RPMs are necessary and appropriate to monitor and minimize the incidental take of ESA-listed species related to the proposed action. The following RPMs 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 authorized. These requirements remain valid until reinitiation and conclusion of any subsequent Section 7 consultation.

RPM 1: Monitoring Brown Shrimp Fishing Effort in the Action Area:

The federal action agencies must ensure the project proponent monitors the annual trip ticket data for area 211 and reports to NMFS (as described below) the 3-year running average of brown shrimp fishing trips on an annual basis.

RPM 2: Monitoring Salinity Conditions in the Lower Barataria Basin:

The federal action agencies must ensure the project proponent develops (in coordination with NMFS), funds and implements a salinity monitoring program in Barataria Bay and reports the data output from that monitoring plan to NMFS on an annual basis (as described below).

RPM 3: Monitor Sea Turtle Habitat Use and Abundance in the Action Area:

The federal action agencies must ensure the project proponent develops (in coordination with NMFS SEFSC), funds and implements a monitoring plan targeting sea turtle distribution, health and habitat use within the Barataria Basin.

8.4 Terms and Conditions

To be exempt from take prohibitions established by Section 9 of the ESA, the Federal action agencies must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are nondiscretionary.

The following terms and conditions implement RPM 1:

The federal action agencies must ensure the project proponent monitors the annual trip ticket data collected by LDWF for area 211 and provides an annual report to NMFS PRD, sent to the following address (takereport.nmfsser@noaa.gov). The federal action agencies may specify if they would also like to receive these reports from the project proponent. The reports shall reference the Consultation Identification Number for this consultation (SERO-2021-00433), and shall provide the raw trip ticket data, as well as the 3-year running average of brown shrimp fishing trips. The first report shall be provided within 1 year of the commencement of MBSD operations, using the previous 3 years' data to calculate the 3-year running average.

The following terms and conditions implement RPM 2:

The federal action agencies must ensure the project proponent develops, in coordination with NMFS (SERO and SEFSC), funds and implements a monitoring program and analytical design that will allow NMFS to determine if seasonal salinity conditions under actual project operations are within the expected range projected by the model relied upon and analyzed in this Opinion. The final monitoring design must establish measurable triggers that will indicate when salinity conditions have exceeded the levels anticipated and analyzed in this Opinion, and would thus trigger the requirement to reinstate consultation on the proposed project. The monitoring plan must be fully developed and approved by NMFS PRD prior to the commencement of MBSD operations. Once the monitoring plan design has been developed and approved, it must be integrated into the existing Monitoring and Adaptive Management Plan for the Proposed Project. The monitoring plan shall be implemented prior to, or immediately following commencement of MBSD operations. An annual report of the data and analytical output from this monitoring shall be sent to NMFS at the following address (takereport.nmfsser@noaa.gov). The first report shall be submitted to NMFS within 1 year of the commencement of monitoring. The federal action agencies may specify if they would also like to receive these reports from the project proponent. The reports shall reference the Consultation Identification Number for this consultation (SERO-2021-00433).

The following terms and conditions implement RPM 3:

The federal action agencies must ensure the project proponent develops, in coordination with NMFS SEFSC, funds and implements a monitoring plan designed to study sea turtle distribution and habitat use to increase the body of knowledge and understanding of distribution, relative abundance, and seasonal and spatial sea turtle habitat use in the action area before project operations and to monitor how project operations affect distribution, relative abundance, and seasonal and spatial sea turtle habitat use of the action area. This sea turtle monitoring plan must include 3 years of field work prior to implementation of MBSD operations, 3 years of field work immediately following

implementation of MBSD operations, and 1 year of data analysis. The field work must include trawl vessel surveys, satellite tagging, health assessment, and data analysis. This study would include deploying up to 240 satellite tags (target of 40 per year), some or all equipped with specialized salinity sensors, and conducting transect surveys to better understand sea turtle abundance and distribution. Turtle monitoring and tagging field work is to be conducted in selected areas of the lower Barataria Basin, from the area below the proposed outfall, down to and including the passes and inlets around the barrier islands and the Gulf-side shallow water habitat adjacent to the barrier islands at the southern end of Barataria Bay. The monitoring plan must receive final approval by NMFS PRD, and shall include the following components:

- **Field Work:** Conduct 6 years of field work (three years prior to implementation of MBSD operations and 3 years after operations start) employing the following methods:
 - Transect surveys - Direct capture of sea turtles using otter trawl and skimmer trawl vessels using standardized seasonal 30-minute transects during spring, summer, and autumn of each year to obtain a statistically appropriate sample size in the action area. Turtles will be captured using skimmer trawls in shallow areas (<10ft), focusing on salt marsh habitat where we expect to find smaller juvenile sea turtles, and larger otter trawl vessels using paired otter trawls in depths > 10 ft. Appropriate scientific research and collection permits will be required for these activities.
 - Health assessments - turtles captured in trawl surveys will be measured, weighed, tagged with flipper and passive integrated transponder (PIT) tags, tissue sampled (for genetic analysis and stable isotopes), and blood sampled (for blood chemistry analyses). Environmental data (salinity, water temperature, etc.) will be collected in conjunction with sea turtle capture efforts. Turtles will be released at or near the capture site.
 - Satellite Tagging – up to 240 turtles (target of 40 per year, with selection based on appropriate size and condition), captured in the trawl surveys will be satellite tagged to monitor location, dive behavior, salinity, and temperature. Salinity sensor-equipped satellite tags will be used on a portion of these turtles to better understand habitat use patterns relative to salinity regimes and if shifts in salinity affect behavior.
 - Annual and seasonal estimates of relative abundance will be generated from the trawl data at the conclusion of each year’s sampling.
- **Analysis and Modeling:** Conduct 1 year of data analysis, including the following:
 - Estimate habitat use by overlaying our satellite tracking data on available GIS benthic habitat layers, as well as salinity information collected by the satellite tags. Additionally, data from any current in-water environmental monitoring stations could be used to provide additional supplemental environmental data. In addition, we plan to coordinate with other research groups, such as benthic researchers studying lower trophic level organisms to provide abundance and species composition data for key prey organisms to further understand habitat use and sea turtle distribution.

- Complete development of a predictive model for sea turtle species habitat use and distribution in relation to physical and biological habitat characteristics and salinity level parameters. The model can be used to assess the overlap of sea turtle distribution with known and emerging threats to prioritize the type and location of restoration activities and to evaluate their effectiveness.
- **Adaptive Management of Monitoring Activities:** Due to the scarcity of information on sea turtle activity and use of the study area, there is uncertainty regarding the expected results and efficacy of the monitoring of sea turtle habitat use and abundance in the action area required herein (number of turtles that may be captured, number that may be suitable for tagging, etc.). There are also many extrinsic factors that may impact monitoring efficacy and results, such as hurricanes and annual hydrologic conditions affecting the Basin. Due to these uncertainties, it may be necessary to adjust monitoring targets and methodologies (gear, locations, effort, etc.) during the study period to ensure the monitoring efforts are optimized to effectively discern the effects of the project on sea turtles. An adaptive management team consisting of up to 3 state (CPRA) and 3 federal (NMFS SEFSC, NMFS PRD, and NOAA RC) representatives (along with any technical experts invited by these entities) will meet at least once a year to review progress and results of the monitoring activities. The USACE may also participate on this team if they wish. This team may make recommendations on any necessary changes to the monitoring and tagging activities, locations, timing, or level of effort, based on current information and monitoring/tagging results to date. Any proposed changes to the sea turtle monitoring activities must be approved by NMFS PRD before implementation.
- **Project Outputs/Deliverables:** Data collected will be used to analyze habitat use in relation to physical and biological habitat characteristics and salinity level parameters. Outputs include:
 - Satellite tagging datasets
 - Transect survey data
 - Health assessment data
 - Modeling outputs
 - Technical report synthesizing data

9 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 listed species or critical habitat, to help implement recovery plans, or to develop information. The following conservation recommendations are discretionary measures that we believe are consistent with this obligation and, therefore, should be conducted or implemented by the federal action agencies:

- To enhance transparency of Gulf ecosystem restoration to the public, coordinate with other restoration partners to ensure efficacy and efficiency of management decision making processes, and ensure accessibility to, and utility of data for the scientific community to provide the best available science, the following steps are crucial:
 - Develop minimum monitoring standards, including monitoring parameters, methods, metadata, and data reporting standards in coordination with other restoration and science programs
 - Validation monitoring should be used wherever feasible
 - Coordinate monitoring plans, data aggregation, and reporting for this restoration plan with all internal and external restoration partners (e.g., RESTORE Council, NFWF GEBF)
 - Data should be timely shared among Gulf restoration programs, and the Trustee Council will make information for projects selected under this LA TIG restoration plan available to the public, as well as to the scientific community and other restoration programs
 - When evaluating irregularities that may signal the existence of emerging unknown conditions that could influence restoration outcomes, analyze aggregated monitoring information provided by the Trustees, *and* other ongoing scientific and restoration efforts in the Gulf of Mexico

- Support in-water abundance estimates of sea turtles, all species and life stages, to achieve more accurate status assessments for these species and to better assess the impact of human activities.

- Work to develop procedures to protect sea turtles and other species during in-water construction activities and other activities that may affect sea turtles.

10 REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed actions. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal action agency involvement or control over the action has been retained, or is authorized by law, and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this Opinion; (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the federal action agencies must immediately request reinitiation of formal consultation and project activities may only continue if NMFS establishes that such continuation will not violate sections 7(a)(2) and 7(d) of the ESA. As first noted in Section 2.1, the lifespan of this Opinion is 50 years. Therefore, barring any other earlier need for reinitiation, a new Opinion on the proposed action will be necessary at the end of this 50-year period if the project is still in operation.

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